6TH INTERNATIONAL BLAISE USER'S CONFERENCE
MAY 2000
KINSALE, IREAND

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Session 1

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Using Blaise to Automate the Clerical Edit and Telephone Follow-up Component of the American Community Survey

by Barbara N. Diskin and Kenneth P. Stulik, United States Bureau of the Census

Summary

The American Community Survey (ACS) conducted by the U.S. Bureau of the Census will ultimately be the largest ongoing survey in the U.S. By 2003 we will sample 3 million households a year to collect housing and population data every month. The ACS is a mail out-mail back survey. Since roughly one-third of all mail returns lack enough critical data, a telephone follow-up (TFU) operation exists to collect this data. The increasing size of the ACS made it imperative to automate the formerly manual TFU step. When we evaluated software that could support the automation effort, Blaise from Statistics Netherlands was the obvious choice due to its features and flexibility.

ACS Basics

The goal of the ACS is to provide current demographic and housing data for small geographic areas. The questionnaire content is almost identical to that of the Decennial Census long form, with a few additional questions on items such as food stamps. The ACS went into production in 1996 in four counties. The initial sampling rate was 15 percent the first year with a decrease in subsequent years.

The Data Collection Cycle

The ACS follows a 3-month cycle. During the first month the sampled addresses receive an initial questionnaire by mail. If they fail to respond, they receive a second questionnaire by mail. If they fail to return the mailed questionnaires, during the second month an interviewer attempts to contact them by telephone. If that too is unsuccessful, an interviewer actually visits a sample of the non-respondents and collects the data on a laptop computer.

Initial Approach to Clerical Edit and Telephone Follow-up

The returned paper questionnaires are often missing data or contain inconsistent data because some of the concepts are difficult for respondents to understand and they make mistakes in completing the forms. For the first 3 years of the survey, clerks manually reviewed each returned paper form to detect deficient forms for telephone follow-up. This was a labor-intensive operation that was itself error-prone because of the difficulty humans have in following algorithms in exactly the same way.

Rationale for Automating TFU

The survey, which started out with 80,000 households in 4 counties the first year, expanded greatly for 2000. It now encompasses 1,239 counties with a sample of 864,000 households. By 1999 it had become apparent that the clerical edit of the mail questionnaires with the accompanying telephone follow-up needed automation to make the operation more consistent and to increase efficiency.

Determining Cases that Go to TFU

We began the automation process by translating the clerical checking into a series of algorithms that would result in either a pass or fail status. If the respondent provides sufficiently consistent data and answers key questions, such as age, for all persons in the household, the questionnaire passes the edit. If not, the questionnaire fails the edit. If there is at least one telephone number for an address with a failed questionnaire, the questionnaire moves to telephone follow-up.

Software Choice and Implementation Strategy

The software for the telephone follow-up operation required the ability to start with reported data and build upon those data. Only Blaise from Statistics Netherlands could do this. With a 9-month window for development and testing, the Census Bureau enlisted the help of Westat for training and consultation. Everyone realized that this was an enormous undertaking for such a short time. The resulting partnership provided the necessary support during these labor-intensive months. Westat had the added advantage of being the U.S. representative for the Blaise software package.

TFU Processing Environment

The TFU processing environment covers several different platforms in two different geographic locations across a wide-area network. Return mail forms are checked into our document control system at Jeffersonville, Indiana, then immediately keyed on a VAX system. Raw keyed data are transferred daily to a Sun server in Suitland, Maryland, where they are processed using SAS to determine the pass/fail cases for TFU. ASCII data representing the failed cases are then daily transferred to a Windows NT server back in Jeffersonville, where they are loaded by automated routines into Blaise format with the ASCIIRELATIONAL method. Case data are then handled by the TFU interviewers using Blaise on NT client stations until the data are resolved in some fashion. Data are output from Blaise daily and ported back to the Sun server in Suitland, where they are further processed and analyzed.

The Blaise instrument

Although not large in scope compared to some CATI instruments, the Data Entry Program (DEP) instrument for ACS TFU is complicated because of a number of non-standard features we felt necessary to build into it. First and foremost, the instrument accepts existing data from the keyed mail forms, a feature that not every CATI software system has. We had to write complicated routines in Manipula for the read-in and read-out of the questionnaire and case header data.

The existence of pre-loaded data in the cases gave us another interesting challenge. It would not do to simply plug through screen after screen in search of an error or omission. We called upon Blaise's navigational flexibility to jump from error to error, often bypassing large sections of the instrument. Interviewers have a choice of "Interview" mode or "Edit" mode to accomplish this. In Interview Mode, an interviewer can efficiently maneuver through sections of the instrument, which may be all or mostly blank. In Edit Mode, the interviewer can use the Show All Errors feature to jump from field to field, often bypassing several screens in the process. Regardless of mode, we were also able to program Blaise in such a way so as to make the majority of the person sections display in a matrix-style format, thus giving our interviewers the flexibility to navigate across persons or across topics (see Figure 1).

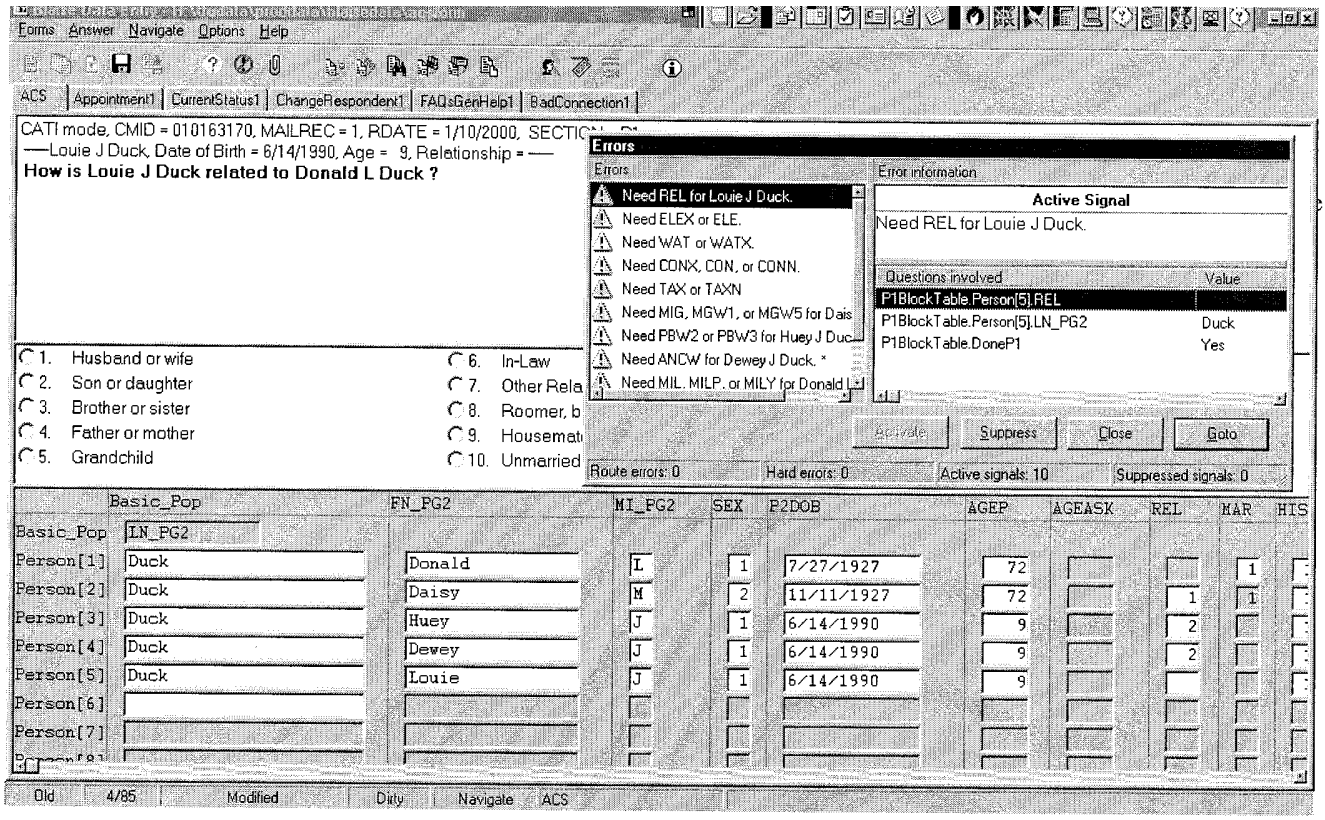

Figure 1: Screen shot of ACS Blaise instrument showing matrix-style format, parallel block tabs, interview (CATI) mode, Show All Errors dialogue, and more. All names depicted are fictitious for confidentiality purposes.

Another feature we built into the instrument was our custom control system, which we were able to effectively integrate with the Blaise call scheduler (BtMana). The challenge was to build in our supplementary CATI control codes into the Blaise framework while still taking advantage of the simple and efficient daybatch concept of Blaise. This was accomplished in

large part by using a series of external lookup files that allowed us to designate our own control codes (primarily case outcome codes and future action queues). There are literally hundreds of combinations of codes and subsequent outcomes based on 6 different case characteristics. The lookup table takes into account these characteristics and assigns our own set of four codes plus the requisite Blaise treatment and routeback. In addition to enjoying all of the features of Blaise CATI management, this approach allowed us to capture all of the internal codes we needed for our own traditional operations analysis while having a coding system that could readily translate to other CATI operations in the Census Bureau.

Yet another feature we wanted to have was a current summary of the pass/fail criteria within the instrument. This allows interviewers to preview the case by looking at summary-level information and rapidly determine whether they need to correct housing errors, correct population errors, add new persons to the rosters, or any combination thereof (see Figure 2). In addition, interviewers can get an up-to-date status of the interview. This could allow them to terminate an interview prematurely, in the event they are talking to a hostile or very reluctant respondent, if the error score is low but not perfect. The parallel block feature of Blaise facilitated this functionality by allowing us to create a separate screen accessible by a keystroke or mouse click from anywhere in the instrument.

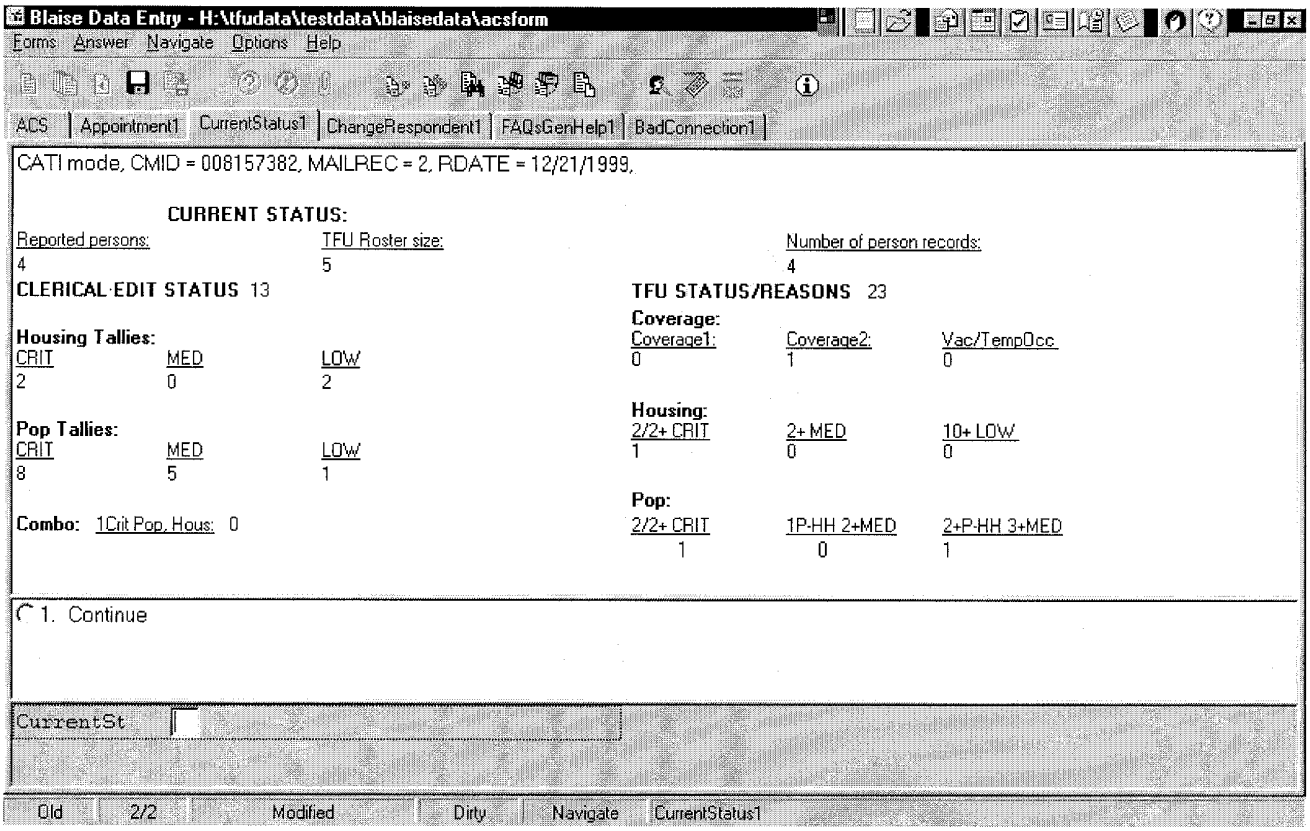

Figure 2: Screen shot of ACS Blaise instrument Current Status parallel block, showing case-level summary of error counts and types.

In designing the TFU operation, we realized we would need to use some of the peripheral components supplied with Blaise in order to make the whole process more efficient. One such feature involved the use of audit trails to track case-level activity

default audit trail dynamic link library (DLL), we decided that its functionality was insufficient for our needs. At our request, Westat modified the DLL such that any activity to a given case creates or appends to an audit trail file (which has as its name

directory and call up the audit trail file with the case ID as its file name.

Another desirable feature external to DEP and
allow the supervisors to have control over the future action of any case, but this would primarily be used to handle special cases that required a human decision.
which call for supervisory decision, obtain summary or detail information about the case, and affect a few key fields such as routeback and future action queue. A logging and reporting feature associated with this utility makes it easier for us to identify

account for these automatically.

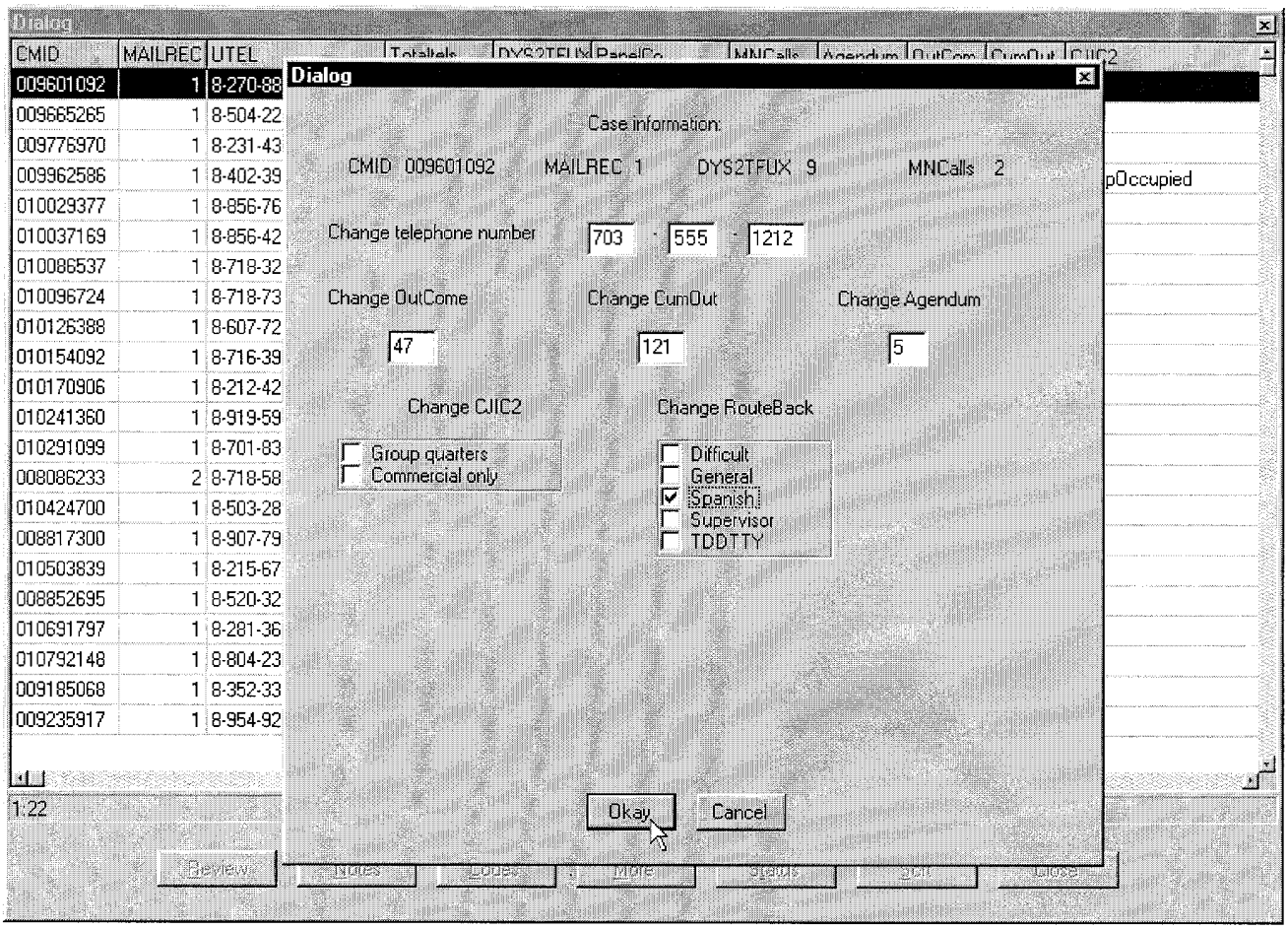

Figure 3: Screen shot of the Maniplus "Supervisory Hold" utility, allowing supervisors case-level control over disposition of individual forms.

One final feature we needed which was not part of the Blaise suite was the ability to monitor an interviewer's computer screen remotely for quality assurance purposes. We chose Stac Software's Reach Out Enterprise because of a recommendation from National Agricultural Statistics Service that it provided excellent functionality as well as peaceful coexistence with Blaise. Today, our supervisors use it continually and it has never been known to cause any problems with the ACS Blaise system.

Moving TFU into Production

Due to the challenges presented by the tight time frame from March 1998 to December 1998, deployment of the Blaise instrument was a harried effort. But a number of things worked in our favor, and the end result was a success. First, the ease of programming in Blaise allowed for the rapid development of the initial instrument, resulting in more time than expected to work out the major problems. While the instrument that was initially deployed in production in December had a host of minor problems, none of them was major and they tended only to affect the navigation of the instrument or handling of cases.

Another factor working in our favor was the support of experienced Blaise consultants at Westat. With their help, we designed a sound instrument, taking advantage of the many features of Blaise described in the previous section. Westat provided professional on-site Blaise training, in addition to periodic classes at their training facility, and this helped to prepare the Census employees that programmed the ACS Blaise instrument.

The deployment of the server and workstations hardware and their integration with the existing network infrastructure in Jeffersonville went off on time and with little trouble. From the first day that we deployed the instrument there, we received excellent technical support and did not need to divert a significant amount of attention to hardware or network issues. There was, however, a learning curve regarding Blaise's interaction with NT with respect to file permissions and user profiles. We also experienced some problems with profiles which at times caused the interviewers difficulty in logging into the correct DEP session (or any session at all for that matter). But in due time we learned the configuration that Blaise needed, and we tracked down the problems with the profiles, so we now enjoy smooth operations from that standpoint.

Of course, our interviewers needed to be trained for their role in the automated TFU. But since they were already familiar with interviewing techniques and were also familiar with the questionnaire, they primarily needed to be trained in using Blaise. While some of the interviewers had little computer experience, others had experience with CATI software in general. And since they were all very motivated individuals, training and ramp-up took less time than we expected.

Problems We Encountered and their Resolution

In deploying an instrument of this magnitude, it is not unusual to encounter technical or software problems, especially when the software is new and non-traditional. So it came as no surprise to us that there were some glitches to iron out during and after the project's initial deployment.

There were a number of bugs in DEP build 269 with which we needed to contend. Some of these bugs, such as the various Access Violations and Sharing Violations that our interviewers received, were easily solvable by changing our NT configuration and allowing read/write (instead of read only) access to key meta-data files. There were also many instances of DEP sessions simply hanging indefinitely, and those likewise were cured by setting the Opportunistic Locking NT setting to OFF. Another DEP bug we encountered was the creation of an invalid key and a null record when routinely entering a form. The problem was, amazingly, found to be triggered by entering the form using the <Enter> key as opposed to clicking 'OK' with the mouse. Statistics Netherlands was able to quickly track down the problem and issue a new DEP build.

We encountered other problems while perfecting our daily routines to load and unload data. The nature of the input data required a complex read-in routine designed to import multiple hierarchical flat files into a Blaise database containing arrayed records of sub-blocks and embedded blocks. It also required us to convert Don't Know/Refused responses into Blaise DK/RF values, and handle field-level comments. While the Blaise ASCIIRELATIONAL read-in method would facilitate this, the need to constantly recompile data models and Manipula routines, coupled with difficulty in handling slight changes to file layouts and handling field-level comments, made the initial development of the read-in/read-out routines cumbersome.

Another minor problem in the daily routine involved a Manipula RUN command occasionally not executing properly, which would bring the whole routine to a stop. Simply resetting and resubmitting the job would usually fix the problem for that day. Eventually, we thought to alter the routine to have the calling batch job execute the DOS command, which fixed the problem. While it was theorized this problem was a result of multiple RUN commands executing simultaneously, causing file locks which prevented multiple simultaneous operations, it was never conclusively determined to be either a Blaise bug or an OS bug.

A more serious failure related to these morning routines occurred when Hospital, designed to detect and repair data corruption (primarily involving secondary keys), began to drop large numbers of cases from the database wholesale. It did not take us long to figure out that this was happening to every case that had been touched the previous day. We were then quickly able to deduce that the handling of an inherent Blaise field left over from a previous build of Blaise was confusing Hospital and causing the cases to be dropped. The immediate solution was to stop using Hospital until the bug could be isolated and fixed. We also were able to reinsert the cases dropped by using a simple Manipula program such that no permanent data loss was suffered. Within a week or so, Statistics Netherlands found the problem and issued a new Hospital program which corrected the bug, and we resumed using Hospital.

Our TFU supervisors did not take long to begin using BtMana to dynamically track daybatch progress, view shift workloads, and reassign cases to specific groups or interviewers as needed. But in so doing, a bug was uncovered that had a serious impact on our database. Soon after the adaptation of BtMana into the daily procedure, we noticed that some cases lost entire blocks of data for no apparent reason. As BtMana was the only new variable introduced at that time, we quickly determined that using it to assign a case to an interviewer was causing the data loss. Again, the bug was quickly located by Statistics Netherlands and a new build of Blaise was released. Upon deployment, that bug did not recur.

At one point, we encountered one of our most severe bugs in a very unusual way. Due to the heavy amount of post-data-collection editing and imputation that is done by the Continuous Measurement Office, another atypical requirement of this instrument is to keep all data, whether on-path or off-path. This, of course, is not a problem for Blaise, as the KEEP statement at the field or block level allows for just that. Our instrument was programmed to maintain all data (including off-path data) from session to session and to future processing operations. But somehow, part of our instrument code was replaced with a version of similar code that lacked only the KEEP statements. This went undetected because, as it turns out, a bug in Blaise build 4.1.0.269 kept the off-path data anyway in those sections of the instrument that had had their KEEP statements removed (imagine, for once, a bug that works in your favor). But when we upgraded to Blaise v. 4.1.1.322, the lack of KEEP statements became apparent. We slowly became aware of the problem of dropping the off-path data, and hundreds of cases became afflicted with this data loss. Luckily, we were able to fix the problem quickly by simply restoring the KEEP statements.

The last major problem involved cases reappearing to interviewers even after they had been resolved or scheduled for an appointment at a different time. When the problem first occurred, it appeared to be epidemic in proportion, but as we began to research it, we discovered that it had probably been happening all along, just at a very low and infrequent level. It turned out that any case outcome was subject to this problem, and that the problem was not isolated to one interviewer, or one computer, or one network, or one instrument, or even one version of Blaise. Once in a great while, in the first year of production deployment, we would get the occasional complaint from the call unit that a closed case would appear again to an interviewer. Tracking of the audit trail would confirm this, but at first we attributed it to a minor glitch in the instrument based on a certain series of responses to the front-end questions. When the problem began occurring dozens of times per day (roughly 5% to 7% of all cases), we soon noticed that there was an inordinate number of "hanging" phone numbers. These occur when there is not a complete set of write operations performed on the dayfile and call history files. As a temporary fix, we were able to stop the problem by simply not clearing hanging phone numbers with BtMana. But this did not address the root of the problem, which Statistics Finland coincidentally discovered to be linked to the Autosave feature. When leaving a case immediately after Autosave was invoked, the case would hang in BtMana. We fixed the problem permanently by turning off Autosave in the modelib.~ml, recompiling the instrument, and reconfiguring our shortcuts to not refer to any dep.diw. A re-issue of version 4.1.2, build 371, was to have allowed for Autosave with no hanging numbers.

We discovered a number of Blaise bugs within the production environment throughout the course of the first year. But this is not unusual when dealing with relatively new software being used in ways which stretch the boundaries of its functionality. One common thread which runs through every problem is that as soon as a bug was identified and found to be replicable in similar environments, Statistics Netherlands was consistently able to identify the source of the bug and issue a new Blaise build within a very short time period. Furthermore, as a result of our close work with Statistics Netherlands in identifying and replicating bugs, we received a number of new Blaise builds containing features that were either never planned or released well ahead of schedule.

The Future

For the ACS, the future of the TFU operation features Blaise. There is still no competing CATI software which has the features and functionality that Blaise for Windows offers. Daily processing of cases through Blaise continues at planned levels, and while there are occasional problems that crop up, the overall effort is a success. The benefits of the system will pay off even more when the ACS reaches planned levels of 3 million mail surveys in 2003. The Blaise TFU operation will at that time process over 1 million cases per year. Because of the functionality of Blaise, our staff will be able to do so in a very efficient manner, allowing us to reach those target levels with a relatively small staff, and thereby greatly improve the ACS data.

Central and local survey administration through communicating data systems

Thomas Hoel
Statistics Norway

1 Overview of the system

Figure 1 shows the three main parts of the new CAI system of Statistics Norway:

- The central administrative database
- The communication system
- The interviewer laptops and their databases

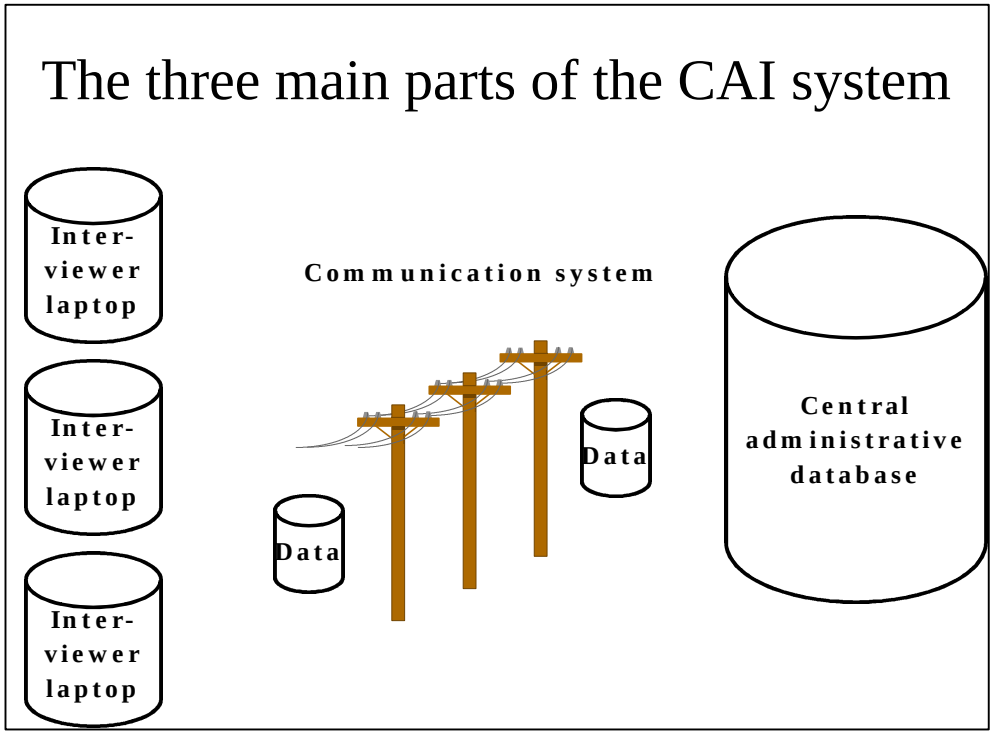

Figure 1: The three main parts of the CAI system

Because of differences in their work area, the three parts are based on different tools. Yet they fit tightly together, through defined interfaces. Table 1 below sums up work scopes, tools and data formats.

Part name	Work scope	Tools	Data formats
Central administrative database	Manages the interviewers, the questionnaires, the respondents, administrative data and questionnaire data.	Oracle and Blaise (Manipula)	Administrative data: Oracle Questionnaire data: Blaise
Communication system	Maintains the connection between the laptops and the central database. Produces a number of status reports.	Internet Explorer 5.0 and Java	Administrative data: ANSI Questionnaire data: Blaise Communication packets: XML
Laptop databases	Manages the questionnaires, the respondents, administrative data and questionnaire data.	Blaise (Manipula)	Administrative data: Blaise Questionnaire data: Blaise

Table 1: Work scopes, tools and data formats.

The term “communication system” may be a bit narrow, since the Java part of the system in addition to the communication performs a number of administrative tasks. There are, in fact, no sharp boundaries between the Java part of the system and the

Oracle part. As will become evident later in this document, the two parts overlap to some extent.

The rest of this document will examine each of the three parts in more detail.

2 The central administrative database

2.1 Overview

The central database is divided in an Oracle part and a Blaise part. The division is based on functional criteria:

- Administrative data is stored in an Oracle database in Oracle format.
- Questionnaire data is stored in Blaise databases in Blaise format.

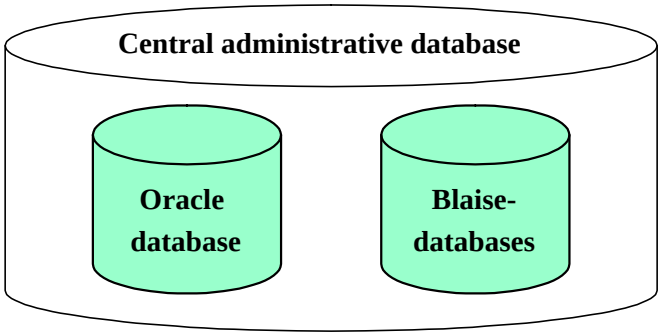

Figure 2: The main division of the central database

The reason for dividing the central database like this was tests that showed us that any conversion from or to the Blaise format led to a loss of some aspects of the data. Consistent use of the Blaise format seemed to be the only way to preserve all parts of the interviewer input: responses, comments and suppressed warnings.

The two parts of the central database is managed from the Oracle part. All events in the central database are initiated in the Oracle part. The Oracle database "knows" about the Blaise databases, knows where to find them and have methods to use them. The Blaise databases are there simply to store the questionnaire data in a convenient format and are absolutely ignorant of anything outside themselves.

From a technical point of view, it may be interesting to note that the Oracle database resides on a Unix machine, while the Blaise databases are stored on an NT file server. The user interfaces to the Oracle database runs under NT.

To get a better understanding of how the central database works, it may be useful to be familiar with some of the basic terms of the system.

2.2 Some central notions in the data model

2.2.1 Project and form

A survey **project** is an entity from the viewpoint of bookkeeping – accounts are rendered per project. A **form**, on the other hand, corresponds to a Blaise questionnaire. A survey project consists of one or more forms.

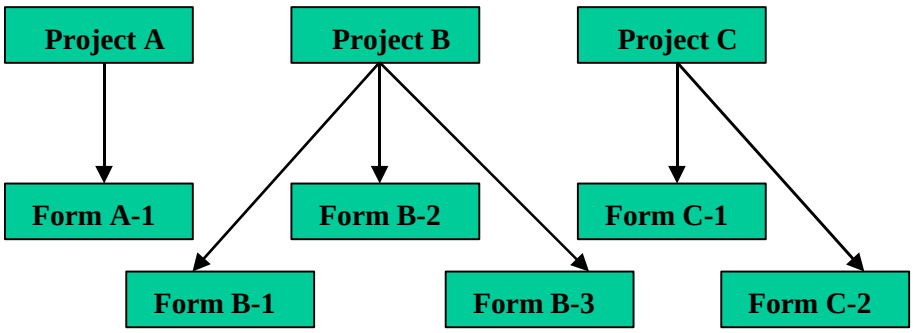

Figure 3: The hierarchy of projects and forms

2.2.2 Interview object (respondent) and period

An **interview object** is an entity that delivers data for a form (a person, a firm etc). Every interview object belongs to a form.

In many cases we want our interview objects to be dispersed over several stretches of time. For this purpose every form is subdivided into one or more **periods**, and every interview object is assigned to its form through one of the periods of the form.

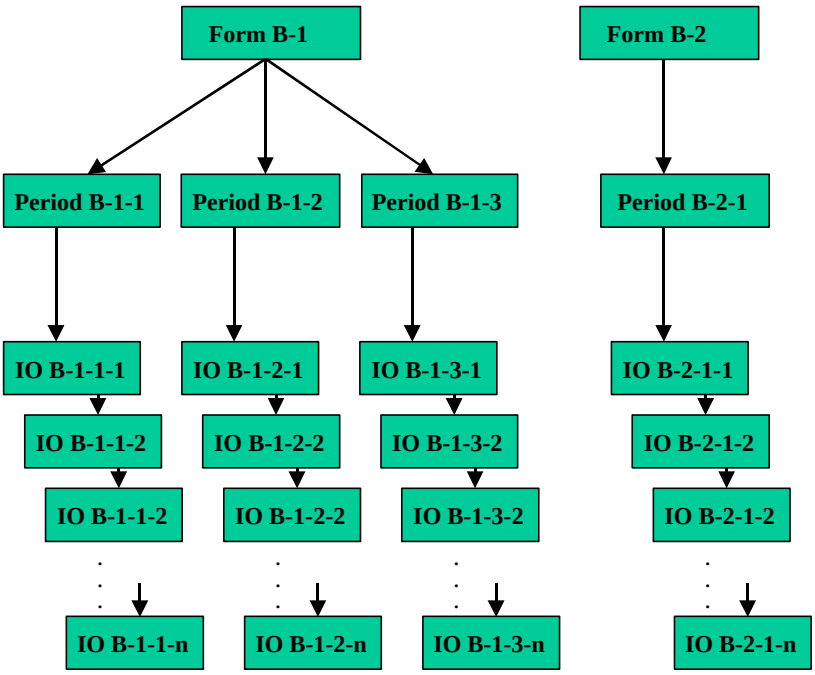

Figure 4: The hierarchy of forms, periods and interview objects

As earlier the interview objects are mostly sampled from the central Norwegian population register, or alternatively from the central industry register. The sampling is carried out in a separate system, not part of the CAI system. After sampling and necessary customization, the samples are loaded into the database.

2.2.3 Task and interviewer

An interview object prepared for a contact approach is called a **task**. An **interviewer** is an entity that accepts interview objects as work tasks. Defined in this way the notion **interviewer** resembles an address, and in fact an interviewer in the CAI system is not necessarily a person. Any mechanism that can accept a task and return it in a well-defined way, can act as an interviewer within the system.

This abstraction gives us a very useful degree of freedom. It is for instance possible to define one of the computers in our offices as an interviewer and then use it for interview work after regular office hours. Or we could establish a regular CATI system based on Blaise as an interviewer and let this system accept interview tasks from the CAI system.

2.2.4 Package

The communication between the central database and the interviewer laptops is for the most part handled through **packages**. There are several types of packages. The communication system knows the different types of packages and handles them accordingly. The packages are, however, not objects in the OOP sense of the word. They have no properties and generally no methods.

The most common package type is the communication container for one task. Tasks are transferred to the interviewers as packages, and they are returned in the same way. There is one Oracle table for outgoing tasks, and another for incoming ones. These two tables constitute part of the interface between the central database and the communication system.

Another type of packages contains the data model for a Blaise questionnaire. These packages are never returned to the central part of the system.

In addition to the task and data model packages, there is defined an “open” type of packages which serve system purposes. It is, for instance, possible to get an overview of the data situation (folders and files) on the interviewer laptops through one of these “open” packages, or corrupt files can be returned for remedy and later reinstallation.

2.2.5 CAP – Computer Assisted Payment

In addition to the interview data the interviewers deliver their time lists as data files. The time lists are compiled through a Blaise questionnaire, then converted to ANSI files and returned as packages. When received by the central database the CAP data is directed to a separate system for interviewer wages, which checks the data and in turn forwards it to the central governmental wages system.

2.3 Data structure

To manage the entities introduced in the text above, we use an Oracle datamodel with a design as shown in figure 5.

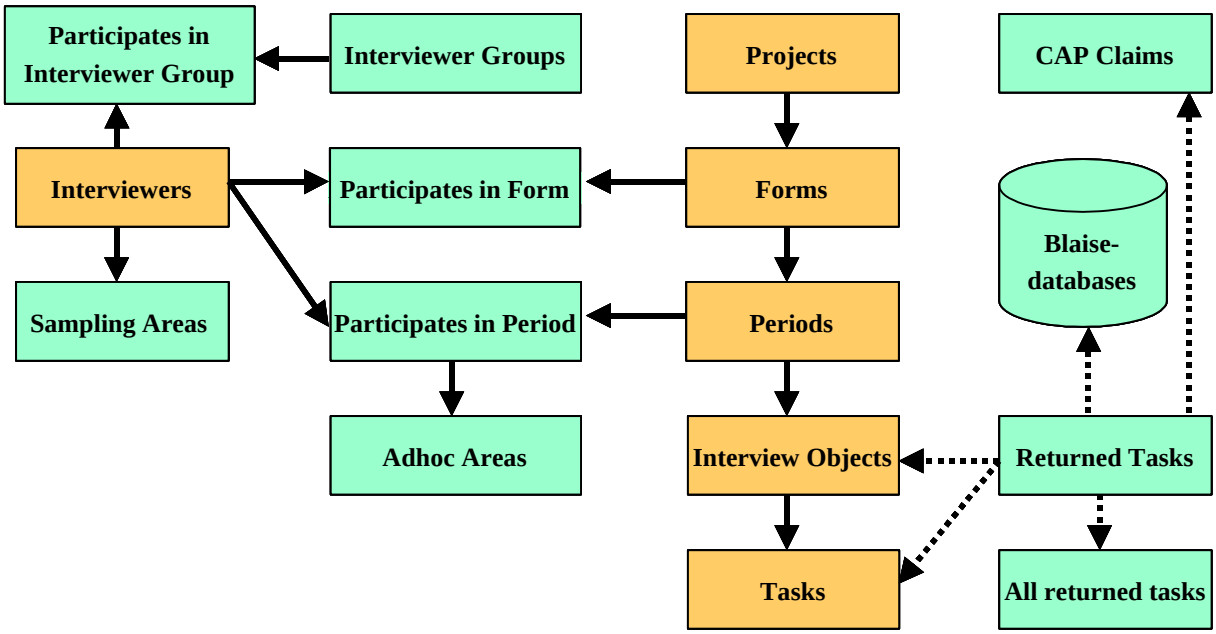

Figure 5: Data model for the central administrative database

The datamodel is mainly operated by screen applications made by Oracle Designer or Oracle Developer. The communication system has access to the database through JDBC (Java Database Connectivity), and contributes to the management with a number of useful status reports. The Oracle tools may be the safest and most flexible ones for editing the Oracle database, but when it comes to reports, Java competes very well. Reports are produced using a Java Servlet based framework resulting in ordinary HTML viewable in a web browser.

3 The communication part

3.1 Overview

The role of the communication system is to connect the interviewers to the central part of the system, transfer data between the central database and the interviewer laptops, and execute a number of defined "business methods" on the laptops based on data in the central database.

The data transfer is based on defined interfaces for collecting and delivering data. The transfer comprises a number of different types of data:

- Setups for Blaise questionnaires to be installed on the laptops
- Interview objects to be installed in the Blaise questionnaires or returned to the central database after interviewing.
- Other data files to be installed on the laptops, for instance revised versions of Manipula scripts.
- Various data to be returned to the central administration system, for instance snapshots of the contents of a laptop.
- A number of tables and status reports for the interviewers generated from the central database.

The "business methods" are predefined actions that the communication system can execute. They include:

- Installing pending questionnaires and interview objects on the laptops
- Finalize and/or remove a Blaise questionnaire from the laptops

- So called "system commands" to be executed on the laptops. A system command is a command package with a defined start method. In principle there are few limits to what you can achieve with a system command.

3.2 Security issues and internal working

Security has been a major issue in the construction of the communication system. For the same reason we cannot describe it in all details, but we can disclose that the security in relation to the central database is maintained through an internal structure containing a number of communication zones and firewalls. From the outside it is not possible to log on directly to the core of the system. All connection to the central database is initiated from the inside of the system. This mechanism slows the system down a little bit, but the capacity is still more than high enough for our 150 interviewers. The interviewers are identified by their username, password and by dial back from the central ISDN-router.

The laptops connect to the central database through an ISDN-router at their home at a speed of 64 Kb/s. The communication system is programmed in Java, and data is transferred as XML-documents. All communication is encrypted.

Ordinary internet protocols like HTTP and RMI (Java Remote Method Invocation) are used for the communication system. The communication module is implemented as a Java applet. As a consequence, the interviewers use Internet Explorer as their interface to the system. An advantage of this choice is that many interviewers know the user interface from earlier experience with computers. Also, the internet approach makes the communication system easy to maintain in the future. By using a Java applet, the communication module can be upgraded on the server, and immediately be available to all the interviewers, without upgrades being necessary on the laptops. The usual trouble with long loading times of applets is amended by applet caching, a feature of the Sun Java VM Plugin.

The interviewers all have their own homepage, presenting the status of their active projects. The homepage has links to static information like postage rates, training material and laws and regulations, as well as more dynamic reports on CAP claims.

At an early stage of the project we considered using Internet Explorer as a general interface to all programs on the laptops, which would give us the possibility to more or less hide the operating system from the interviewers. It turned out, however, that the Blaise-programs on the laptops for some reason did not function well when started from Internet Explorer, and this idea was abandoned. The main user interface on the laptops is Windows NT version 4.0. From Windows NT the interviewers may start the Blaise-applications, the communication system and some other programs.

4 What happens on the laptops

4.1 Overview

On the laptops there is a two level database structure. The top-level database contains one record for each interview object on that particular laptop. The purpose of the top-level database is to present to the interviewer a combined list of all the interview objects, no matter what questionnaire they belong to. In addition appointments with the interview objects are handled in the top-level database.

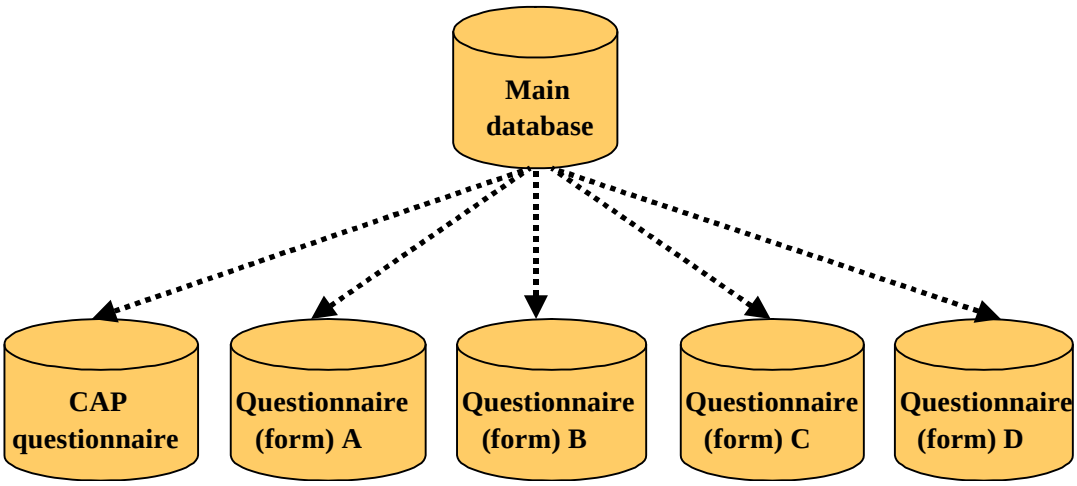

Figure 6: Database structure on the laptops

The databases on the second level are the Blaise questionnaires. Several questionnaires can exist at the same time at the second level. The relationship between the top-level database and the questionnaires on the second level is purely logical - there are no constraints or other formal structures connecting the two levels.

4.2 Management of the databases

Both the main database at the top level and the questionnaire databases at the second level are managed by a Manipula-application. For running the application we use Manipula version 4.3. The Manipula-application starts by showing the user a list of all the interviewable objects from all the accessible questionnaires. From this list an interview object can be selected for a contact approach. A contact approach can terminate with one of three statuses: Interview, non response or unfinished. After an interview or a non response the interview object is removed from the list. Unfinished interview objects remain on the list.

An interview object is transferred from the central database to the laptops in a data package, one interview object in each package. When a package is delivered to a laptop, its contents are appended both to the main database and the questionnaire database. This act of appending is done in a transaction-like way: Either both appends succeed or both are rejected and rolled back.

4.3 Packages – interface and carrier

Packages are a central part of the CAI system, and there are even two levels of packages. On the lowest level are the packages that the central database and the laptops use to communicate with each other. These packages are common zip-files, and their contents are the entities that need to be transferred between the laptops and the central database. On a higher level are the XML-packages (XML-documents) which the communication system uses to perform its part. The XML-packages resemble objects, in the OOP sense of the term, and one XML-package may contain one or more of the lower-level packages. Four types of XML-packages are defined.

At the present time five types of lower-level (zip-file) packages are known by the system. The communication system recognizes the difference between these package types, but has no knowledge of their internal structure. The role of the communication system is to collect packages at certain points in the system, deliver them at other points, and for some packages at some of the delivery points start a predefined action. The five types of packages contain:

- Setups for Blaise questionnaires to be installed on the laptops
- Interview objects to be installed in the Blaise questionnaires or returned to the central database after interviewing.
- CAP data (the interviewers' time lists) to be returned to the central database
- System commands to be executed on the laptops (program and necessities in one package)
- Various data to be returned to the central administration system, for instance snapshots of the contents of a laptop.

A short discussion of two of the package types will illustrate how the system works.

A questionnaire is installed on a laptop through a package that contains the datamodel for the questionnaire, three files in the simplest cases, plus three Manipula-scripts to handle the questionnaire. The communiaction system collects the package in the central database and transfers it to the laptop. Some folders are created for the questionnaire, and the compressed files are unzipped from the package. Now the datamodel is ready for receiving interview objects.

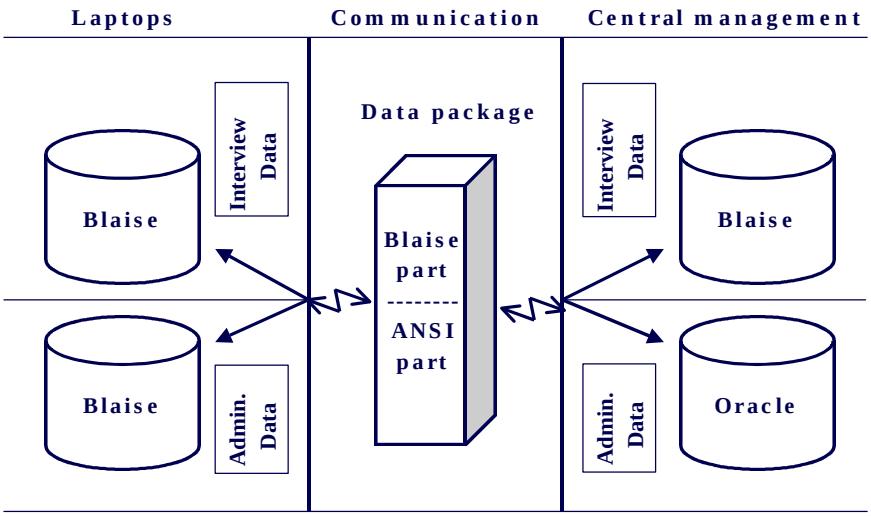

Figure 7: Work areas and data formats

The packages containing interview objects are a bit more sophisticated, as you may see from figure 7. Firstly they contain an initialized Blaise-record for the interview object. In addition they contain a file with a record of administrative data in ANSI-format for the top-level database. A new interview object is to be installed both in the top-level database and in its Blaise questionnaire. This double installation is handled by the communication system through a Manipula-script. The communication system transfers the package to the interviewer laptop, saves the package on the hard disk as a zip-file, unzips it and then lets Manipula execute the installation script.

5 A summary of a typical interview project

In the new CAI system a typical interview project will be conducted like this:

1) The Division for Sample Surveys decides to run a survey project. A **project** instance is created.
2) A **form** instance is created and a Blaise questionnaire is written.
3) An installation package is made for the form.
4) The total contact period for the form is divided into one or more **periods**.
5) A sample of **interview objects** is selected (outside the CAI system)
6) The interview objects are distributed over the periods of the form, and the sample is loaded into the database.
7) **Interviewers** are selected for each period of the form.
8) The interview objects for a period are assigned to the interviewers selected for the period (by a program).
9) **Installation packages** for the interview objects are generated.
10) The form is "opened" for use by the interviewers.
11) The interviewers collect their installation packages and install the form and their interview objects on their laptops.
12) Completed interviews and non responses are returned to the central database when the interviewers log on through the communication system. The updated status in relation to the forms in which the interviewers participate, is accessible to each interviewer on his or her homepage.
13) In the central offices the situation of the survey project can be continuously monitored through status reports from the central database.
14) When the contact period of the questionnaire is expired, the data from uncompleted interviews is returned. Then the questionnaire is removed from the interviewer laptops.
15) The questionnaire data is extracted from the Blaise database and delivered to the users.

Survey Management for the United Enterprise Statistics Programme at Statistics Canada

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March 2000

Background

In October 1996, Statistics Canada was presented with one of its largest and most complex initiatives of the decade. It was a direct result of the decision taken by the Federal government and the Provincial governments of Nova Scotia, New Brunswick and Newfoundland and Labrador. These four governments decided to consolidate the Federal Sales Tax and the Provincial Sales Tax into a new combined Harmonized Sales Tax. The main objective of this initiative was to reduce the administrative burden (and costs) of administering four separate tax collection systems. They agreed on a complex formula to distribute the tax revenues among the four governments. Statistics Canada was asked, indeed challenged, to provide the detailed economic data needed for the formula. The result of this challenge was the creation of a new programme to improve the statistics gathered for the business sector. This new programme became known as the "Project to Improve Provincial Economic Statistics" (PIPES).

The PIPES programme has many goals and objectives affecting all aspects of the survey collection process. In general terms, the main objective of PIPES is to supply the data needed to support the agreed revenue distribution formula. Gathering the necessary raw data meant a very substantial increase in the amount of available provincial economic statistics. The data had to measure the final sales of goods and services, on an annual, calendar year basis, by province and industry, by commodity and class of respondent. The end result being a transformation of these data into a set of Provincial Economic Accounts.

The Provincial Economic Accounts would collect additional data on both the expenditures and the incomes of households and businesses. To increase the data for the expenditure side, improvements would include larger and more frequent surveys to a number of personal surveys such as the Household Spending Survey and the Repairs and Renovations Survey.

But, the large majority of the changes were needed on the income side. The major changes to these surveys would occur with the development of a new integrated programme that would eventually replace all the existing programme of annual business surveys. This new programme within the PIPES initiative is known as the United Enterprise Statistics Programme (UESP).

United Enterprise Statistics Programme

The UESP would reform all the processes associated with conducting any business survey. This includes such basic components as sample selection, questionnaire development, data collection, data editing, imputation, analysis and dissemination. The UESP as a departmental programme has many goals and some of the basic principles that are guiding its evolution include:

- business surveys would be enterprise based;
- all data for an enterprise and its establishments will be collected and analysed together;
- special attention would be placed on the complex enterprises, which, although small in number, have a large impact on all economic production;
- reduce the response burden, particularly for the small business, by making use of administrative (Tax) data wherever possible; and,
- harmonize the concepts, definitions and questionnaires used in business surveys.

The UESP consists of four parts (figure 1) depending on the type of enterprise (simple or complex) and the type of data required (enterprise-level or establishment-level). Part 1 would be a census of the complex enterprises collecting primarily financial data. Part 2 would be a census of the establishments belonging to the complex enterprise collecting financial and non-financial data. Part 3 will be a sample survey collecting primarily non-financial data at the establishment level for simple enterprises. Part 4 would be the use of Tax data for simple enterprises.

Figure 1. Components of the UESP

	Enterprise Data	Establishment Data
Complex Enterprises	Part 1	Part 2
Simple Enterprises	Tax	Part 3

The development of the UESP would mean that the methodologies related to business surveys would change in many aspects. One of the biggest and one of the first to be encountered involved the survey questionnaire. A major objective is to harmonize and simplify the number of questionnaires sent to businesses. Statistics Canada currently has about 100 annual business surveys involving more than 700 different questionnaires. This is a result of the long established traditional vertically integrated method of survey collection.

The UESP approach is to have one consolidated questionnaire at the enterprise level, supplemented with industry specific “Schedules” at the establishment level. Standard concepts and question wording would be used across industries wherever possible. The questionnaires would also be simplified by using concepts and terms familiar to the respondent. And eventually, personalized questionnaires would be created showing only their previous responses.

The emphasis on the enterprise or enterprise-centric approach to the UESP will also affect sampling and data collection. The foremost of the concerns being the response burden, especially with small businesses, some, of which may not even be able to provide the requested data. In the past, data at the enterprise and establishment level have been collected by separate surveys with different sample designs. The UESP approach, which combines them into one vehicle, requires a new approach. Collection of data for both the enterprise and establishments in a coherent manner would be a challenge with many questions.

UESP Data Collection

Now in its third year, the UESP is a work in progress and it continues to evolve in all aspects. This paper will concentrate on the data collection process.

The PIPES programme developed a plan for the integration of surveys into the UESP process. For the first year, 14 surveys were identified for inclusion. This meant that these surveys had to be developed and the data collected in a very short time period. Most of these surveys had to be developed from the beginning because the surveys collected data for new industries not previously sampled. These surveys varied in size from 9 pages to 30 pages (including annexes). Sample sizes also varied from 12,000 for the Wholesale Survey to only a few for the Banking Survey (90).

The primary collection tool was the CASES software. The development methods and survey management processes of the existing annual and monthly collection cycles were used. This software and management system was not built with the UESP model in mind. While the first year proved workable, it would not serve as the model for the future.

The search for a replacement collection tool began in earnest. New data collection software had been the subject of much discussion within our collection groups for some time. There were several factors influencing which software would meet Statistics Canada's requirements. We did not want to build it; the implementation time frame of PIPES would not permit this. We knew that we had to move to a Windows environment in order to make efficient use of our existing base of computers. DOS, as an operating system was nearing the end of its life cycle. It was not flexible enough nor was it stable enough to keep up with the ever increasing demands of the surveys. Survey requirements were becoming more and more complex. At the same time, our capi surveys were experiencing growing pains and limitations as well. They too were interested in finding a Windows based collection tool for use on the field interviewers laptop computers. Unix was not seen as a viable tool for use on laptops and seen only as a tool available to a central collection facility. A Windows based collection software was the only solution.

Blaise happened to arrive on the scene with its new release of Blaise for Windows. At first appearances, it looked very promising. The timing could not have been more fortunate from the perspective of Westat and Statistics Netherlands. The timely release and initial demonstration of the Blaise for Window's capability clearly started the department thinking of its possibilities.

From our perspective, some of the main features of Blaise that worked in its favour were:
- a production version of the software was available in Windows including documentation;
- the data model could present the questions in more than one language;
- program code was easily reusable in different data models;
- it was easy to switch between multiple data collection modes (data entry, cati, capi) using the same program;
- ease of programming (modern programming concepts);
- speed of the collection application;
- built in cati scheduler;
- the appearance of being able to quickly develop a collection application; and,
- access to training and support from a reliable organization.

While Blaise has many of the essential elements of an ideal data collection tool, it did and still does have its limitations. At that time, some of the more important missing features, from Statistics Canada's perspective, included:
- no data capture keying verification for a high speed data capture operations;
- no capability to directly read and write to an external database, a beta version of read only is now available;
- data editing, since upgraded in a recent release with the addition of user defined edit types and edit masks;
- capability to easily change the default screen layout, since upgraded with a release of Emily;
- edit tracking (keeping a record of which edit failed); and ,
- a facility to produce management information reports.

But, it was the opportune emergence of Blaise for Windows and its many other desirable features that resulted in it being selected as the standard data collection software for Statistics Canada.

Year two was a new beginning for the UESP. It was a year of transition from the old to the new. Conversion from one software collection tool to another is never an easy task. But, the UESP had a distinct advantage; their requirements were new requirements. New software, new concepts, new approaches, new development. A huge advantage over trying to fit a new data collection system into existing methods and operations.

During the second year, the original 14 surveys were rewritten and 18 new surveys were added. With new surveys being introduced each year into the UESP model, being able to quickly add a new survey is very important. The PIPES strategy has all of Statistics Canada's business surveys being folded into this same model.

The process model used for the first year of UESP identified areas where improvements would have to be made. A new process model was developed. Briefly stated, it consists of:
- a mail out of a paper questionnaire;
- data capture of the completed paper questionnaire;
- follow-up of late returns;
- follow-up of edit failures from the data capture operation;
- on-line capture of identified cati respondents; and,
- feedback to the business register.

This process model may not appear to be any different then the process model used by many other statistical organizations but what is different is the data, the collection entities and the inter-relationships demanded by the UESP. Another major difference is the annual collection cycle for UESP. PIPES requires that the data be collected for a calendar year and as near the end of the year as possible. This meant that a mail out and collection operation had to take place over a relatively short time period. A staggered mail-out throughout the year is not an option for the large majority of these surveys.

For this cycle, a new survey (case) management system was also developed to better manage the centralized data collection operation. Again, for this process, good survey management at Statistics Canada is no different then good survey management at other statistical agencies. Information is required on completion status, who is outstanding, ensure timely non-response follow-up; in simple terms, what has been completed and what remains to be done.

UESP year three brings the introduction of 20 additional surveys, including the conversion of some of our bigger, more complex surveys. And, further refinements to the survey management system. Components to control what data editors are allowed to work on, information on the status of the survey's environment and who is using which application. Included also, is an option to report data electronically. For surveys that report their data electronically, the data is re-integrated into the Blaise data model for editing and follow-up.

Survey Management System

Survey management starts with the mail out of questionnaires and is followed by their return, in various states of completeness, to the mailroom. Questionnaires are logged as received and sent to data capture and editing. Non-responding units are identified for follow-up and reminders sent. Other units are scheduled for cati collection. Probably very similar and familiar to many organizations. What makes this different, is the tools that are used and the operational constraints of the surveys. Under the constraints imposed by the UESP previously mentioned, you can imagine that the return of many thousands of questionnaires for many surveys could mean total confusion. Knowing the processing status of a particular questionnaire could be very difficult to determine. And, this status must be known as soon as possible particularly if a non-response follow-up is scheduled. One would not want to have a questionnaire being identified for a non-response follow-up when that completed questionnaire is in fact being data captured. One central repository had to exist to manage the many questionnaires in their varying stages of processing. A central database would be a natural choice. But, with the lack of a facility within Blaise to directly access an external database, a Blaise database was used instead. The resulting system actually consists of four Blaise data bases supported by a number of Maniplus and Manipula programs.

This management system is a series of menus and sub-menus presented in the familiar Blaise format that provides information relative to each individual survey and each respondent within the survey. Data is stored that records information such as the status of the survey environment (internal testing, client testing, production), access privileges (interviewer, supervisor, administrator), and management information (complete, partial, non-response, refusals, etc) and permits access to the central document control, survey collection functions and administrative utilities. This whole system of managing the surveys uses Blaise tools only.

In these menus are two very important functions that deserve special mention. The first is the central document control. This menu includes the ability to:

- log-in incoming questionnaires sent through the mail;
- update mailing label information;
- view, add to or create mail groups;
- view, add to or create combined reports;
- produce labels for re-mail; and,
- produce Fax follow -up.

The second important menu is called active surveys. It is through this menu that the actual survey collection takes place; again assisted by a number of sub-menus. Some of these functions include:
- selecting a respondent by specifying its unique identification number;
- creating a day batch;
- starting the data entry program;
- starting the cati call scheduler;
- starting cati management; and,
- producing status reports.

Each time that an interviewer enters and leaves the central document control or the active surveys, status information is collected. This information can be stored on one of four Blaise databases. As you can appreciate, since these four databases are used throughout the system, it is extremely important that the databases are kept synchronized. Before an interviewer enters one of these functions, the databases are synchronized by a Manipula job. Every night, another Manipula job is run to further ensure that the databases are synchronized and readied for the creation of the next day batch.

This process is not without its problems. The problems that arise are not from its functionality but rather in the performance of some of its functions. Most functions execute quickly, but some are slow. Analysis and system monitoring is being done to try and pin point the exact cause, but that has not yet been determined. Some problems may be related to our system design and solving this problem remains a top priority for us. However, for an organization that is relatively new in its experience with Blaise and particularly Blaise for Windows we feel that we have made considerable progress. We certainly have not discovered all of its quirks. Perhaps our expectations for the product are too high and it may become necessary to use tools outside the set of Blaise software to meet some of our requirements. We very much wanted to use Blaise as it comes “right out of the box” without any extra software.

What lies ahead for case management within the UESP is more evolution. The development of a personalized questionnaire for a respondent has completed the analysis phase and is progressing to development. Its design includes the use of an Oracle database and XML. While this does not directly use Blaise, it is a highly desirable feature within our survey collection process. Other enhancements currently under construction include a component to handle the mail out of questionnaires, a component to manage all the various survey outputs and a component to move a survey unit which is “out of scope” for one survey to being “in scope” for a different survey.

Conclusions

As mentioned earlier, Blaise is not without its limitations and the good news is that additional features are being developed. We feel that having a direct read and write capability to an external data base would go a long way to addressing our performance issues. A beta release that permits a read is available and a write capability is planned. We are looking forward to its release.

The ability to keep a record of which edit has failed within a data model is also very desirable. This information would be used to analyse how often and under which conditions edits are being triggered. This would be used to define better edits in the future.

Also, we need the capability to perform data entry verification. We still receive a large portion of our questionnaires by return mail. If a completed questionnaire is returned by mail, it remains a very cost efficient method of data collection. But, in this day of e-commerce and the explosive use of the Internet, traditional methods of data collection may become a thing of the past. Some respondents are currently returning their completed questionnaires electronically and this is expected to grow. How will it be done in the future? A very good question but no final answers. We are actively working on collecting and editing data electronically, particularly using the Internet. A proto-type for use in our 2001 census of population is being developed but a lot of challenges remain. That work, for us, is very much at the research and experimentation stage and clearly the topic for a future conference.

Back to the present, Blaise is proving to live up to its billing even though production problems continue to creep into our operations. These problems are more a result of our application design, programming errors and improper operational instructions then problems with the software itself. We are continuing to build our Blaise expertise and increase the number of developers. Recent changes within Statistics Canada, which re-organized all the computer assisted interviewing applications development into one division, has re-enforced the original decision to select Blaise. A long process of conversion and re-writing all of our existing collection applications now lies ahead.

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Monitoring CATI Enumerators

by

Leonard Hart and Asa Manning
National Agricultural Statistics Services

Introduction

In the fall of 1997 the Census of Agricultural was transferred from the Census Bureau to the National Agricultural Statistics Service (NASS). To meet the new demands for this survey NASS had to revamp all aspects of its computer systems. With 46 locations throughout the USA this was a major undertaking. All servers were upgraded to Dell muti-processors and the server software was upgraded to Novell 4.1 from Novell 3.12. The major client operating system at the time on the desktop computers was upgraded from Windows 3.1 to Windows 95. In Headquarters and our 45 field offices this meant all 386 and 486 machines were replaced with Pentium base machines. Almost all 16 bit software packages had to be replaced since they did not work in the Windows 95 environment or functioned improperly. One of the packages NASS lost was our video monitoring system.

In early 1998 NASS took on a special survey for National Institute for Occupational Safety and Health (NIOSH) called the Childhood Injury Survey. NIOSH demanded that NASS monitor a certain percentage of the CATI interviews. NASS needed an inexpensive solution very quickly.

Past History

In the past NASS has had problems with both the audio and video parts of its monitoring system. Phone systems differed across the 43 state statistical offices where CATI was used. For the majority of the offices the telephone supervisor had the ability to select a certain phone line and could tell who was using it. Other offices had rolling phone numbers and this meant the supervisor had no way of telling who was talking on the phone. These office phone systems were upgraded when budget permitted. The major problem with the monitoring system was the video system. In the past the video system was very faulty. It caused machines to lock up during interviews resulting in the loss of data. At times it also slowed down the delivery of Blaise forms to the machine. The major contribution to this problem was the limitation of one meg of base memory under Windows 3.1 and DOS. The video monitoring package that NASS was using had to be loaded into base memory. Over time NASS Blaise applications were getting larger. It reached the point where these two systems were fighting for conventional memory. We loaded as much software into upper memory as possible. Loading these applications to upper memory only bought NASS time. We eventually had to totally unload the video monitoring system.

New system

Any replacement product would have to be very flexible. It needed to work on a variety of personal computers. With the client software in our field offices being converted at various times from late fall of 1997 through spring of 1998, the new system had to work under Windows 3.1 and Windows 95. Another major concern was cost. Since NASS had just gone through a major hardware and software conversion there was a limited amount of money left to spend on new items. Also, man hours were not available to develop an in house system.

As we started to look at other criteria, security was another main issue. All field offices are connected to a WAN which connects all field offices together with HQ. We needed to be able to restrict and/or control access across the WAN environment. We also had the concerns of outside forces hacking into our system. We had to have control over the system since many of our machines during the day are used by the office staff and at night the machines or used by the enumerator staff. Since the offices were setup as an LAN, which was connected to a WAN, we wanted to make sure unauthorized people inside and outside of NASS could not view any machines. Data confidentiality takes an extremely high priority in NASS. We needed a system that was easy to use with little or no maintenance once it was set up, and required minimal training.

About this time telecommuters were starting to use a new package call Reachout. This allowed them to log in from remote locations and work on their personal machines. After some discussion we decide to pursue this system as a possible replacement for our video monitoring system. It seemed to fit most up our criteria NASS needed and it was a package we already owned.

Problems

Once the system was up in a test environment, the system basically met all our goals. In implementing the package we did however have to overcome several hurdles. When the viewing machine (this is the machine setup to view other machines) called a host machine (this is the machine that is being viewed) the host machine screen display slowed to a crawl. It was as if the machine was locking up. The individual Blaise questions would slowly be displayed on the screen. The screen problem increased as the viewing machine tried to view more then one machine at a time. Another problem was the viewing machine keyboard and mouse. If the viewing machine moved the mouse or typed something on the keyboard the host machine keyboard and mouse would react to the input. This problem was easily fixed. NASS discovered one of the options for the viewing machine was to disable the local keyboard and mouse. We could set this option on the host machine too. We opted not to do this since most host machines were used by Stats and they would need to control the keyboard and mouse from a remote location. By setting this option on the host machine all viewers to this machine could not use the keyboard and mouse. By setting the option on the viewer machine we could control who had command of the input on the host machines. The down side to this option was it had to be made to each icon (each host machine is represented by an icon on the viewing machine) setup under the viewing machine. This option is not a global setting.

A major benefit of this option was that the screen display speed on the viewing and host machine increased to an acceptable level. The host machine user did not see any degradation in displaying questions to the screen. The viewing machine could view one or many host machines at one time and the refresh rate of the viewing machine was acceptable. This totally took care of the viewer machine disrupting the host machine during calling.

We had various other problems in the beginning. Machines were locking up or the installed package was not completing properly. Through testing we discovered these problems were inherent to Reachout and not in our setup. The initial version of Reachout that NASS was using was version 8.0. As we moved to a newer version of Reachout, these problems disappeared. NASS is currently using version 8.41 of Reachout and looking to possibly upgrading to version 8.42.

Another problem that NASS still has is the inability to hide the viewer toolbar. This toolbar has a keyboard and mouse button that supercede the viewing machine setup icon defaults. If a supervisory enumerator clicks on the keyboard and mouse button on this toolbar, it can turn on the local keyboard and mouse. Then this causes the viewer machine to affect the host machine and slows it down. Currently there is not a way to turn off or hide these buttons on the toolbar. NASS has determined this to be a training issue for the supervisory enumerator.

Another slight problem occurs when a workstation does not have the proper video resolution settings. The current NASS standard is 800x600. If a machine gets set to another video resolution, the viewer machine has more difficulty viewing the host=s screen. It can still see the screen but the text resolution changes a little. Again NASS has determined this as a training problem and suggests users don=t change their video resolution from the agency standard.

Excellent results

The first real test for the monitoring system came when NASS had a training school for the NIOSH survey. Toward the end of the training school as everybody was busy inputting data with the Blaise NIOSH instrument a viewing machine called all 15 computers at once without them knowing it. After monitoring them for about thirty minutes their attention was bought to an overhead screen where they were shown that they were being monitored. They were totally amazed. Nobody had noticed anything in the audience as they were being monitored. Another test was done at a later date at one of our call centers with 25 machines. Again people were not told they were being monitored and nobody saw any degradation in any of the machines that were being monitored.

As mentioned earlier one of our goals was to make the system easy to install and maintain. One of the first states to implement the system was setup by a non-computer person in that state office. With the simple instructions provide by Headquarters they were able to install the system within a few hours.

A great side benefit from this system once it was installed was the debugging tools it allows us. Using Reachout across the NASS WAN, staff in headquarters can visually see what is happening on a workstation on another LAN. Of course this can only take place with the permission of the end user on the other LAN. This greatly cut down support time for fixing bugs in Blaise applications or getting a wayward end user back on track. One of the tools that makes this possible is Reachout=s own built in Explorer. Reachout Explorer has the capability for us to upload a fix on the spot or download data as needed to or from the remote location. The old way of fixing a problem normally had the field office send the directories to headquarters and we would try to recreate the problem on our LAN. This took a lot of time and it did not always work. With Reachout, we can see the problem first hand, which allows us to spend less time and yet with better results.

Future enhancements

With the basic video monitoring package installed in the field offices, NASS still wants to add several new enhancements to the system. The first major enhancement is to convert all paper forms used by our supervisors to an interactive supervisor interface. This system would wrap around the video system so the supervisor can input their data directly into a database. Another feature that NASS wants to add is the ability to capture screen displays. This could be used to capture Aproblem screens@ to aid debugging or training.

Summary

NASS developed an extremely useful system that met our goals of a secure system with no side affects to the host machine. It is easy to install and maintain and allows us to view enumerator machines in an unobtrusive manner. NASS also discovered a great side benefit to this system. It allowed the Blaise programmers to see problems in the field offices as they occur in a live environment. This allows for quicker problem resolution. NASS did this without buying a new software package and with limited man hours. With the future enhancements NASS feels this system will meet all of ours goals of a well rounded monitoring system.

Session 2

Surveys using Blaise

Use of CAPI instrument in a blind test of the UK 2001 Census form
Lucy Haselden, ONS

Developing a Blaise instrument for the Spanish Bladder Cancer Survey
Richard Frey, Westat

Using Blaise in a nationwide Food Consumption Survey
Lois Steinfeldt, US Department of Agriculture

Challenges in developing a longitudinal survey on income dynamics
Brett Martin, Statistics New Zealand

Data Collection in Two Phase and multi centre Health Survey
Vesa Kuusela, Statistics Finland

Use of the CAPI instrument in a blind test of the UK 2001 Census form

Introduction

This paper describes how Blaise III was used in the Census Quality Survey (CQS). The Census Quality Survey was commissioned by the Census Division of the Office for National Statistics in England and Wales. The survey had two principal aims:

- Firstly, to provide details of any questions on the Census form that were not working well and might need to be re-thought;
- Secondly, to provide end users of Census data with some information about the accuracy of the answers given to each of the Census questions so that they could gauge the level of error involved with any analysis that they were to carry out.

In order, to achieve these aims, we needed to compare the answers given on the Census form by respondents filling in the form themselves, in conditions as similar as possible to those they would experience when filling in the real Census form, with the answers they gave in an interview, where details given can be fully probed and checked by the interviewers. We felt this could most effectively be achieved by carrying out a "blind test" where respondents were re-asked the questions on the Census form without access to their original answers. However, it was also important that where the answers differed between the Census form and the interview, that the interviewer would be able to ask which answer was the better answer, given the situation on Census night and also be able to ask why the answers differed.

We decided that using the Blaise instrument we would be able to achieve all these aims. By storing the original Census form data in the Blaise instrument in a particular way, neither the respondent or the interviewer would have access to the original form data until they had given an answer in the interview. This paper gives details of how this process was carried out.

Methodology

The first part of the survey involved delivering test Census forms to 4640 addresses. 58 addresses in each of 80 areas were randomly selected. Interviewers called at each of these addresses and acted as far as possible as Census enumerators. They established how many households there were living at each address and ensured that at least one form was delivered per household. The interviewers then explained to a member of the household that the form was to be completed on the test Census night, 16th May, and then posted back to the office, using a pre-paid envelope. This was the same routine that enumerators would have to follow on the real Census night. Interviewers were asked not to give detailed instructions or advice on how to fill in the form. This aimed to ensure that there were no inequalities in the level of help given to different households. If interviewers were unable to make contact with a particular household, they were asked to simply deliver a form through the letter box, as enumerators would.

Once the Census forms had been delivered, respondents were left to complete them on their own. A help desk telephone line was provided, but it dealt mainly with practical issues such as lost forms. Where respondents were unsure of what a question meant or where they had difficulty answering a question, they were generally told to fill the form in as best they could and then to send it back, leaving out those questions which they felt they could not answer. A week or so after the test Census night, a reminder letter was sent to all those who had yet to return a form.

The forms that had been returned were keyed into a Blaise data entry programme. In the real Census it is hoped that the forms will be scanned. However, this was not possible for the survey and so all forms were double keyed. Where there was a discrepancy between the first and second key of a form, this was referred to supervisor who would resolve which was the correct entry.

Once the forms had been keyed, the data from them could be read into the CAPI instrument and sent to the relevant interviewer. The interviewers received cases which had all the keyed data read into them, but they did not have direct access to this information. When the interviews were carried out, respondents were asked the answers to a variety of questions which related to the Census form. In some cases, they were simply re-asked the Census form question. In other cases, where the question had a higher priority or where the Census question seemed complicated, a variety of questions were asked which would ultimately seek the same information as on the Census forms. Where discrepancies occurred between Census and Survey answers, respondents were told what their Census answer had been and were asked which was the better answer and this was taken to be the "true" answer. This final answer is referred to as the reconciled answer. Respondents were then generally asked for any reasons for discrepancies. They were also given an opportunity to give their opinions on the Census form and answer some general questions about the look and layout of the form. Throughout the interview, interviewers were encouraged to make notes if there were circumstances where the question did not seem appropriate to the individual's circumstances.

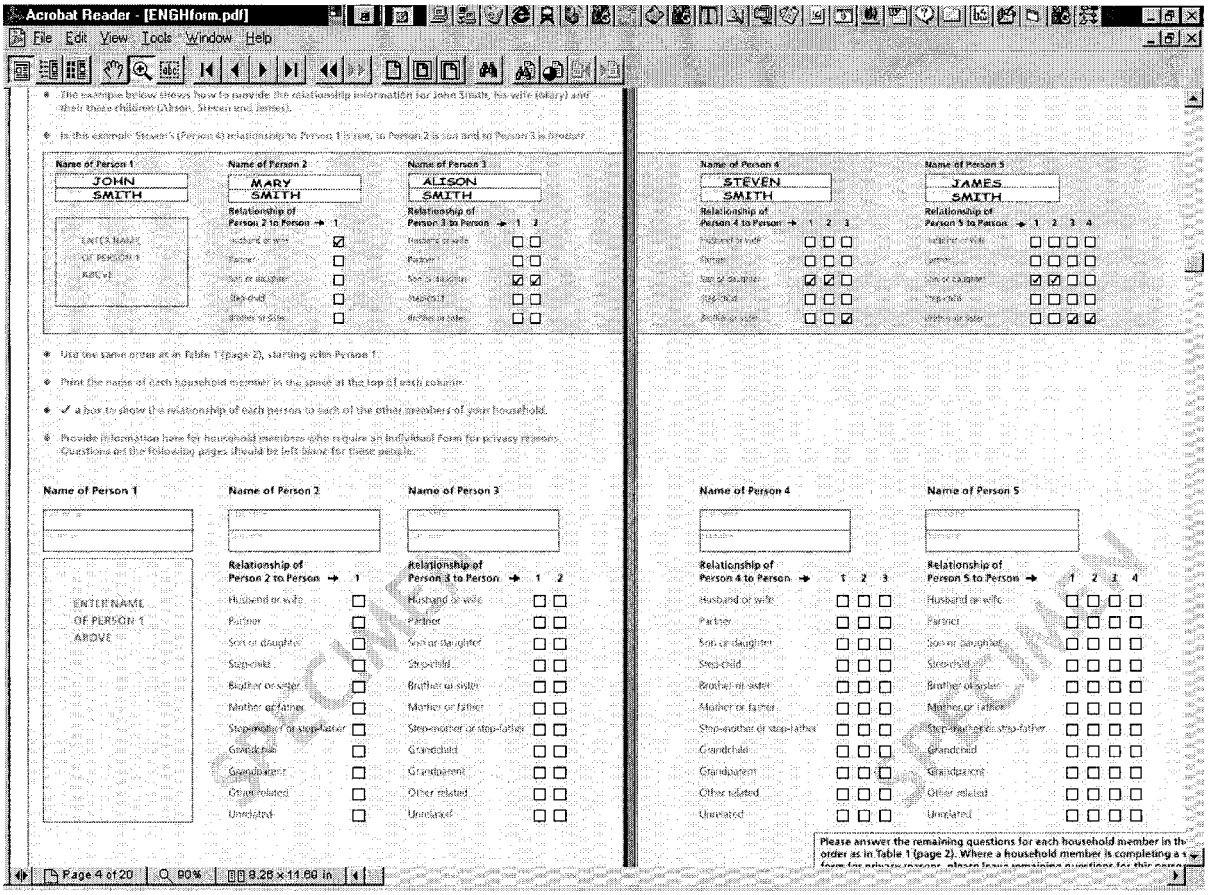
The aim of the analysis of this data was to provide a comparison between the original answers given on the Census form and the final answers given during the interviews. The analysis also gave details of why particular questions had caused difficulties for respondents.

The Census Form

The Census form was a twenty page document that asked a variety of questions about the individuals who formed the household and the accommodation they lived in. Instructions about how to fill in the form were given on the first page along with the household's address details and the signature of the householder. Respondents were asked to fill in the names of all members of the household on a table on the inside of the front cover. They were also asked to fill in the names and addresses of any visitors present on Census night. A household questionnaire asked nine questions about accommodation and cars. This was meant to be completed by the householder.

For the first time in any Census, respondents were asked to complete a relationship grid. The grid spanned two pages and asked for the first name and surname for each household member as well as the relationship of each household member to other household members. Person 1 was simply asked for their name; person 2 was asked about their relationship to person 1; person 3 was asked about their relationships to persons 1 and 2 and so on. This is shown in diagram 1. The relationship grid was thought to be an ambitious idea because although it was thought from earlier studies, that some 10% of the population would have trouble completing a grid in this way, it would provide a rich source of data about household composition that had simply not been collected before.

Diagram 1 – The Relationship Grid



The form also contained questionnaires for up to five individuals. Each individual questionnaire contained thirty five questions and spanned three pages but routing instructions on the form meant that respondents would not have to answer all these questions.

Respondents answered these questions by ticking one or more of the answer categories provided or by writing in their answers in the spaces provided, according to the question. Respondents were given instructions as to whether they could tick one or more box at each question and where they were expected to write in an answer they were instructed to do so.

Although it was hoped that each adult member of the household would fill in their own individual forms, there was no explicit instruction to do this. It was known from earlier testing that in some households, there would be one form filler who would fill in the details for all other household members. This main form filler may or may not ask the relevant individuals for details they were not sure about. In other households, each individual concerned would fill in their own form (with obvious exceptions for small children or very frail household members). In other households, some people would fill in their own individual sections whilst others would leave it to the main form filler.

Planning for Integrated Keying and Interview Programmes

In order for the details filled in on the Census forms to be used in the survey it was important to develop a Blaise programme which would hold all this information in a way that would be accessible to the interview programme. This involved planning for both programmes at the same time.

Naming Conventions

In order to facilitate programming and for ease of reference at the analysis stage, we decided to apply a naming convention to the variables in both the keying and the interview programmes. The naming convention had to be able to quickly identify whether the variable related to individual, household or relationship grid data and also whether it related to form data or interview data. To this end, a five character code was devised. The first character was either a C, an S or an R which denoted whether the variable related to the Census form (C) or the Interview (S for all questions asked and R for calculated reconciled variables which would be used in the final analysis) . The Second digit indicated whether the data was from the household section (H), the relationship grid (R) or the individual section (P). The third and fourth digits related to the question number on the form. Finally, a fifth digit was reserved for denoting parts of questions. In the keying programme this could indicate that there was an “other – write in” part of the question. During the interview, respondents were generally asked more than one question in order to get the final reconcile answer. These questions were referred to by a letter. Thus SP02b would refer to the second question about question 2 on the individual section of the interview programme. By keeping the naming convention to five characters, there was room to allow for multiple responses and arrays.

Types

The interview programme would compare the answers given on the Census form with those given during the interview. This involved using a “Types” paragraph for enumerated type questions and this paragraph had to be consistent across both the Census form keying programme and the interview programme. All enumerated type questions where the answers were going to be compared had the answer categories listed in the “Types” paragraph. Since the interview programme was developed in parallel with the keying programme, it was important that any changes to these sets of answer categories were changed in both.

Reading in Data

In order to carry out the blind testing required, the data from the keyed Census forms would have to be read into the Blaise interview programme. Two ways of doing this were considered:

- Reading in the data at the top level of the data model and putting all the external data into locals at this level;
- Reading the external data at the lowest level, into each individual block.

Because we had to read nearly all the keyed data into the Blaise interview programme, we had to consider the implications of the size of what we were reading in. Reading everything in at the top level of the data model was simply too slow and meant it would take interviewers too long to load up each programme. We therefore decided to read the data in at the lowest possible block level. It was felt that this would speed up the programme considerably. Although this was the best solution at the time, the interview programme remained slow but usable.

Developing a Keying Programme

The Programme Design

However well designed a self completion questionnaire is, there will inevitably be times when respondents do not follow instructions and as a result, tick two or more categories when they should only tick one, do not follow routing instructions and answer questions when they should not or do not answer questions when they should. Some respondents might decide that a question they were not routed to applied to them and then answer it anyway.

The keying programme had to reflect the way people might actually respond to the Census form, rather than the way they should have. Therefore, multiple responses were allowed for all enumerated type questions. The exception to this rule was for yes/no type responses. It was anticipated that respondents would rarely answer both yes and no for a particular question. In addition, it was thought that in the unlikely event of someone answering that way, it would be same as if they had not given an answer at all. Blanks were allowed for all questions, as there was always a possibility that the a respondent elected not to answer a question. Finally, there was very little routing between questions in the keying questionnaire. This meant that the programme could cope even with someone who had just answered a random selection of questions and paid no heed at all to the routing instructions on the form.

It was possible, therefore, to keep the keying programme relatively simple, with separate blocks for each of the sections of the form namely:

- A block indicating whether or not the front of the form had been signed by the primary form filler and if so, who had provide the signature (this was captured in order to give interviewers some information about who they should interview);
- A block which allowed all the names given in the table for the list of household members, to be entered;
- A block which allowed all the names given in the table for the list of visitors, to be entered;
- A block allowing all the information in the household section of the Census form to be entered;
- A block which allowed all the information in the relationship grid to be entered;
- An array of blocks which allowed all the information in all the individual forms to be entered.

The blocks the household members and visitors and the household information section, were relatively simple to devise. The naming conventions and rules about types were followed throughout and very little routing was used.

The relationship grid proved to be the most complicated part of the keying programme. As well as having to write some fairly complicated code so that the keying programme followed as closely as possible the paper Census form, additional code had to be written to record “consistent errors”.

It was known that some people could not fill in forms presented in this grid-like fashion and such people, if they attempted the question at all, would make a large number of mistakes. Testing had shown that these mistakes fell into three broad types:

- Reverse logic mistakes – here the respondent gets the relationship the wrong way round and instead of recording the relationship of John to Ann, the respondent would record the relationship of Ann to John.
- Relationship to person one only – it was known that some respondents would be able to cope with working out the relationships of each person to person 1 but the grid layout of the form would mean they have difficulty working out what to put in the columns for the relationships of person 3 to person 2.
- Not entering a person 1 – Tests had showed that some people would not fill in any details for person 1 because there were no boxes to tick for this person. However, not filling in these details would make the rest of the grid difficult to complete.

We decided that if a respondent had made anyone of these mistakes, it was likely that the whole of the relationship grid would be incorrectly filled in and rather than asking the respondent why they had made an error every single time there was a discrepancy between the Census form and the interview data, we would just ask these respondents why they had made the overall error.

In order to do this, we would have to be able to spot these types of errors at the keying stage. This could be done by asking keyers to spot these types of mistake while keying in the form and indicating if any of them had occurred at an appropriate question in the Blaise programme. This was done for the pilot but at the main stage, we decided to let the Blaise programme double check. If there was no information at person 1 but details had been filled in for all other people then we could calculate that one of the consistent errors had been made. Similarly, if the only boxes ticked were for the relationship to person 1, another of these errors had been made. Finding out if the respondent had got the relationships the wrong way round was more complicated. However, in the individual sections of the form, respondents were asked to fill in details of their date of birth and so if these two sections could be linked it would be possible to use signals to alert keyers to situations where fathers where older than their children or other unfeasible situations.

It was possible to link the data in each individual form to the relevant part of the relationship grid by having a screen which appeared every time a keyer wanted to enter data for a new individual which asked which person from the relationship grid you wanted to enter individual data for. The answer categories used text substitution to give all the names of the people mentioned on the relationship grid and a further category which said “Person not mentioned category” which would then require you to enter the name of the person. This had to be an option as people were frequently left off the relationship grid but included in the individual questionnaires.

By linking the relationship grid and the individual sections in this way, it was possible to identify individuals who were not included on the relationship grid so that they could be asked why that had happened during the interview. Similarly, it was possible to tell if there was no individual information for someone who had been mentioned on the relationship grid.

Double Keying

In the real census, forms will be scanned and the data will be double checked as part of the scanning process. Scanning was not a possibility for the CQS, partly because the apparatus for the Census scan was not yet in place and partly because keying seemed to be a more appropriate way to enter the data into Blaise.

It was extremely important that all the data entered was accurate and in order to achieve this, the data needed to be double keyed. This was done using one programme to key the form twice into two separate datafiles and then using a Manipula programme to verify that each key had resulted in the same data being entered.

Ten keyers worked on entering all this information. They worked from the same programme on the same file server and each Census form was keyed by two different interviewers.

One problem that arose out of this was the keying of text fields. All the keyers were given instructions ensuring that they always used capital letters, always left one space between each word and always typed exactly what they saw, even when spelt incorrectly or when abbreviations were used. Despite the instructions, many second keys were failing because of tiny differences at these text fields. This was delaying the keying process and it was felt that these small differences would have no material effect on the interviews or subsequent analyses.

It was therefore decided that it would be best if the second keyer simply had to confirm that what the first keyer had entered was correct. This meant reading in the data from the first key. As soon as the first keyer had entered all the information from one Census form, they saved it all as a datafile which would then be accessible straight away to a second keyer. This would mean all the information from the first key would have to be read into the second key. However, with so many different keyers working from one file server, which was kept on a different site, reading in large chunks of data became unacceptably slow.

It was decided that the best way around this to create a separate datafile which only contained the string fields. This was the only thing read into the second key. Because we had to extract data from the first key, it was only possible to carry out the second key after this had been done. This small disadvantage was easily outweighed by the improved speed of the keying process.

Serial Numbers

We anticipated that some interviewers would enter incorrect serial numbers for particular addresses. This was an extremely serious issue as it meant that the data from the form would be scattered to the wrong interviewers or interviewers would try and interview at the wrong households. Beyond the practical implications for us, such as time wasted interviewing at the wrong household, this had very serious implications for confidentiality. Although respondents would not see the data keyed from the form for their address, they would, under certain circumstances, hear what had been written for certain questions. It was therefore extremely important that no mistakes were made because of serial number error. This problem was generally picked up when forms were booked in but we needed to be completely certain. To this end, a checking procedure was established. The serial numbers were based on the area number (2 digits) the address number (2 digits) and the household number (2 digits). A check was used so that for any given area number, the correct postcode had to be used.

Making Notes

Some respondents dealt with the Census form in ways that had not been anticipated. Rather than answering some questions, they had written a full explanation of their circumstances in the space around the tick boxes. Others had simply written “same as person 1” beside on the top of individual forms. Many other unusual ways of filling in the form were discovered as the forms were keyed. Guidelines were established, and added to in order to ensure consistency in dealing with these problems. At the same time, keyers were asked to use the notes facility in Blaise whenever they had to deal with unusual situations. This allowed the keyers to describe the types of difficulties they experienced and this information was in turn passed on to the client in Census division and has been useful for them in planning the scanning operation for the actual Census.

Developing the Interview Programme

Once all the data had been keyed it would have to be read into an interview programme which would be used to carry out a blind trial of the Census form. The interview programme would be required to re-ask the respondents about all the information on the Census form and compare the answers given on the form with those given in the interview and, where necessary reconcile the two answers and probe out reasons for discrepancies.

Structure of Programme

Gathering all this information would require a significant amount of routing within the programme. This problem was exacerbated by the routing on the Census form. We decided that all routing in the interview should be based on final reconciled answers.

The structure of the programme could be broken down as follows:

Household level. One “include” file was used for the household level information. That “include” file called on four further “include” files – one relating to the members of the household and; a second include file contained all the information in the household questionnaire; two other include files were used to time how long it took interviewers to complete this part of the questionnaire.

Relationship Grid This consisted of one “include” file.

Individual level. It is possible to think of the individual level questionnaire in a number of sections. These sections were based on routing breaks so that wherever there was a routing instruction, a new section would start. Each of these sections was represented by one block. One “include” file was called at the datamodel level and this “include” file called a number of other include files and each file contained one block. Routing at the highest person level meant that these blocks were called only for the appropriate groups of people, as indicated by the Census form. This system simplified what would have been very complicated routing.

The household questionnaire, the relationship grid and each of the individual questionnaires were stored as parallel blocks.

Format of questions

For each Census question on the form a basic pattern was formed:

- One or more questions were asked in order to gather the information required at each question on the Census form. This had to take into account all the definitions that Census wanted to apply.
- The answers from these questions were then calculated into a hidden variable which was designed to be in exactly the same format as the question and answer categories on the Census form.
- This interview answer was then compared with the answer or answers given on the Census form. If the answer was the same in the interview as on the form, respondents were asked about the next question on the form.
- If the answers differed from each other, they were then asked “On the Census form, you told me that _____, but you have also said _____. Which would you say was the better answer?” Generally they would be expected to say the interview answer was the better answer but sometimes they would think the Census form answer was more correct for the circumstances on Census night. The way the keyed data was read in meant that the text substitution could be simply achieved by typing `^CENSUS.Qperson.Bperson[Lper1].CP01` or whatever was appropriate for the Block or Question names.
- A final, reconcile variable was calculated but not shown to the interviewer. This recorded the final answer given by the respondent in a form which could be easily compared with the answers given on the Census form. Calculating derived variables within the Blaise programme saved large amounts of time at the analysis stage.
- If the interview answer was the better answer, respondents were asked why they had given the answer they did on the Census form.

In addition, if respondents had not followed the routing on the Census form correctly, we wanted to know why that was.

This basic pattern was used for the household section, the relationship grid and the individual section. However there was an added level of complexity in the individual section that related to who filled in the form for that person.

For all adults, we were only interested in interviewing the actual person to whom the individual data related but for children under sixteen, we wanted to ask parents for that information. Initially we thought that information about the respondent’s age would be available from the form, but past testing had revealed that date of birth is often filled in incorrectly, with respondents frequently putting the current year rather than their birth year on the form. Proxy interviews would have slightly different routing to adult interviews and so if a respondent entered a date of birth that suggested they were under sixteen, interviewers were asked to check if this really was so. Where the respondent really was under sixteen, interviewers were provided with an on-screen instruction to only take a proxy interview.

In the interview, we always wanted to asked the individual questions to the person to whom they related. This was not always the same as the person who actually filled in that section of the form as many individual sections were completed by proxy. It was important to establish whether the respondent had filled in the form themselves or if had been filled in by proxy at the beginning of the individual interview as this would determine to what extent it was relevant to examine the motivations behind the answers given on the form. All adults were therefore asked if this section of the form was:

- filled in by you
- filled in mainly by you but with someone else's help
- filled by someone else who asked you about some or all of the questions
- filled in entirely by someone else?

Whether they filled in the section themselves would also determine later routing. If a question had been filled in by proxy on the Census form we would assume that the answer given during the interview was always the better answer. Similarly there would be no point asking the respondent why there was a different answer on the form. If the form had been filled in entirely by the respondent or entirely by someone else, we could extend that to any particular question. Where forms were partially filled in by someone else and a discrepancy occurred, we would have to check who actually filled in that question on the Census form. The answer to this would then determine what further questions needed to be asked in order to gain a fully reconciled answer.

Thus for each question in the individual section, rules had to be written which would take count of whether:

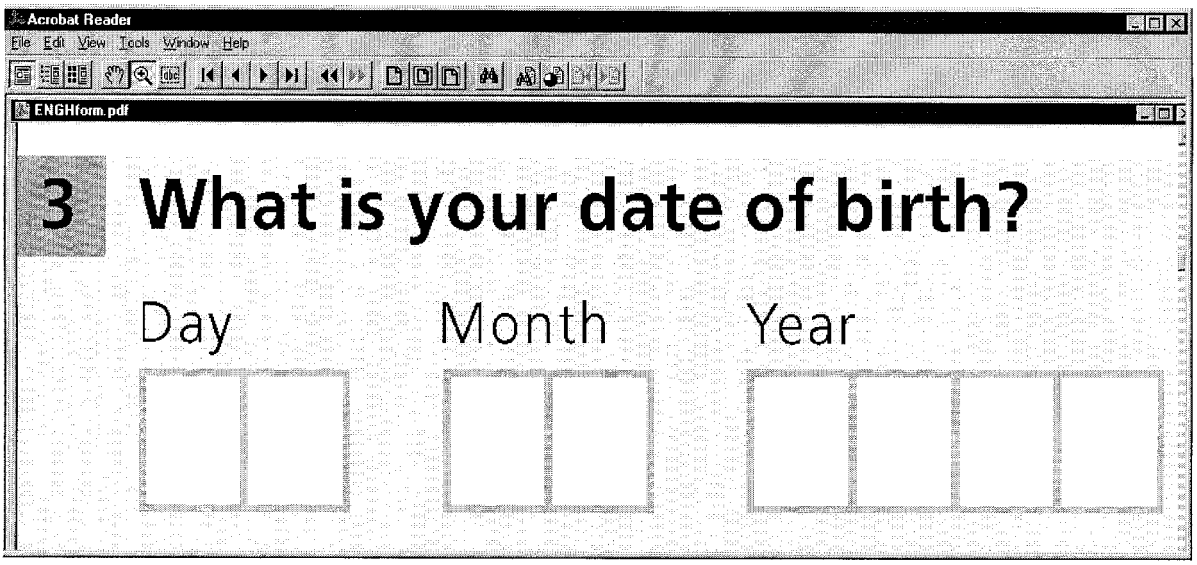
- The respondent was aged over sixteen or not;
- The routing on the Census form;
- The answer on the Census form was the same or different to that given in the interview;
- The question on the Census form had been completed by the respondent

Conclusions

The fieldwork for this survey was carried out relatively smoothly and a good response rate was achieved. Preliminary analysis has already been carried out and showed that respondents were answering most questions with few problems. There were, however, one or two questions that were slightly redesigned to take account of the problems highlighted by the survey. Census Division now hope to scan and edit the original forms. We will then compare those answers with those given in the interview to see how well these processes work.

Appendix

Example of Question on the Census form



Example of Code on Keying Programme

```
BLOCK Bperson

FIELDS {Bperson}
        CP03    “What is your date of birth?”
        :DATETYPE, EMPTY


RULES {Bperson}
        CP03
ENDBLOCK {Bperson}
```

Example of Code on Interview Programme

```
BLOCK Bindiv

        EXTERNALS
                CENSUS: CQSFORM(‘CQSFORM’)

        FIELDS {Bindiv}
        SP03a           "^CENSUS.QPerson.BPerson[LPer1].CP01  @/@/
                        What is your date of birth?"
                        /"Date of Birth"
                        :DATETYPE, RF

        SP03b           "^CENSUS.QPerson.BPerson[LPer1].CP01 @/@/
                        Can I just check, how old were you on your last birthday?"
                        /"Age"
                        : 0..120, RF
```

```
SP03c           "^CENSUS.QPerson.BPerson[LPer1].CP01 @/@/
                On the Census form you don't seem to have filled in the question about date of birth.
                Do you remember why that was? @/@/
                INTERVIEWER: SHOW BLANK CENSUS FORM"
                / "DOB - Reason for not answering"
                : STRING[150], RF

SP03d           "^CENSUS.QPerson.BPerson[LPer1].CP01 @/@/
                On the Census form, did you write in or give an answer to this question or did someone
                else answer this question for you?"
                / "DOB - who answered question"
                :(Self  "gave an answer to this question myself",
                other  "someone else answered it on my behalf"), DK

SP03e           "^CENSUS.QPerson.BPerson[LPer1].CP01 @/@/
                INTERVIEWER ASK OR CODE@/@/
                On the Census form you said your date of birth was
                ^CENSUS.QPerson.BPerson[LPer1].CP03.
                Can you remember why you put that?" / "DOB - reason for discrepancy"
                :(thisyear  "put this year rather than year born",
                forget      "can't remember why I put that",
                notme       "someone else wrote in the answer to this question",
                other       "other - specify")

SP03f           "^CENSUS.QPerson.BPerson[LPer1].CP01 @/@/
                Write in other reason"
                / "DOB - other reason for discrepancy"
                :STRING[150]

RP03            "^CENSUS.QPerson.BPerson[LPer1].CP01 @/@/
                What is your date of birth?"
                /"DOB - Reconcile"
                :DATETYPE

RULES {Bindiv}

SP03a
SP03b
LIndiv1:= SP03a.AGE

CHECK
SP03b = LIndiv1 OR SP03a = RF
OR SP03b = RF INVOLVING (SP03a)
"The computer calculated your age as ^LIndiv1 from your date of birth. This does not seem to be the same
as the age you have given me"

IF QintroInd.Under16 = yes THEN SP03b < 16
"You have entered that this person is aged Under 16. You must make sure of this person's age and make
the necessary changes to the questionnaire"

ELSEIF QIntroINd.Under16 = no THEN SP03b > 16
"You have entered that this person is aged over 16. You must make sure of this person's age
and make the necessary changes to the questionnaire

ENDIF

RP03:= SP03a

IF (RP03 <> CENSUS.QPerson.BPerson[LPer1].CP03) AND (SP03a <> RF) THEN

        IF (QIntroInd.SPa = consult AND QIntroInd.Under16 <> Yes) THEN
                SP03d
        ENDIF
```

```
        IF ((QIntroInd.SPa = Self OR SP03d = Self) AND QINtroInd.UNder16 <> Yes) THEN
                SP03e

        SIGNAL
        IF (QIntroInd.Spa = self or SP03d = self) THEN SP03e <> notme
                "You have said that you filled in this question yourself"
        ENDIF

        IF SP03e = other THEN
                SP03f
        ENDIF

ENDIF

ENDBLOCK {Bindiv}
```

Developing a Blaise Instrument for the Spanish Bladder Cancer Study

Richard Frey, Westat, U.S.

I. Introduction

The Spanish Bladder Cancer Study (SBC) is an occupational health epidemiologic study that has involved development and programming of an innovative Blaise computer assisted personal interviewing (CAPI) system for administering, in Spanish, seven core health study sections and sixty-three occupational module questionnaires. There are other study components that involve hospital case ascertainment and control selection in multiple hospital locations throughout Spain, along with a self-administered dietary history questionnaire and blood, urine and toenails specimen collection and shipment. The study is, however, mainly characterized by a large Blaise CAPI system with technically complex programming requirements, an extremely tight design and development schedule, and international study implementation challenges.

It was the development and implementation of the programming requirements that presented the Blaise development staff with the technical challenges this paper addresses. Challenges include instrument size and complexity, moving from a DOS environment to Windows, the design of a many-to-many data relationship, some bugs, instrument change restrictions, and data export.

Finally, this paper will address some of the major keys to the success of the Spanish Bladder Cancer Study CAPI system and how the staff organization, the development process, and the working relationship with Statistics Netherlands contributed to its successful implementation.

1. Study Background

Westat is assisting the Occupational Epidemiology Branch of the Epidemiology and Biostatistics Program, Division of Cancer Epidemiology and Genetics of the National Cancer Institute (NCI) in conducting this interdisciplinary case-control study of bladder cancer in Spain. Westat has established a subcontract with investigators from the Institut Municipal d'Investigacio Medica (IMIM) in Barcelona, Spain, who are conducting the study to evaluate the etiology of bladder cancer, particularly in relation to external risk factors such as occupational and environmental exposures.

The case respondents are patients who have been diagnosed with bladder cancer in Spain, and control respondents are those who have been diagnosed with other specified diseases and conditions The personal interview typically takes place in a hospital room in several collaborating hospital study centers in Spain.

2. Topic of this Paper

This paper is limited to the technical challenges and the solutions of implementing this survey instrument in Blaise. It does not address the research, methodology, or other aspects of the project.

II. Challenges in Developing the SBC Instrument

There were several technical challenges that had to be met to put the Spanish Bladder Cancer (SBC) survey instrument into Blaise. These challenges included the size of the instrument, many-to-many data mappings, enforced backward movement to jump from a work history table to a selected occupational module, English speaking programmers developing for Spanish-speaking interviewers, efficient implementation of so-called time spent blocks, and programming a custom occupational coding procedure.

In addition, three other factors added complexity to the design of the instrument. First, the initial development and statistical production use of the instrument were to be in Blaise III, the last DOS version of Blaise. While this version has very large capacity, we did not feel we could not execute some potential solutions that might work much better in a purely Windows environment. Secondly, while we knew the basic structure of the instrument, it was designed while many of the sections and most of the occupational modules were still being specified. Thus at the time of instrument design we did not have a good idea of eventual size. Third, we were aware that the interviewers would not be using the most powerful laptops available. An alternative architecture, for example, could be to tie together a main instrument with 63 separate instruments, one for each occupational module. But then we would have had the overhead of 64 different instruments in computer memory and in a management system. If we were to start from scratch today, given the wealth of project experience and the much more powerful Windows version of Blaise, and the advanced state of computer laptops today, we may well do some things described here differently

1. Scheme and Size of Instrument

The SBC instrument has two main parts. The first part is the main part of the instrument with a succession of sections for demographics, tobacco use and coffee/other beverage consumption, occupational history, residential history and environmental background, medical history, family history and quality of life/personal information. This main part of the instrument, by itself, would qualify as a medium- to large-sized questionnaire of some complexity.

The second part of the instrument, 63 modules that were designed to assess occupational exposures for selected job titles, gives the overall instrument a totally different quality. Each of the occupational modules can be considered to be a questionnaire in itself. On paper, the modules range in size from 2 or 3 pages (for a street vendor) to over 70 pages (for a welder or farm worker), with about 8 to 10 questions per paper page. The overall number of pages for a paper questionnaire, of only 1 copy of each module, is 1,675. However, there can be up to 10 instances of each module, so the approximate number of pages for the full paper questionnaire is about 16,075. This would be about 1 meter tall (using a very conservative estimate of pages per centimeter). If you take into account that the survey was done in two languages, then the overall paper questionnaire is 2 meters tall.

It should be mentioned that the bulk of the paper questionnaire involves measuring the time spent on a particular activity or time spent in exposure to a substance. Every time it is necessary to measure 'time spent,' there are several questions that have to be asked to make sure that an accurate measure is achieved. The questionnaire's design resulted in a reasonable average length of administration, approximately 90 minutes. The following technical descriptions illustrate the size of this Blaise instrument.

1. Overall counts	**Value**
Number of uniquely defined fields*[1]	22,314
Number of elementary fields*[2]	18,941
Number of defined data fields*[3]	119,896
Number of defined block fields*[4]	3,373
Number of defined blocks	224
Number of embedded blocks	108
Number of block instances	20,877
Number of key fields	4
Number of defined answer categories	2,476
Total length of string fields	1,677,270
Total length of open fields	0
Total length of field texts	1,128,212
Total length of value texts	52,292
Number of stored signals and checks	161,511
Total number of signals and checks	161,511

*1) All the fields defined in the FIELDS section
*2) All the fields defined in the FIELDS section which are not of type BLOCK
*3) Number of fields in the data files (an array counts for more than one)
*4) Number of fields of type block

2. Data fields, number fields in data file	**Number**	**Length**
Integer	30,729	102,482
Real	14,156	85,099
Enumerated	45,931	46,788
Set	443	611
Classification	0	0
Datetype	1,397	11,176
Timetype	1,408	112,264
String	25,832	1,677,270
Open	0	0
Total in data model	119,896	1,934,690

In addition, there are thousands of pages in the Blaise instrument, it is in two languages, and there are over 100 ASCIIRELATIONAL output files.

How the Interview Works

For each respondent, the interviewer completes the first two sections on demographics and tobacco use, coffee and other beverage consumption. The third section consists of the occupational history and module questions. This information is collected in a table of about 40 columns by 20 rows. Each row collects descriptive information about each job the respondent held in his life for a period of 6 months or more. For each job the instrument collects start date, end date, name of employer, job title, job description, names of chemicals and tools worked with, and other information. From several of these descriptive fields, the interviewer codes an occupation with the aid of a classification procedure programmed in Blaise. If the occupation matches any of the 63 modules, the module is to be collected immediately. In other words, it is necessary to jump from the table in the occupational history section to another part of the instrument and then back to the next row in the table once the module is completed. After the occupational section (and all appropriate modules) is completed, the interviewer proceeds to the next sections (residential history/environmental background, medical history, family history, and quality of life/personal information) and finally exits the instrument.

2. Many-to-Many Data Relationships

Each row in the occupational history table can map to any of the 63 modules in the instrument and this mapping can occur more than once. For example, the first job may be *welder*, the second *fork lift operator*, and the third *welder* again. This model is more of a relational data structure than a hierarchical data structure (which Blaise explicitly supports). Blaise does not naturally support a relational data structure, so a programming strategy was devised to deal with this problem.

Programming Pointers

The essence of handling a relational data structure is in defining pointers from one data block to another and keeping track of the pointers. In every row of the occupational table, there are fields for module acronym and module instance number. These two fields together point to a specific instance of the appropriate module block where the data for that module are collected. In the module itself are fields that keep track of the instance number of the block and the number of the row of the table it is connected to.

A summary of these pointers is kept at a high level in a block called *BookKeep* with the fields *Counter*, *Module*, and *Number*. The *BookKeep* block is an array that tracks the number of instances that a module is used in the instrument. The rules of the data model both within the occupational module and a higher level keep straight which instances of which modules connect with which line in the occupational table. While the block *BookKeep* is simply defined, the rules to make the module and instance number assignments are complex and took a great deal of testing.

3. Jumping to an Occupational Module

As we began constructing the instrument, it became apparent that there would be two limitations that we had to overcome. The first is a hard limitation of the number of Blaise pages (or FormPanes). The maximum page limitation of Blaise is 16,000 pages. We found this limit the hard way by trying to prepare the instrument with all instances of all modules appearing in a Blaise page. In the process of troubleshooting the page limitation problem, we discovered a second problem with instrument performance. We found that when you try to move across thousands of Blaise pages to arrive at the correct instance of the appropriate module, processing time might be slow, taking many seconds to get to the appropriate module.

Ask Module and Copy To Holding Modules

The solution to the these problems was to put only one instance of each module in a Blaise page. This process became known as the *Ask* version of the module. When it became necessary to jump from the occupational module, the interviewer traveled to the *Ask* instance of the module. For each *Ask* instance of a module there are 10 holding instances. When the interviewer is finished collecting data for a module, the data from the *Ask* module are copied via a Blaise block copy to the proper instance of a holding block for that module. This solved the two problems mentioned above. First, we could prepare the instrument with all 63 modules, and second, we increased the speed of the jump from the occupational table to the appropriate asking block.

When programming these complicated movements, you need to manually adapt that which Blaise normally does for you. For example, if you want to re-enter a specific instance of an occupational module, you have to cause the Data Entry Program to copy the appropriate block instance from the holding module to its *Ask* instance.

We also had to cause the cursor to jump back automatically over several hundreds of thousands of pages. This task is done by bringing an *Ask* module onto the route and with an empty field that has the NOEMPTY attribute. While this backward jumping technique is introduced in the Blaise Developer's Guide, it is not something you implement casually. This technique itself was well tested.

A bug was found in the block copy from the *Ask* block to the holding blocks. In Blaise III and in the first Windows versions of Blaise, remarks would not be copied with a block copy from one instance of a block to another. This problem was identified during the survey, and the solution to this bug is discussed later in the paper.

4. ¿Habla Español?

Programming the survey instrument in two languages presented its own set of challenges. Since the survey was to be conducted in Spain for a Spanish-speaking population, the instrument had to be translated into Spanish, a foreign language for most staff on the project at Westat. In order to meet the language requirements of the survey, specifications and paper versions of the survey instrument were first produced in English, and programming of these sections similarly followed first in English. In this way, the overall survey development proceeded first in English. As development proceeded, concurrently English specifications were sent to translators in Spain where each section was translated into Spanish. When the translation for a section was completed, it was returned to developers for implementation in the Blaise program.

Parts of the instrument that had to be translated into Spanish included question text, response categories, hundreds of thousands of text fills, interviewer instructions and edit messages. While the implementation of the Spanish version had to wait for the translations (which were completed in a timely way), the programming strategy allowed for the copying in of the Spanish text by leaving hooks throughout the instrument source code, making great use of the Blaise ACTIVELANGUAGE feature in the rules section. When the translations arrived, it was another task to copy the appropriate texts from a word processor to the application source code. There were other challenges as well. For example, we had to make sure that the proper 'code page' was in place on the developers' computers so that the diacritical Spanish characters would be recognized in the U.S. (This was a DOS problem.)

5. Time Spent Modules

Much of the instrument asks about the amount of time spent doing an activity or time spent in exposure to a substance. There was a great deal of sameness and similarity in how all 'time spent' constructs appeared. Several time-spent blocks were defined and re-used repeatedly. The most common time spent block, *TimeSpent1*, has the following elements:

```
P1   {Entry cell, gives chance to change mind.}
P1A  {Number of times per day, week, month, or year}
P1b  {Time unit (day, week, month, or year)}
P2a  {Number of hours, or days, or weeks, or months}
P2b  {Second time unit (day, week, month, or year)}
P2c  {Time unit}
P3   {Percent of time}
P4a  {Fraction of time, numerator}
P4b  {Fraction of time, denominator}
P5a  {Number of minutes or hours}
P5b  {Minutes or hours}
P6   {Yes no question}
P7   {How many times}
```

Routing through this construct depends on how the respondent wants to answer a question about time spent in an activity. For example, the respondent was allowed to answer "I did this activity 10 times per day, 5 days per week, for about 20 minutes each time." Or she could say, "I spent half of my time doing that." The interviewers were able to easily administer these questions, with proper routing through the several fields depending at any time on the pattern of responses.

There are several hundred lines of code for the *TimeSpent1* module including complex routing, text manipulations, and several edits that checked reasonableness of answers. This particular module, considering all instancing, is used several thousand times. Overall there are 6 time spent modules, 3 number of times modules, and an assortment of other similar measurement modules that were programmed one time and used all over the place in a very efficient use of Blaise blocks and procedures.

The extreme re-use of these time and number measurement modules meant that the question text and fill text had to be customized for each instance. The following code snippets show how this works. First we imported text before the block call using parameters.

```
PARAMETERS
  IMPORT
    Phrase1, Phrase2, Topic : STRING
```

The field text was defined as follows:

```
P1a "^Phrase1 ^Phrase1a
    @/NUMBER OF TIMES PER DAY OR WEEK OR MONTH OR YEAR.
    @/@/@Y[INTERVIEWER] PRESS <ENTER> TO ANSWER IN TERMS
    OF TIME UNITS, PERCENT OF TIME, OR FRACTION OF TIME."
    "^Phrase1 ^Phrase1a
    @/NUMERO DE VECES POR DIAS O SEMANAS O MESES O AÑOS.
    @/@/@Y[ENCUESTADOR] PRESIONE <ENTER> PARA RESPONDER EN
    TERMINOS DE UNIDADES DE TIEMPO, PORCENTAJE DE TIEMPO, O
    FRACCION DE TIEMPO." : 1..9990, EMPTY
```

where *Phrase1* was imported into the block and *Phrase1a* was computed in the block if necessary. A few within-block computations of text strings are shown next.

```
IF ACTIVELANGUAGE = ENG THEN
  Fraction := 'FRACTION OF TIME'
ELSEIF ACTIVELANGUAGE = ESP THEN
  Fraction := 'FRACCION DE TIEMPO'
ENDIF
```

6. Occupational Module Selection

The occupational table collects descriptive information about the kind of job that was actually being performed. This method of collection also identified key aspects of the job that could be used for selecting the most appropriate occupational module programmed into the instrument. The descriptive information consisted of job title, main activities and industry description, as well as other items such as 'chemicals exposed to' and 'tools used on the job.' For each job, the instrument was required to first collect and then inspect these descriptions, and suggest to the interviewer possible occupational modules that might be mapped to the job.

The first attempt to do this process was with the Blaise trigram coding scheme. This approach did not work mainly because the concatenation of all the descriptions could be hundreds of characters long. This length of text string feeding into a trigram search does not work well (the trigram was not meant for this purpose). The solution was to create a procedure that could take the concatenated descriptions, and inspect them for exact matches to a list of hundreds of keywords. A score is kept internally to the procedure and it then displays the modules that possibly match. The interviewer, in consultation with the respondent, can accept any of the suggestions or override them.

This was first programmed and debugged with English. Then the keywords were translated into Spanish and that version of the procedure was used in the instrument. We found out, among other things, that the effectiveness of the procedure is somewhat dependent on the language. For example, precision in spelling is key to the process. Spelling a Spanish word without the appropriate diacritical mark causes a problem. Overall, however, this process works well.

7. Meeting the Technical Challenges

There were several aspects to meeting the technical challenges of developing such a demanding instrument. First, the clients (both in the U.S. and in Spain) and the project personnel at Westat did an excellent job of communicating the needs of the survey and in specifying it. Additionally, they were able to identify challenging aspects of the instrument in advance. Secondly, there was very strong prototyping of solutions for all of the above mentioned challenges and more. These were done with so-called mini data models. These mini data models allowed the programmers and the project people to focus on particular issues and specific parts of the instrument, and facilitated iterative development to a solution. Thirdly, the instrument as a whole was developed in terms of mini data models, with well over 80 of them that are used. Given the size of the instrument, it was inconceivable that it could have been developed any other way. Using mini data models allowed programmers to work on different sections simultaneously, and allowed their sections to be compiled more quickly. The use of explicit parameters to connect completed blocks into an integrated instrument made it very easy to link these modules into a coherent whole. If a repair has to be made to a module it is done with the mini data model, and then re-integrated into the main instrument.

Simultaneous Top-Down and Bottom-Up Development

At the same time the prototyping and the module development were undertaken, a parallel development with the overall instrument structure took place. There were several issues in tying things together that had to be worked out. Most integration issues were resolved when there were only a few of the questionnaire sections and modules finished (indeed, even before most modules and sections were specified). This meant there was effective top-down and simultaneous bottom-up development of the instrument.

Standards and Use of Expertise

Other aspects that were critical for the success of the instrument development were the early setting of programming standards and ways of working. There were code reviews early in the process to make sure that methods developed in the prototyping were applied correctly to production code. In addition, the project drew on the experience of Blaise experts at Westat.

III. In the Beginning There Was Blaise III for DOS

The development of the Spanish Bladder Cancer instrument was undertaken first in the final DOS version of Blaise, that is, Blaise III. This was because the Windows version was not yet even in beta mode. In fact, the beginning of the survey was conducted in Blaise III. Blaise III has some limitations that affected the survey, and those limitations and their solutions are discussed here.

1. Memory Limitations

The instrument was first prepared and fielded with 48 of the 63 modules in place, but in both English and Spanish. As the instrument was tied together in full for the first time, we found a memory limitation that prohibited it from running in a DOS window under Windows (any version). As discussed above, the instrument had already been as efficiently designed as possible, so there wasn't very much inefficient code to optimize, and we wouldn't have had the time anyway. Since the survey is operational only in Spain, and in that sense English is not necessary, it was decided to comment out all the English language text to see if that would allow the instrument to run in a DOS window. However, as described above, the language statements and manipulations appear all over the source code. It would have been impossible to comment out all the English text and computations by hand.

Automated Parsing and Commenting Out of English-Language Code

Since the instrument authors programmed according to well-defined standards, it was possible to comment out the English language text and code by automated means. In a few days time, a senior Blaise engineer programmed a Manipula setup that was able to parse all the source code files and comment out English text and manipulations. The virtual perfect implementation of the source code according to standards enabled the Manipula program to search for a do-able set of patterns and keywords and comment out the English code wherever it found it. For example, it could search for the phrase IF ACTIVELANGUAGE = ENG and figure out where to put the beginning comment brace and where to put the ending comment brace. In actual fact, this parsing and automated commenting out of the English proceeded with few problems and the first operational version of the instrument was fielded on schedule.

While it was possible to field the 48-module instrument in Blaise III, it would not have been possible for all 63 modules. The timely arrival of the Windows version of Blaise enabled the instrument to handle all 63 modules and work again in both languages.

2. Other Limitations

Some limitations in the DOS version of Blaise affected the project, including overall block size and the size of the rules section. We found, for example, that the absolute limit on size of a rules section, including programmers' comments, is 64Kb. And we found that some blocks were too big to parse. The solution to these problems was to break big blocks into smaller blocks and to program some rules sections as efficiently as possible. Some of these limitations extend into the Windows version of Blaise.

Another limitation is with the size of a TYPE section that can be compiled with other instrument code. There are almost 2,500 type definitions. When the type definitions were incorporated into the Blaise source code with an INCLUDE statement, the instrument would not prepare. The solution to this problem is to pre-prepare the type library. This simple step not only allows the preparation of the instrument, but also speeds up preparation considerably.

IV. Progressing into the Windows Version of Blaise

The eventual arrival of the successive Windows versions of Blaise provided a more robust platform for this project. The Windows version of Blaise provides much better memory management and 32-bit processing, both of which are indispensable to the project. With these capabilities, Blaise can now handle all 63 modules and both languages.

Windows 95 has its own large memory requirements and so each machine was upgraded to 48 MB of RAM. Though Blaise in Windows has a graphical user interface, the system operates in much the same way as it does in DOS and thus the transition from the DOS version to the Windows version was relatively smooth for the interviewers.

Even before the first Windows version was released, the developers began using the Windows developer's environment to produce the DOS instruments. They found, as have others, that the Windows Control Centre is much more powerful than its DOS counterpart and could prepare the modules faster. When it was time to produce Windows instruments, the project verified that there is true upward compatibility between the two versions.

Bugs

As one of the world's first surveys to be fielded in Blaise for Windows, the SBC project found several bugs in the software. One of these is worth mentioning here. When copying a block of data from an *Ask* block to a holding block, the copy did not include the copying of remarks. Westat reported this problem to Statistics Netherlands and they corrected this bug. During the interim, a manual work-around procedure was implemented in Spain where the interviewers recorded their remarks in any occupational module separately. This quick response of Statistics Netherlands fixing important bugs was very important for this groundbreaking effort.

New Features in Blaise

The Windows version of Blaise also came with new features that were found to be very useful. First was the audit trail that is not available for the DOS version. This provided a means of data backup for lost remarks (see above) and for debugging some problems. Another feature that is the new ability to tie an executable program to a function key. This was used to enable an interviewer to invoke another data entry program and instrument when the respondent was getting tired or starting to refuse the questionnaire. This is called the *Critical Items* questionnaire. The idea is to get key data from these respondents if possible. Since this situation could arise at any point in the interview, the ability to tie this to a function key was very important. This could have been executed through a parallel block as well, but then the data model definition would have changed and the project wanted to avoid that.

V. Operational Considerations

There are some operational issues with Blaise that were important for the SBC to anticipate and manage correctly. These include performance of the instrument on the supplied hardware, versioning of the data models, use of Maniplus for laptop survey management, SAS limitations, and supporting operations in Spain.

1. Instrument Performance

The laptop in use in Spain has 48 MB of RAM and 133 Mhz processors. These were not top-end machines even when they were purchased and are considered slow by today's standards, but the huge data model runs fast and well. The key to this performance was the advanced appreciation of the challenge, expert knowledge of the Blaise selective checking mechanism, and programming standards that met this challenge. The key to improving performance in a large data model is to reduce the amount of parameter administration between blocks, and to reduce the number of blocks that are checked at any one time. This is an advanced topic not suitable for this paper, but if the selective checking mechanism is taken into account, you can implement large and complex data models.

2. Data model Data Definition Changes

It is a fact of life in the Blaise world that even relatively minor changes in an instrument can result in a change in data file definition. When such a change happens, it is necessary to translate the database definition from the old to the new manifestation. This process can be automated on a laptop and in the home office, but there is still a versioning issue. That is, with several data files in different locations, how can you be sure which database is in which version? This challenge was met with strict versioning procedures and planning for version changes. Changes to the data model were allowed more frequently if the data file definition did not change. If a data file change was necessary, the change had to be strictly executed and scheduled.

3. Survey Management on the Laptop in Maniplus

A Maniplus survey management system was used on the laptop to control access to the cases, data transmission, and other aspects of operations for the interviewer. The use of Maniplus to execute the instrument and the survey management is crucial to this survey given the combination of low-end hardware configuration and the size and complexity of the instrument. The advantages of Maniplus for this are several fold: the Data Entry Program and the Manipula are part of the Maniplus executable file, and when the instrument or a Manipula function is executed, it is not necessary to invoke another executable. Maniplus also has full knowledge of Blaise metadata and can write to and read from a Blaise database. It also loads the instrument ahead of time and this allows the interviewer to start the interview quickly if necessary.

Another decision was to put each data record in its own zip file. This decision was made because of the tremendous size of each record. We did not want to have to try to rebuild a data set with Hospital in case of data corruption, though this latter possibility has not been a problem.

4. SAS Output and a (Former) SAS Limitation

Due to the size of the data model, data are exported from the instrument with ASCIIRELATIONAL output. Over 100 output tables are produced. A former SAS limitation, that of 8 maximum characters for SAS VAR names, had to be overcome because some of the Blaise field names were over 8 characters. Another challenge was to get SAS data descriptions for the ASCIIRELATIONAL output. The Blaise system does not come with a totally automated way of getting the data description for each output table. With over 100 tables to take into account, even a one-time effort to produce descriptions by hand would have been very tedious. When you consider data model changes, the potential to have to redo these by hand becomes impossible. The solution here was to develop programs in Cameleon, Manipula, and DOS BAT files that totally automate this process.

5. Supporting Operations in Spain

There were several challenges in Westat's support of operational data collection in Spain. These problems included language differences, time zone differences, and long distance support. When an operational problem occurs, getting an accurate description of the problem is the first step at diagnosing and resolving the problem. Reporting the problem clearly and succinctly in two different languages does not always happen immediately, and sometimes additional time is required in iterations just to understand the problem. Also, the issue of a six-hour difference in time zones becomes another factor to weigh in responding to problems in the field. Even with these challenges, the project has proactively addressed problems with the cooperation and good will of everyone involved.

VI. Keys to Success

The success of the Spanish Bladder Cancer Study CAPI implementation can be summed up into these three key areas: the organization of staff; the development process, and the working relationship with Statistics Netherlands.

The organization of staff was simple in design but powerful in its operation. Heading the development side was the senior integrator. Below the integrator were five programmers each assigned to the section and occupational module programming. In a staff position was the independent test team, which also filled the role of specification writer. A senior Blaise technical expert gave strategic advice on design and instrument development methodology. The key, however, was the senior integrator. While not a Blaise expert, it was the integrator who understood the importance of following established standards and processes.

The key in the development process was that all standards and processes were defined up front. Based on requirements and the design it was decided that each section and each module would be developed and tested as its own data model. Later, each section and module was incorporated into the instrument 'mainline.' For each occupational module, 90% of the questions asked involved measuring how long it took to do something or how long an exposure there was. Type blocks and procedures were created and eventually used many thousands of times in the instrument.

The independent development of the sections and occupational modules gave way to the independent testing of each section and module. This testing process enabled the testers to focus on the results of each section and module test without concerning themselves with influences from other components of the system.

A final key was our working relationship with Statistics Netherlands. Whenever there was a problem, such as remarks not being copied from one block to another, or the Don’t Know/Refused symbols not being displayed, we were given a prompt response and in many times a version of Blaise with a fix to the problem. This relationship allowed us to continue developing the instrument without having to worry about 'a work around.' In addition, it built credibility, not only with those doing the development, but also with our client.

Using Blaise in a Nationwide Food Consumption Survey

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Introduction

The Food Surveys Research Group (FSRG) at the U.S. Department of Agriculture, working with Westat, Inc., is in the process of converting the nationwide food consumption survey from a paper and pencil questionnaire to a computer-assisted interview programmed in Blaise 4. Collecting and coding information about the foods consumed by individuals in large-scale food consumption surveys requires asking specific questions for each food. There are numerous factors affecting the nutrient content of foods that must be captured. The questions required across all foods can easily reach into the thousands and the number of responses to an individual question can reach into the hundreds. The large number of questions and responses has presented many challenges in developing and managing questionnaire specifications and testing the instruments.

Background

The U.S. Department of Agriculture (USDA) has conducted surveys to collect national information on food consumption since the 1930's. These surveys monitor food use and food consumption patterns in the U.S. and provide data used to address economic, nutrition and food safety issues. For example, the data are used to evaluate the nutritional adequacy of the American diet and the impact of food assistance programs. The data are also used to estimate exposure to pesticide residues and to study the impact of food fortification, enrichment, and food labeling policies.

The Continuing Survey of Food Intakes by Individuals (CSFII) is a nationally representative sample of individuals of all ages. The screener questionnaire is used to identify eligible households. A household questionnaire is administered to the household member most knowledgeable about household characteristics such as income, education and food shopping practices. Selected individuals are asked to provide food intakes for 2 days, spaced 3-10 days apart. One respondent over age 19 within a household, who provided at least 1 day of food intake, is selected to complete the Diet and Health Knowledge Survey (DHKS).

During the intake interview, individuals recall the foods and beverages that were consumed the day before the interview. Details about each food and beverage are collected as well as an estimate of the amount consumed. Information is also collected on the time of day the food was eaten, the name of the eating occasion, whether the food was eaten at home or away from home, and where the food was obtained. Each food reported is then linked to nutritive values in order to calculate how much of each nutrient the individual consumed. Fifty-two different nutrients are calculated including calories, fat, protein, carbohydrate, vitamins, and minerals. Plans are underway to integrate the CSFII with the National Health and Nutrition Examination Survey (NHANES) conducted by the National Center for Health Statistics (NCHS), U.S. Department of Health and Human Services (DHHS). Both surveys will use the USDA dietary collection method and nutrient database. Each of the surveys will produce a core set of variables for estimating and interpreting dietary intakes in a combined yearly sample.

Description of the Instruments

Table 1 shows the number of questions, enumerated responses, lookup files and responses in lookup files for each of the instruments after the conversion from paper and pencil to the computer-assisted interview version. The table clearly shows that the food intake instrument is the largest of the instruments in terms of the numbers of questions and responses. Most of the food intake instrument consists of questions about specific food details, including the amount of food eaten. The large number of questions and responses produce an even larger number of skip patterns because the questions asked about a food depends on the responses to the previous questions. The number of possible paths through the food detail questions is roughly estimated to be over four hundred thousand. The size and complexity of the food intake instrument is what makes this application unusual and challenging.

Table 1
Pilot Study I CATI

Instrument	Questions	Enumerated Responses	Lookup Files	Responses in Lookup Files
Screener	52	74		
Household	112	248		
Food Detail Section	2389	11932	93	9352
Total Food Intake	2515	12414	96	9959
Diet and Health Knowledge Survey	137	429		

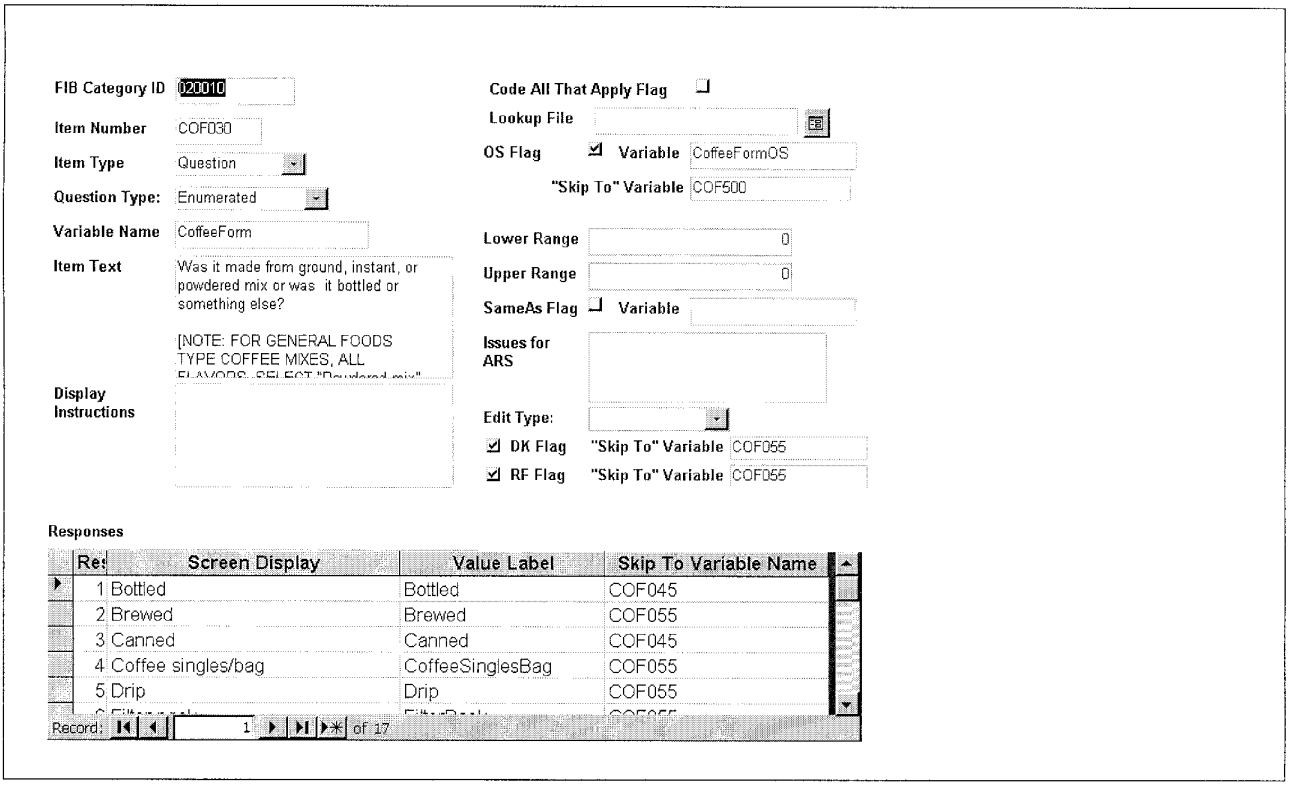
Food Detail Specifications

Creating the food detail specifications began with the Food Instruction Booklet (FIB). The FIB was an 80-page booklet used as an interviewer aid in earlier food intake surveys. It was designed to assist interviewers in collecting detailed descriptions of foods and amounts for the paper and pencil version of the food intake questionnaire. Foods had been grouped into 16 broad categories. Since the questions and responses within these categories were very different, a decision was made to further divide them into 132 categories for the computerized version. Each of the food categories was assigned a unique code. The categories made it possible to ask more specific questions and made writing, programming, and testing the specifications a more manageable task.

Early in the planning stages, the decision was made to use a database approach to writing the specifications. From years of experience maintaining a large and diverse food coding database in a constantly changing food market, it was clear that the food intake specifications would be large and complex and would need to be updated periodically. This approach produced many advantages in the writing, reviewing, and editing of the specifications. When changes were made that affected more than one category, it was easy to review and apply the changes uniformly.

Figure 1 shows the form used to enter and edit the specifications. The specification database has two main tables: Items and Responses. The Item Number uniquely identifies each item and links the Items and Responses tables. Included in the Items table are questions, boxes, and edits. Question types include enumerated, open ended, lookup file, and continuous. The responses for enumerated questions are stored in the Responses table. Enumerated questions are used when the responses fit on one screen. Lookup files are used when the number of responses would exceed one screen (approximately 40). Some of the largest lookup files include candy, cake, cereals, and frozen meals, all of which have more than 300 responses. Questions with continuous responses are used for the amounts of food eaten. Open-ended questions are used for “Other, specify” responses.

Figure 1
Specifications database data entry and edit form



When there is a lookup file for a question, the name of the file is stored in the Items table. Lookup files allow the interviewer to search for a response using the trigram search rather than having to page through multiple screens. Lookup files can be used with more than one question. Table 2 shows examples from the "CheeseKind" lookup file. This lookup file provides response options for the "What kind of cheese was it?" question for the Cheese and Grilled cheese sandwich categories. Each category that uses the question has a column in the lookup file for the Skip to Variable Name field. In this example, when cheddar cheese is chosen in the cheese category, the instrument skips to item CHE010. When cheddar cheese is chosen in the Grilled cheese sandwich category, the instrument skips to item GCS440.

Table 2
CheeseKind Lookup File

Food Name	Cheese Category Skip to Variable Name	Grilled Cheese Sandwich Category Skip to Variable Name
Cheddar cheese	CHE010	GCS440
Cheese spread	CHE017	GCS335
Provolone cheese	CHE020	GCS345

Most questions allow only one response. Questions that allow more than one response are flagged as Code All That Apply. There are 188 Code All That Apply questions in the food detail instrument. DK flag, RF flag, and OS flag fields are checked when "Don't know", "Refused to answer" and "Other, specify" are allowed responses. DK Skip to Variable, RF Skip to Variable, and OS Skip to Variable fields contain the Item Number that identifies the question to skip to for those responses. "Don't know" and "Refused to answer" responses are allowed for every food detail question. "Other, specify" is also allowed for every question with a few exceptions such as questions with only "yes" and "no" as response options. Edit ranges are stored in the Lower Range and Upper Range fields, and Edit Type specifies whether the edit is hard or soft.

The Responses table contains the Response Number, Screen Display, Value Label, and Skip to Variable Name for each of the responses for the enumerated questions. The Skip to Variable Name indicates the question to skip to for that response. Skip patterns were provided for every one of the approximately 21,000 responses in the Responses table and lookup files.

Edit items use the Item Text box to explain complex edits. An example of a complex edit is checking for impossible combinations of answers between two or more questions. Edits are also used for impossible combinations of responses within a Code All That Apply question.

Boxes are used to explain complex skip patterns that can not be defined using the Skip to Variable Name fields in the Responses table and lookup files. The skip instructions are written in the Item Text box. Boxes are also used for instructions on lookup files used by more than one question. As shown in Table 2, these lookup files have a Skip to Variable Name column for each question that uses the file. The box is used to specify which column in the lookup file applies to which question.

The database approach saved time in writing and reviewing specifications. This method made it possible to easily copy questions, edits, boxes, and responses within a category as well as across different categories. Templates were developed for questions that were asked across multiple categories. Text areas that display instructions for the programmer and issues to resolve provided flexibility to specify unusual conditions. A variety of reports were created and used during the review process.

Main Food List

The first step in the food intake interview is to obtain a list of foods consumed. In order to produce the correct set of questions for each food, there must be a link between the reported food and the food category. This link is provided by the Main Food List (MFL), which is a Blaise lookup file containing approximately 2500 food names. Each food name is linked to a food category number that determines which questions are asked for that food. The food names on the MFL must reflect current food supply and food consumption patterns. General descriptions such as lunch, buffet, or unknown food are also included and linked to a special unknown category to collect further detail later in the interview. The trigram search mechanism is used to locate foods on the MFL as the respondent reports them. A complete, easy-to-search MFL that can be updated in a timely manner is extremely important to the success of the survey.

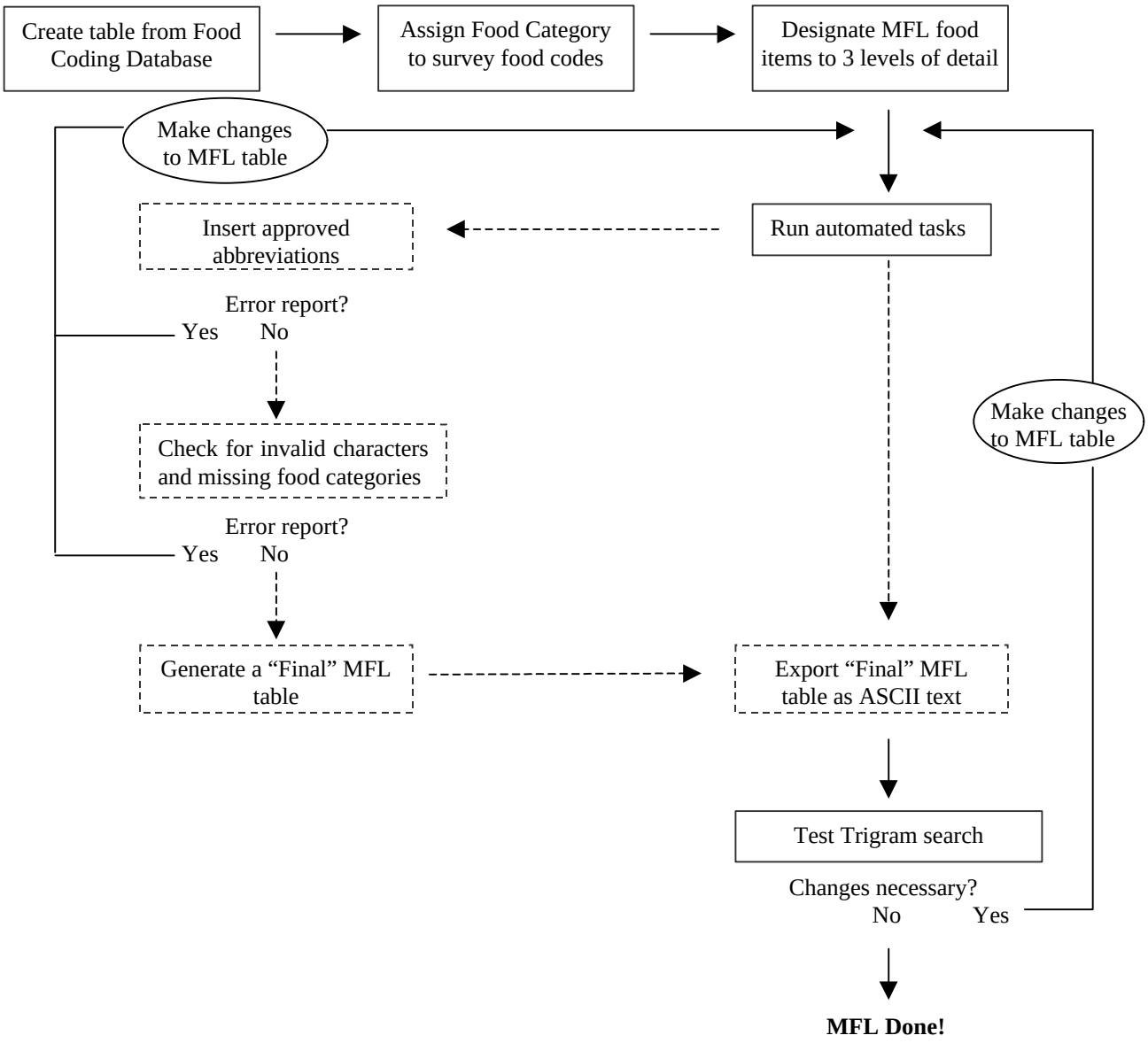
The process of creating the MFL is shown in Figure 2. It was constructed primarily from the CSFII Food Coding Database. The Food Coding Database was a logical starting point because:

1) it is a large and diverse collection of foods and brand name products;
2) frequency data from previous surveys identified the most commonly consumed foods and ensured their inclusion on the MFL;
3) the relational database format of the Food Coding Database files made extracting foods for the MFL very easy and enhanced our ability to manage the progress of a constantly-evolving MFL.

To begin building the MFL, a database table was created that contained all 7300+ survey food codes, their generic food descriptions, and brand name information extracted from the Food Coding Database. Additional fields for Food category, MFL name1, MFL name2, and MFL name3 were added to the table. Each survey food code was assigned one of the 132 food categories by a food specialist. By linking the survey food codes to food categories, it was anticipated that:

1) this information could be utilized for automated coding purposes;
2) maintenance of the MFL would be enhanced by tracking changes and additions to the Food Coding database, which in turn, may affect the MFL and the food category questions.

Figure 2
Creating the Main Food List from the Food Coding Database



As shown in Table 3, three separate fields for MFL name were used to record different levels of detail for MFL food items. For example, "oatmeal" was assigned to MFL name1 representing the least amount of detail, whereas the more specific "instant oatmeal" and "Quaker instant oatmeal" would be found under MFL name2 and MFL name3, respectively. Having these three fields made it possible to generate three different MFLs based on the level of detail desired. A team of food specialists reviewed the survey food codes category by category, assigned food items to a level of detail, and decided what food items would be included on the MFL. In some cases, MFL food items were added to the table but were too general to link to a specific survey food.

Table 3
Food Coding Database table used for constructing the Main Food List

Food Description	Survey Code#	Food Category	MFL name1	MFL name2	MFL name3
Oatmeal, cooked, NS as to regular, quick or instant	56203000	50020	oatmeal		
Oatmeal, cooked, instant	56203080	50020		instant oatmeal	
Oatmeal, cooked, quick	56202970	50020		quick oatmeal	
Oatmeal, cooked, regular	56202980	50020		regular oatmeal	
Quaker Fruit and Cream, all flavor varieties	56203080	50020			Quaker instant oatmeal

Automated tasks included:

1) A list of approved abbreviations (e.g., “bf” for baby food; “lf” for low fat) replaced longer words in some MFL food items;
2) MFL food items were checked for the presence of invalid characters which could hamper the trigram search (e.g., extra blank spaces between words; dashes “-“ and slashes “/”);
3) Every MFL food item was verified to have a food category assigned to it;
4) MFL food items and their corresponding food category were extracted from the original table and copied into a final MFL table;
5) The final MFL table, shown in part in Table 4, was exported as an ASCII text file to be prepared for use in Blaise.

Table 4
Final Main Food List format

MFL Name	Food Category
American cheese	60010
Blue cheese	60010
Brie cheese	60010
Cheddar cheese	60010
Cheese	60010
Cheese ball	60010
Cheese spread	60010
Cheese sticks	60010
Cheez Whiz	60010
Feta cheese	60010

During the development of the MFL, a Blaise program was used to test how well the MFL would work during the interview. Food specialists entered food names and evaluated the results of the trigram search of the MFL. The goal was to have common food names show up at the top or close to the top of the list returned by the trigram search.

Since the MFL information is in a database table, changes can be made with ease, and the programs can be re-run as many times as necessary to generate the final MFL table. This entire process was executed 9 times over a time period of about 6 months during development.

Limitations of Using CAI in Food Surveys

Although the use of database management software was a big help in the specification process, it could not solve all the difficulties in converting the food intake questionnaire from PAPI to CAI. One of the issues is how to balance the need to collect complete and accurate intakes with the size of the data model. When thousands of people, every year, are asked what they eat, their answers will be very different and some will be quite unusual. This occurs in both the numbers and the types of foods and beverages consumed. Although national averages of nutrient intake are not affected by the data for a few foods, for some uses of the data, it is the outliers that are important. An example of this is estimating pesticide exposure from dietary intakes. For this purpose, the tenth fruit or vegetable eaten in a day may be important. Setting array sizes to accommodate the highest intakes of foods per day and foods per category per day does not seem to be possible without compromising the instrument. The ability to dynamically change array sizes would be very useful in this application.

The fixed array sizes also produce a very large, although very sparsely populated data set when the data are extracted from Blaise. This very large set of files (> 900) requires a complex post-interview processing system to extract and condense the food intake data reported in the interview. We are looking forward to seeing how the implementation of Open Blaise Architecture (OBA) can improve the post-interview processing on the food intake data.

Another major concern in using CAI in food surveys is the need to continually update responses and even questions as the food supply, eating patterns, and dietary concerns change. Since the responses are the basis of skip patterns and edits, it appears that the kind of continual update done on Food Coding databases will be difficult to implement on a CAI instrument. Although some changes can wait until for the end of each survey year, some will need to be made while the survey is in the field. We are interested in finding designs or processes which would be able to produce changes in a cost-effective and timely manner.

Summary

The features of Blaise and the extensive use of database management applications made it possible to create a very detailed food intake questionnaire. The database management system made it easy to search for specific questions across all categories, compare questions and responses between categories, and copy specifications from one category to another. The database format also made it easy to find and make changes to the specifications. Utilization of Blaise's trigram search for the Main Food List linking food names to food categories provided a quick way to select the appropriate set of food-specific questions. Creating the Main Food List from a database table proved to be useful for organizing and maintaining different versions of this lookup file and for automating processing tasks. The extensive use of lookup files for long lists of possible responses made it possible to ask more specific questions and will also be easier to maintain as foods change over time.

Challenges in developing a Longitudinal Survey on Income Dynamics

Brett Martin, Statistics New Zealand

1. Introduction

The development of a longitudinal panel survey is a very complex and challenging process. Statistics New Zealand is currently running a project to evaluate the feasibility of a Longitudinal Survey on Income Dynamics. This paper discusses some of the challenges involved in building the Blaise instruments for the two field tests involved.

For the first time in Statistics New Zealand a large Computer Assisted Interviewing (CAI) instrument has been constructed without creating an associated paper form. New ways of working together to specify and develop the Blaise programs have evolved as the project progressed.

Checking large instruments takes a considerable amount of time and effort. In a longitudinal survey the need to refer to data collected in earlier waves increases the complexity of routing and editing and the amount of validation required. Ongoing changes to questions and edits further increase the workload.

Data obtained from the Longitudinal Survey on Income Dynamics (LSID) field testing programme is being investigated by the project team to see whether the required analysis and outputs are feasible. The results will be reported in September 2000.

The experiences gained in developing the instruments for these field tests have highlighted many areas where improvements can be made in future projects.

2. The LSID project background

The objective of the LSID project is to determine an appropriate methodology for a longitudinal panel survey on income dynamics. This is an ambitious task with many different facets including:

- reaching agreement on the survey content with the clients
- developing a sample design
- developing CAI instruments and associated field collection systems
- field testing
- specifying systems for estimation, imputation and sample error calculation
- creating and testing an output database

There is little information currently available in New Zealand on income, labour market and family dynamics. Some of the benefits of obtaining this information are seen as:

- understanding what prevents people reaching desirable social and economic outcomes
- assessing the role of policy interventions in creating or alleviating any blocks
- improving the targeting of Government services to those most in need

Achieving these benefits requires information, allowing comparison of the positions of individuals and their families over time and also in relation to particular social and economic benchmarks. The outputs from a survey of income dynamics would be used for developing policies on:

- taxation
- retirement provisions
- assisting people move from income support to paid work
- assisting people improve their income levels
- support for families and children
- education

Statistics New Zealand has obtained additional funding to do this research. Not all of the systems required for a production survey are being fully developed. Instead some aspects are only being investigated and documented to a stage where they are ready to be specified. This provides more opportunity to evaluate alternative approaches rather than just focusing on the construction of production systems.

The project commenced in July 1997 and the first of two waves of field test interviewing took place in July 1999. The respondents were re-interviewed, along with any new household members, in a second field test held in March 2000.

A final report recommending a methodology for a longitudinal survey of income dynamics is due in September 2000. Following the completion of the project, it is hoped that a full survey will be approved. There is a great deal of interest in the research community in such a longitudinal survey as well as wide support across the public sector.

3. The LSID project team

The LSID Project Manager co-ordinated a team of up to 15 people. They have consulted with clients, developed the topic specifications, evaluated hardware, put together training manuals, organised the field work and managed the budgets. The sample design, questionnaire design and instrument programming was undertaken by specialist sections within Statistics New Zealand.

The Questionnaire Design Consultancy section develops questionnaires used for most of Statistics New Zealand 's surveys. The LSID survey instruments are the first they have developed without an associated paper form. Previously paper forms have been created along with new Blaise instruments. The questionnaire design staff involved had no prior experience with Blaise.

Developing Blaise systems is the responsibility of the Technology Application Services division. Over the past three years they have built up considerable Blaise expertise. A full time programmer was assigned to the instrument development. A part time analyst / team leader and several part time programmers worked on other aspects such as derivations and the output database.

4. The LSID design

The LSID aims to collect information on:

- the level of earnings from employment, government support and other income sources over time
- the length of time spent at different income levels
- changes in family status and the length of time spent in different family situations
- the length of time spent in employment, unemployment, part-time work, out of the workforce
- the factors that may be associated with these changes such as education qualifications, health status, age of children, occupation, hours worked, ethnic group and age.

These objectives were developed from the information needs of the clients. Topic specifications were written to cover all the objectives. The topic specifications, detail the different types of data required and were the starting point for the design of the survey questions. In the final report all the topics will be assessed for their feasibility and cost effectiveness.

For longitudinal data the unit of analysis is the individual. Information about each person's family and household is also required. For example, individuals will have a family type, a family income, a household income etc. All LSID data has one of three time-based attributes:

- spell data
- annual data
- point in time data

Spell data relates to a period of time. For example the receipt of government income support payments from start date to end date. Annual data comprises of one value for a 12 month period, such as the income from interest in the 12 months prior to the interview month. Point in time data relates to situations as at the interview date. For example a persons educational qualifications at the interview date.

The LSID is an interviewer administered survey. The large number of detailed questions involved, make it unsuitable for other collection methods. CAI was chosen over pen and paper interviewing because it automates the complex routing, and it allows information from previous interviews to be more easily used.

The field test sample comprised 436 households. Every eligible person, 15 years and over, in a sampled household is asked a personal questionnaire and those under 15, a child questionnaire. The sample size of a full longitudinal survey is proposed to be around 10,000 households.

Other considerations in the design of the survey included:

- how to achieve better estimates for the Maori population through over sampling
- obtaining background information on the respondent's current situation
- calculation of derived variables such as annual income and family income spells
- cross sectional outputs from each survey wave
- treatment of non response, proxy and partial responses
- continuous or windowed interviewing
- the reference period used for data collection
- interviewer training requirements
- strategies for approaching respondents
- incentives to retain respondents
- tracking methods to reduce attrition
- privacy implications
- respondent burden

Longitudinal surveys run by other Statistical Agencies were investigated and the information obtained has helped improve our designs. The Australian Bureau of Statistics carried out two formal peer reviews of the project as it has progressed. Inevitably though there are many aspects that can only be learnt from experience.

5. Development challenges

5.1 Specifying the questions

The questions for the two field tests were developed from the detailed topic specifications. The LSID instruments are far more complicated than any conventional paper based questionnaire and cannot easily be described in traditional ways. Building a Blaise instrument without a corresponding paper form meant a new approach to specifying the questionnaire was needed.

Flowcharts were agreed as the best means of specifying the questions and routing. A very basic flowcharting package, 'Easyflow' was obtained. The designers found this package easy to use and really helpful. It enabled them to concentrate on the job of designing and specifying the questions.

Flowcharts visually depict the flow of the questions involved and document the question texts. They convey the very complicated routing involved in a way that is easily comprehended by everyone involved. Flowcharts were also used as simple paper questionnaires for early cognitive testing. However some things such as table structures are more difficult to show on a flowchart. Over 100 pages of flow charts were produced.

The programmers took full responsibility for writing the Blaise code. The division of labour was simply accepted at the start. By the end of the development of the instruments for the first test this approach was beginning to be questioned. However the pressure to meet deadlines left little scope for changing roles. Originally it was envisaged that the questionnaire designers would be able to access and edit the Blaise scripts but this was never implemented. Only now after the completion of the LSID instrument development is the idea of the question designers working directly with Blaise being re-addressed.

5.2 The development process

When development of the questionnaire started the detailed topic specifications were not ready. The designers began by trying to second guess what was needed. Unfortunately this initial work was not correct but it helped the designers understand the differences between Blaise and paper questionnaires. For example they learnt that it is not possible to ask a question in Blaise with both numeric and written response categories.

The development staff worked together to figure out what was possible. In some places the designers thought it would be better to leave the flowcharts vague so the Blaise programmer could work out the best approach. The programmer suggested alternatives where he thought things could be improved. Most times this worked really well and helped to make the instrument more straightforward. Other times the designers had to make lots of changes because the questions didn't flow well.

Initially the programmer's role was more like a questionnaire designer. He reviewed early drafts of questions made suggestions and comments on how things could be done. When both parties were happy with the flowcharts the programmer would develop the Blaise code. The designers did not really have much idea of how their questions would look like on screen at the start. Once a module was working in Blaise, the designers would review and check it. Then the whole cycle would start over.

The question designers found it a real plus that the programmer was very approachable and good at seeing issues from the questionnaire design point of view as well as a programming point of view. The relationship between the two groups worked well and hopefully this can continue in future developments. There were a few difficulties when staff moved on. New relationships had to be fostered and the protocols re-established.

A lot of work was involved in generating and keeping flowcharts and Blaise scripts up to date and synchronised. Because all the information had to be manually transferred from the flowcharts into the Blaise scripts there was a lot of duplication of effort. And when the inevitable changes were required, the work had to be done over again. In hindsight more training, better procedures and scheduling would have avoided much ‘on the job’ learning and duplication.

5.3 Establishing the timeline

Each set of spell data questions is dependent on the respondent's activities during the reference period. To find out what the respondent was doing they are asked questions about their activities along with the start and finish dates. For example: 'Were you in paid work at any time between date x and date y?'

In Blaise these questions were implemented as a simple table with activity type, start date, end date fields. The activities were then organised into to a timeline. This can be visualised as a sequence showing what a respondent was doing on any given date during the reference period, usually the previous year.

The challenge is not so much recording a respondent's activities but with the many edits that need to be applied. These checks involve finding overlaps and gaps in the timeline. They can only be applied after all the activities are recorded and sorted, otherwise error messages would appear straight away. Getting this to work in Blaise was harder than it might seem. To see whether the interviewer is ready to check the timeline a (Auxfield) question is asked. The field is used to trigger the timeline sorting and edit checks. When all the checks are resolved the field is reset. This means an interviewer can go back and change the timeline without invoking the edit checks until they are needed again.

In the second interview additional activities may need to be included in the timeline. The interviewer first confirms the activities recorded in the first interview then enters any new activities since the first interview into another table. These two timelines are combined using a temporary table and then moved back into the standard timeline. Once the time line is established it determines the relevant spell data questions to be covered.

5.4 Structuring the instrument

The household instrument for the first test had over 700 fields and the personal instrument over 6000. For the second test the household instrument was the same size but the personal instrument expanded to 7800 fields with the addition of questions on the value and type of assets and debt held by the respondent.

When the total size of the LSID instrument became evident it was decided to split the Blaise code into separate household and personal programs. This was a straightforward change as there was little need to share or edit data between the different household members. A separate personal instrument helps ensure that response times do not deteriorate when the number of questions increases. The household and person instruments are linked together for the interviewers with a simple Maniplus interface.

The only performance issue mentioned by the interviewers was the time it takes for the program to open. Some resorted to starting the questionnaire before entering the respondent's house. Once the interview is started, moving between questions is nearly instantaneous. Interviewers were equipped with new Toshiba Portege 3010CT computers running Windows NT Workstation and Blaise 4 Windows. These are lightweight 226 MHz Intel Pentium machines with 64 MB of memory.

The detailed topic specifications were drip feed to the questionnaire designers. The questionnaire specifications were then delivered to the programmer in a similar manner. This meant the over all structure of the instrument was not evident and there was little opportunity to plan or optimise it. Having all the topic specifications to start with would have allowed a better overview and more logical arrangement of the components.

The Blaise data structures for large questionnaires end up being extremely complicated. In some places the programmer tried to simplify the data structure by combining questions asking for the same information. Appropriate question texts for the different situations were computed and one field used to store the answers. While this sounds attractive it makes the route logic much more complicated. This approach will not be used again, as it became too difficult to maintain. Instead data, from separate fields for each question, will be combined with Manipula.

It took a lot of time and effort to get meaningful data from the first pilot test. Cameleon was used to create the scripts to define the Sybase database output tables. Apart from splitting large arrays with Manipula, the Blaise data was exported in its original structure and loaded to the database tables. SAS was used against the database to transform data and derive new variables.

For the second test Manipula was used to export the data in a 'record per question' structure. The data was read directly by the SAS derivation programs and then loaded into the database. While this method required more Manipula code, it simplified the overall process.

Data collected in the first interview is used in the follow-up interview. If the paths to the external files containing the data from the first interview are not specified correctly, Blaise cannot find the data. During development the instrument was run on our internal network. This required different external file path definitions than were eventually used on the interviewers' laptops. Mapping the path to a drive letter, such as E: did not always work. To fix the problem the full path to each external file had to be specified in all cases. This of course is not ideal, as the Blaise scripts have to be altered and re-prepared for each environment.

5.5 Managing changes

In any large development it is inevitable the requirements will evolve and be refined. How these changes are managed is often the difference between a successful or a stressful development. As milestones approach, and it becomes obvious that there is more work than can be done in the timeframe left, priorities have to be determined and the hard decisions made about what will be left out. Often the need to accommodate change is not allowed for in the project planning and scheduling.

Late delivery of topic specifications meant questionnaire development also ran behind schedule. Frequent changes to the question texts also became a significant issue. The large number of variables used as fills in the question text along with the poor methods used to identify changes in the flowcharts and transfer them into the Blaise scripts all helped to compound the delays.

Given the designers inexperience with Blaise and the complexities involved it was not considered viable for them to manage changes to the question texts in Blaise. With appropriate training and systems it would be more efficient for the question designers to maintain the texts themselves.

The delays with the topic specifications worked against an orderly sequence of development and also impacted on the time available for specifying, testing and programming the questions. Modules developed in the earlier phases needed to be revised in light of later topic specifications. All the changes required stacked up to the point where they impacted on the ability of the programmer to effectively deal with them in the time available.

5.6 Validating the instrument

Testing a CAI instrument is vital. Considerable time and effort was spent in cognitive testing as well as ensuring the question texts, routing and edits were correct. The need to refer to data collected in the first test considerably increased the complexity of the routing and editing for the second test instrument and thus the amount of validation required.

The question designers carried out cognitive tests using their flowcharts. Feedback on the flow and comprehension was used to shape and refine the questionnaire specifications. However the opportunity to 'desk check' the questionnaire using the flowchart was not utilised as extensively as it could have been. Mostly this was due to time and resource constraints. Testing the route did not really commence until much of the programming was completed. This meant a lot of effort was required over a relatively short period.

The number of ongoing changes also impacted on the timeframes available for testing and validating the instruments. Modules had to be rechecked again and again. The lists of changes became longer and longer as the project went on. As there is always room for improvement it was not until the pressure of impending deadlines became obvious that the issues were prioritised and the modules finalised. It would have been preferable if individual modules were signed off and put aside earlier, so efforts could be focused on higher priorities.

Many of the people who tested the first field test instrument had moved on by the time the second instrument was ready for checking. Training new people in what the instrument was intended to accomplish and helping them distinguish genuine errors, took almost as much effort as the testing itself. A variety of people were involved in the instrument validation, including people outside project. The instruments were checked against the questionnaire specification flowcharts. The fact these specifications were in an easily understood format helped the testers determine whether the behaviour of the Blaise program matched the documented requirements.

The majority of the routing involved in the LSID instruments was programmed using 'State Rules' technique(1). Although this method requires a lot more lines of code than the usual Blaise rules section, it makes the route logic much easier to implement and validate. The routing conditions for each question can be written and verified independently of surrounding questions. This is especially beneficial when changes or corrections are needed, as testing can be confidently focused on only the altered questions.

Incremental validation would certainly have spread out the huge workload involved in checking the instrument. If individual modules were programmed, tested and signed off as the development progressed then the final 'build' would simply involve checking that everything had been assembled correctly.

6. Interviewer training and support

Interviewer training for the first field test included pre-course reading material, followed by a five day face to face training session, covering laptop use and specific LSID survey content. Nineteen interviewers attended. The project team developed the training course with assistance from Statistics New Zealand 's Training and Development section.

The interviewer manuals and support materials were very well received. After the five day training, and a week of practice prior to going into the field, the majority of interviewers were confident about their ability to conduct an interview. The main changes made for second field test training were to keep training groups smaller (no more than 8 people) and to have as much hands on practice as possible. Interviewers requested more detailed information regarding the survey content prior to the training course.

A 0800 (free phone) number provided first line support for interviewers and respondents with problems, queries or concerns. Subject matter experts provided further assistance as required. Most calls from respondents were general queries about the survey. In total over 100 calls were received for both tests. The interviewers found the free phone number helped to resolve problems and provide guidance quickly and effectively especially during the initial settling in period.

7. Field test results

The first field test, held in July 1999, aimed to:

- provide an indicative response rate
- trial the CAI instrument and proposed field procedures
- trial performance of laptops and accessories
- assess respondent load

Overall the Blaise instrument worked successfully. Only a couple of minor routing errors were discovered. Interviewer reaction to the laptops and the Blaise system was very positive, with almost unanimous agreement at the debriefings that more questionnaires should be done this way. Feedback from interviewers and analysis of results so far indicate respondents had few difficulties with the questionnaire content.

The laptops proved reliable with only a couple of problems very early on. The screen quality of the laptops was excellent. However there were the usual problems when interviewing in strong light. Some interviewers accidentally hit the F2 key (which exits the questionnaire), while using the numeric 2 key. This problem was resolved by reassigning the F2 key function. Two batteries provided ample power for a day's workload and respondents had no objections to interviewers plugging in on the odd occasions when it was necessary.

The average interview length for the personal questionnaire was around 30 minutes. This is well within the upper limit target of 45 minutes on average. Interviewers indicated the length of the personal interview varied greatly, depending on the complexity of the household and each individual's situation. Interviewers commented that respondent fatigue was a problem with the longer interviews and stressed the importance of preparing respondents to help avoid difficulties.

Over 70% of eligible individuals provided a full response. Item refusals were very low overall with only very small numbers of respondents refusing to answer income questions. Offering the choice of answering to the nearest $100, $1000, and finally income ranges seems to have been very successful in minimising refusals and don't know responses to these questions.

Respondents were asked to provide a contact person to assist with follow-up and 21% answered "no" to this question. While this appears high, interviewer feedback indicated that some of these people felt that the information was not required, as they had no intention of moving, while others may have had difficulty providing a contact. The real impact of this non-response will not be known until we analyse the contact results from the second field test.

Each interviewer's work was pre-loaded onto their laptop. Interviewers transferred their completed cases onto floppy disks and mailed them to Statistics New Zealand each week. This eliminated the need to develop a full-scale case management system. Wrapping disks in plastic bubble wrap and using courier bags provided ample protection at an acceptable cost. Of the 80 disks returned only one was damaged, most likely before posting.

The data was amalgamated for in-house processing such as coding of occupation, industry and education qualifications. Analysis of the first field test cases helped identify potential problems with the questionnaire and will contribute to developing cost estimates for the full-scale survey.

The second field test was conducted in March 2000. This test involved the adults who responded to the first test, together with anyone else living in the household at the time of the second interview. The main aims of the second test were to:

- provide indicative overall panel and longitudinal response rates
- trial the asset questions
- assess the respondent load
- trial interviewing using data from the first wave of interviews
- further trial performance of laptops and accessories and proposed field procedures
- provide data for testing database design
- provide more information to estimate costs for a full survey

8. Lessons learnt from the LSID development

The experiences gained in developing the instruments for these field tests have highlighted many areas where improvements can be made. Some changes can be easily implemented others will take longer and require more research. Key considerations include fostering better communication between all the parties involved in the development more effective and more disciplined development methods and improved project management.

The question designers clearly need to understand what it is possible to do with Blaise. The challenge involved in creating such a complex questionnaire was more than enough for them to deal with at the start. Learning to write Blaise code at that stage may have been counter productive. Now there is a much keener appreciation of the benefits of questionnaire designers developing their own Blaise programs. A recent Blaise training course for the designers was enthusiastically received. Understanding what is involved in converting flowcharts into a Blaise program will at the very least improve the communication with the programmers.

The programmers and questionnaire designers could benefit from a working environment more conducive to project work. There is a need for places where all the developers can meet to discuss issues, and also quiet areas where they can concentrate on writing flowcharts or code. Another idea is to have at least two Blaise developers in the team. This would allow one to be the main contact and be available to consult, propose alternatives, to understand the topic specifications and learn about questionnaire design. The other programmer would also be involved but able to concentrate on writing code as well. The main developer could be shared amongst several projects and act as a 'mentor' for less experienced programmers. This arrangement also ensures there are knowledgeable backup staff available.

Flowcharts have proved to be an excellent communication and documentation tool. They successfully moved the designers out of the mode of creating paper questionnaires and provided a common reference point understood by both technical and non-technical staff. There is scope now to work towards refining the way in which flowcharts are used. Current flowcharts only represent the interview, and do not include all the programming elements. Ways to represent some design aspects, such as tables, need to be worked out. Other items, such as the field identifiers and types need to be included. This information would help with generating code, testing edits, creating derivations and with resolving interviewer problems. Spell checking and editing to get the question texts accurate and finalised earlier is another area where attention is required. More sophisticated flowcharting packages are being evaluated. These may allow additional fields to be specified and extracted.

For large projects formal methods of documentation, change control and program version control are necessary. Informal communication can mean systematic and or documented outcomes are not generated. For example, written amendments are preferable to asking for changes via phone calls. The challenges for those who will have to maintain the instrument in the future need to be considered. Implementing a more formal change control process to keep track of questionnaire amendments and any consequential impacts on other questions is a priority.

A repository, where question specifications can be documented and re-used, is an attractive proposition. Initially a simple Lotus Notes database was set-up. This was not used due to the overheads of capturing all the specifications and a perception that it did not provide any utility. For a repository to be useful has to be kept up to date with any changes. Ideally it would be linked to the flowchart specifications and allow the extraction of information for use by other programs. Providing different users with views of the specifications tailored to their needs is likely to be an incentive for them to put in the required effort.

Using a repository could also facilitate better change control processes. If designers specified and maintained their question texts in such a database it would hopefully lead to greater efficiency and consistency. Various staff could contribute different aspects of the specification. For example the Blaise programmer might determine the field identifiers, while the question designers define the texts and field types. Better procedures for program version control and for carrying out testing could also be supported with a repository. Linking flowcharts with a specification repository would eliminate duplication and save a considerable amount of work. How flowcharting tools can be integrated with a repository is being investigated.

Cameleon's potential to access and manipulate Blaise metadata was not fully exploited. New uses for the Blaise metadata could be developed especially when the Blaise language is understood and used by all the designers. Setting up scripts to create database tables for the LSID is only a small example of how Cameleon could be employed.

The instrument development sequence used in this project, where flowcharts were prepared and then programmed in Blaise, is somewhat cumbersome and caused delays. Other approaches are being considered. For example the question designers could write their own prototype Blaise code. The programmers could then focus on integrating modules and look after quality management issues. With appropriate training and support it should be quite straightforward for questionnaire designers to set-up and maintain simple prototype questionnaires themselves. Team members could then carry out cognitive testing using Blaise and review questions at a much earlier stage.

Having the ability to quickly document, build and demonstrate questionnaire proposals would have helped make the LSID development more effective. Running programs on a laptop as early as possible also ensures there is time to understand and address any issues associated with the laptop environment. It could be useful to include some fields in these prototype questionnaires to document feedback on the proposed questions. Finalising questionnaire design earlier will reduce rework and the overheads associated with making changes after the whole instrument is constructed.

The facility in Blaise to add descriptive information within the field definition caught the attention of the questionnaire developers during their training course. They were quick to see the potential to record information relating to the question development process, such as when changes were made and by whom. Cameleon could be used to extract and manipulate these descriptions.

The development process involves refining the detailed topic specifications into a questionnaire. Establishing a high level flowchart at the start would give all the team a sense of the whole questionnaire much earlier in the development process. Clarifying the big picture first and then working into the detail later provides a sense of direction and ensures the overall structure is considered.

A corresponding high level Blaise program structure is also needed. Now that the development of large-scale electronic questionnaires is an ongoing activity in Statistics New Zealand, the impetus (and funding) to standardise and reuse existing code has increased. Many of our household surveys have a common high level structure and a standard Blaise 'template' is planned to formalise this. The template instrument would include the standard survey management questions such as the scope and coverage rules etc. Survey specific modules could then simply be added as required.

All the developers need to work together to initially plan the high level structure of the survey. Deciding which related groups of questions fit together into modules a fairly early stage would help with organising and scheduling the development work. Modules could then be developed and tested as they are detailed.

A modular building block approach implies that related sets of questions, such as income or house ownership, are specified, written and tested discretely. This contrasts with the LSID development where large parts of the questionnaire were specified, before any programming started. Edits were added even later and testing only commenced once the whole instrument was completed. This process meant there was less opportunity to revise and correct the instruments once they were built.

Edits, and any associated questions to assist in resolving edit failures, need to be designed in from the beginning instead of at the end of the development sequence. Adding new questions and edits or changing the sequence or routing of questions often involves consequential changes. All of these things naturally increase the amount of rechecking required and contribute to the long development times. Developing and testing edits earlier in the development cycle would reduce the number of last minute changes.

Many of the scheduling and change control difficulties are typical project management issues. Managing deadlines, prioritising and making trade-offs were tough decisions especially when they involved compromises that made it difficult to bring the programs into line with what was wanted. Decisions often took a long time to be made.

Ensuring target dates are met helps to minimise consequential impacts. The lack of previous benchmarks made it difficult to estimate the time it would take to develop and test the instruments. More time and

resources were needed especially for the cognitive and usability testing. It would also be beneficial to have cognitive testing completed before serious programming is undertaken. Quicker turnaround of changes along with a formal confirmation of programming interpretation before module testing will reduce some of the larger development iterations. Given the benefit of our experiences more realistic timeframes to complete validation can be scheduled in future. Combined with better planning and training, more systematic overall validation will be possible as well.

9 Conclusions

Overall this project has been a success. The skills of the LSID team members along with their ability to work together and deal with the stresses involved has contributed greatly to the positive outcome. Everyone focused on what they could improve, rather than looking at what others might do better.

Blaise 4 Windows performed superbly. It met all of the challenges that come with such a large and complex interview. Very few Blaise programming issues arose during the development and the instruments worked flawlessly in the field.

The two field tests involved in the LSID research have been extremely valuable in helping build our capacity to develop Blaise instruments. Managers have come to understand and appreciate the requirements and benefits of CAPI in a very tangible way, without having to deal with the risks usually associated with implementing production CAI surveys. These experiences have favourably influenced the direction of CAI within Statistics New Zealand. Funding and resources have recently been allocated to implement two production CAI surveys during the 2000/2001 financial year.

In any development, complexity initially arises through the tendency to make use of all the available options. This seems to be an inevitable part of learning. With experience it becomes easier to recognise what can be left out and over time adopt simpler approaches. New systems and better processes will also assist.

Everybody involved has learnt a lot. While some have commented this project 'has taken years off their life' generally there has been a high level of personal satisfaction with what has been achieved. A number of staff who worked on this project, have now rotated into other CAI developments where their experience will be of much benefit. The knowledge gained over the past couple of years will prove to be very valuable for future developments.

(1) IBUG Newsletter March 1995 'Blaising the Paper Route - A method for converting paper questionnaires to Blaise ' describes the 'State Rules' technique.

Data Collection in Two Phase and Multi Centre Health Survey

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Introduction

National Public Health Institute (NPHI), Social Insurance Institute (SII), and Statistics Finland (SF) are undertaking a large-scale health survey in Finland. The major aim of the survey is to collect information about the health and functional ability, and about the need for care, rehabilitation and help. Additional aims are to find out the change of populations health status, functional ability and health needs; to estimate the future trends of health and need for services and social security; to find out cross-sectional associations between living conditions and living habits and health; and also to develop the health survey methods. An ultimate goal is to estimate what will be the use of health services and medicines, and the need for care, help and rehabilitation in the future.

The survey is composed of two consecutive phases. The first phase (autumn, 2000) will be a face-to-face health interview carried out by the interviewers of SF. The second phase will be an extensive health examination. Specialists having medical training will carry out the health examination in five similar mobile clinics. Clinics will move several times during the second phase in order to keep the distances reasonable for the examinees. Altogether, the clinics stop at 80 sites and the duration of a stay varies from two days to two weeks. Accordingly, each clinic moves more than fifteen times.

The primary reason to have two separate phases was to split the respondent burden in two smaller pieces. The health interview takes 60 minutes in the average and the health examination about three hours. Additionally, it is hoped that the use of professional interviewers in the first phase would reduce non-response. Interviewers also agree with the respondent the time when he or she goes to the mobile clinic for the health examination. It is important part of the survey, because the clinics stay only a few days on one site.

Contents of the survey

The purpose of the survey is to collect a comprehensive set of information concerning the health and living conditions of the adult population living in Finland. Individual based stratified two-stage cluster sample of 10 000 people will be drawn from the Population Registry. Municipalities or clusters of municipalities are the first stage sampling units.

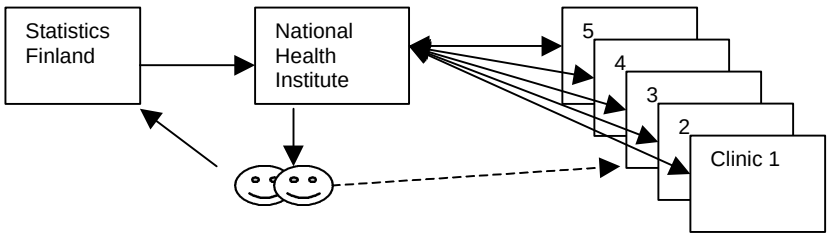
The first interview at respondent’s home is focussed mainly on living conditions, working conditions and living habits. Also, some general aspects of health, like experienced symptoms, and use of health services and medicines will be covered.

In the clinical health examinations, respondent's risk and protective factors, as well as symptoms and signs will be explored in an interview. Functional and working ability will be determined by specific tests accompanied by an interview. The major diseases and disorders, whose prevalence will be found, are cardio-vascular, respiratory, musculoskeletal, mental health, and oral health and dental diseases. Mental health examination is a psychiatric interview. Specific equipment are needed in the examinations of the other diseases and disorders (e.g. EKG, spirometer, dental x-ray).

Data collection and data flow

The first phase is planned to last about six months and data collection will be carried out by the standard CAPI system of SF. However, the second phase begins soon after the beginning the first phase. Time difference between the interview and the health examination will be approximately two or three weeks. Consequently, the two data collection phases overlap and some parts of the health interview will be needed as background information in the health examination. Therefore, the interview data have to be transferred the mobile clinics soon after the interview.

At SF, the Blaise forms will be assembled in a file or files. The files will be delivered to the server at NPHI, from where they will be distributed to mobile clinics via modems and mobile phones. Mobile clinics will receive also the appointments interviewers have agreed with the respondents.



The results of the completed examinations will be sent to NPHI only a few days after the examinations, without any further processing. Data processing and analysis mainly takes place at NPHI. Also, a standard health report will be printed for each examinee, a physician looks into it, and finally the report will be sent to the examinee.

Data collection in mobile clinics

In every clinic, specialists like physicians, dentists, psychologists, and nurses will carry out several different interviews, measurements and examinations. Each clinic will have altogether 12 different measurement or interview rooms. Most of the data will be entered by Blaise instruments either directly or typing in the results from the measurement devices. Therefore, in all examination rooms at a clinic will be a workstation that has all the necessary Blaise questionnaires, and access to database composed of sample data and parts of the health interview. For some measurements, e.g. functional capacity, there will be two similar examination rooms enabling parallel examinations.

The hardware for the clinics is designed so that moving the installation from one place to another is easy. Therefore, all workstations will be similar laptops, which are connected with a wireless network to the local server. Also the servers are laptops. Each laptop needs only a PCIMCI card by which it can be connected to network. Because of this installation, the workstations may be moved freely in the range of some 50 meters from the server, i.e. in a circle whose diameter is 100 meters (nearly 8000 m^2). Each server has a modem connected to a mobile phone for communication with the server at NPHI central office in Helsinki. The operating system will be Windows NT 4.0 WS in workstations and Windows NT 4.0 Server in servers.

Identification

The health examination sets new demands for the identification of subject data. For instance, bar code labels are needed for the blood and urine samples. In the clinic each respondent needs some 30 identification labels to be attached on sample tubes and on paper forms. The problem is that it is not known early enough in which of the five moving clinics he or she will be examined. Therefore, the labels cannot be printed for him or her in advance.

The standard identification key of SF will be used in the health interview at respondent's home. However, using the original identification keys for the identification in the health examination had been difficult to arrange and error prone in any case. Therefore, each clinic will have several sheets of labels with new identification keys. Before the opening interview at the mobile clinic, respondent gets the first available identification. In practice that is a sheet with the labels. The new and the original identifications will be linked together in the opening interview, and only the new identification key will be used later.

Files structure

Most the data will be stored directly or indirectly by Blaise instruments. That is, there will be no paper forms for most of the measurements. Therefore the collected data have to be secured in many ways, including backup copies, encryption and also fastening computers on tables. The servers will be backed up (continuously) in Iomega ZIP stations.

Some common files like the sample file and some part of the health interview, will be stored in the server so that they may accessed from all workstations. Other data files will be stored primarily in the local workstations. A few times a day, the local (Blaise) files will be appended to the main data files in the servers, however. Every time the clinic moves from one site to another, the data files will be renamed and copied NPHI main server. At the next site, data will be stored in a new (empty) file.

Technically it was possible to have all data files on the server only. It is not known yet what will be the local circumstances and therefore, how reliable the network will be. Therefore, at least in the pilots files will be stored locally on the workstations.

Conclusions

Computer assisted data collection is commonplace in professional survey organizations but the possibilities computers bring in the data collection are new for specialists in many areas. For instance, health surveys have a very long history using PAPI. However, health surveys are not repeated very often and therefore, the recent development in data collection methods is not well known among the health survey professionals. Methodologically SF's impact, apart from the sampling expertise, has been to introduce computer assisted data collection methods in a health survey. Partly the ease of authoring made it possible to use Blaise (and CAI) for the data collection.

CAI introduces some new features, like the checking mechanism and the possibility to apply computer assisted coding, which reduce substantially the need of data editing. Previously, data editing after the actual data collection has been a very time consuming task in health surveys. Now, data files are ready for analysis much faster. However, it has been difficult to convince the researchers of how much in advance the data entry instruments should be ready.

In theory, data entry had been possible also with other types of software, e.g. database systems, but probably the designing process of data entry forms had become much more laborious. Though the other system may had made easier the design of the other parts of the information system. A clinical health examination involves several other aspects than only interviews, which should be incorporated in the data collection plan, which are more difficult to accomplish by Blaise system.

Only the first, fairly small pilot (without telecommunications) has been undertaken up to this point. The second, more comprehensive pilot study will take place in May, 2000. As the first experience, the computer assisted data collection was considered successful. The specialists who did the data entry found it very convenient, and at least as good a method as using paper forms, in any case. Some of the comments were praising.

Session 3

Blaise and the Internet

Internet assisted coding
Sylvia von Wrisberg, Bavarian State Bureau

Blaise Internet Services put to the test: Websurfing the Construction Industry
Hans Wings and Marko Roos, CBS

The use XML in a Blaise environment
Jelke Bethlehem, Lon Hofman, CBS

The Internet, Blaise and a representative sample
Dirk Sikkel, Adriaan Hoogendoorn, Bas Weerman

Internet Assisted Coding

Thesaurus-based Software Solution for the Support of Coding Acitivities as an Example of NACE

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1. Introduction

A basic prerequisite for statistical work is the existence of a systematic to order available data so that they may be evaluated and analyzed according to the rules of statistics. Systems for classification serve as the foundation of systematic ordering of recorded data in order to raise and prepare statistics. In the following we shall deal with methods of classifying trade branches and goods.

- Classifications of trade branches serve to order data which relates only to the statistical unit, that is to say relates to only one single business or a group of trades, e.g. one company. They are the foundation for an economically significant creation of statistics for production values, production factors, creation of capital and financial transactions of these units.

- Classifications of goods serve to order goods (merchandise and services) according to uniform characteristics. They are the basis for the preparation of statistics on production, domestic trade, consumer use, export trade and transport of these goods.

The methodology described below codes the economic data on the foundation of a thesaurus and a basic knowledge with electronic support on the basis of a system of classification. To this end, the Bavarian State Bureau for Statistics and Data Processing has developed the software “Classification Server” which will be described here using the example of the trade branch systematic (NACE).

2. Coding Branches of Trade and Industry

To guarantee the comparison of economic statistics within Europe it is necessary that the trades within Europe be classified in a uniform system. When coding industrial activities (that is the assignment of a particular class to a data set) a numerical key is assigned on the basis of the interpretation of a verbal text in natural, colloquial form, as an example the activity *“Buying of wine”* is given the key *“51.34 Wholesale of alcoholic and other beverages”.*

The foundation of trade coding is the German version of the European economic branch systematic “NACE Rev. 1” (Nomenclature générale des activités économique dans les Communautés européennes). The German form of NACE in brief “WZ93” (Classification of trade branches 1993 Edition) refines the systematic of the European NACE from a subdivision of 4-digits to a 5-digit code. The activity *“Buying of wine”,* therefore, in Germany is

given the code *“51.34.3 Wholesale of wine”* as a further detailing of the codes 51.34 according to the European systematic.

On decentralized Coding in the Federal Republic of Germany

At this point we must draw attention to the federal state and administrative structure in the Federal Republic of Germany. Throughout the Federation official statistics (“federal statistics”) are carried out in cooperation between the Federal Bureau of Statistics and the Offices of Statistics in the sixteen federal states (lands). The federal statistic is therefore to a large extent decentrally organized. In the framework of this division of labor, the Federal Bureau of Statistics primarily has a coordinating function. Accordingly, it is responsible for issuing and maintaining the classification systematic such as is represented for example by the “WZ93”. The collection of data and its preparation by means of the classification systems up to the findings of the individual lands, are the purview of the offices of statistics of the lands.

In this manner, the offices of statistics obtain information on registered trades (officially registered trades) from cities and communities for the preparation of national industrial and trade statistics. According to the economic and trade code, the establishment of a business (new registrations), the change of the place of business, any change or expansion of a practised activity and of course the report on the closure of a business is subject to registration. The form for business registration is at present one original and twelf carbon copies, which are forwarded to various offices such as the Board of Trade and Industry, the Internal Revenue Service or the officies of statistics.

Organization of Coding in the State of Bavaria

Between the years 1997 and 1999, the Bavarian Bureau of Statistics and Data Processing developed and put into operation a system for network-supported processing of business registrations (filings for new businesses, closures of businesses and changes in business activities) for cities and communities.

The goals of this pilot project are

- *the media-free electronic transmission of trade data to the twelf authorized offices (Board of Trade and Industry, Chamber of Manual Trades, Internal Revenue Service, Bureau of Standards, etc.)*

- *Uniform, coded data collected at its point of origin*

In the frame of this project, the classification software “*WZ93 Thesaurus*” described here was developed which as an independent component is of use to the statistical offices of the lands, the Federal Bureau of Statistics and other interested administrative departments such as the Board of Trade and Industry. It supports software-technically the coding activities of administrative clerks in the communities, in the offices of statistics and other administrative offices concerned such as the Board of Trade and Industry. The previous manual codification, which required the application in book form, is considerably reduced by the use of the software solution. The media reference work book and CDROM are completely replaced. Another advantage in its use is that different

code results can be for the most part avoided, such as the assignment of “*Production of tricycles*” at one time to “*Production of toys*” and another time to “*Production of bicycles*”.

In the ideal case, the comfortable search program offers the administrative clerk only one code on the basis of a verbal description of an activity. If a search is unsuccessful, the program offers a list of choices and the administrative clerk can narrow the search for the correct code step-by-step. The product is above all capable of learning, that it is able to consider changes in economic activities which arise from the constant growth of new businesses, e.g., “*Internet Provider*” and consider them online in the knowledge base.

3. Components of the system

The most important points of the software can be listed in the following main components:

- the intelligent search
- the learning component
- the central arrangement

3.1 The Intelligent Search

Contrary to simple search machines which are found in a number of word processing programs, our classification software does not employ pure character string comparison (model search) but rather an intelligent search based on semantics. As an example, using a pure model search various, regional names for one and the same business as "*taxi*" or "*cab*" would not be found. On the other hand, when searching for “rape*”, “*”d*rape*ry” or “g*rapes*” would also be shown which is by content absurd. Also various female or male forms like "actor" and "actress" cannot be determined by the model search. Such common trades as “butcher” or “baker” could not be

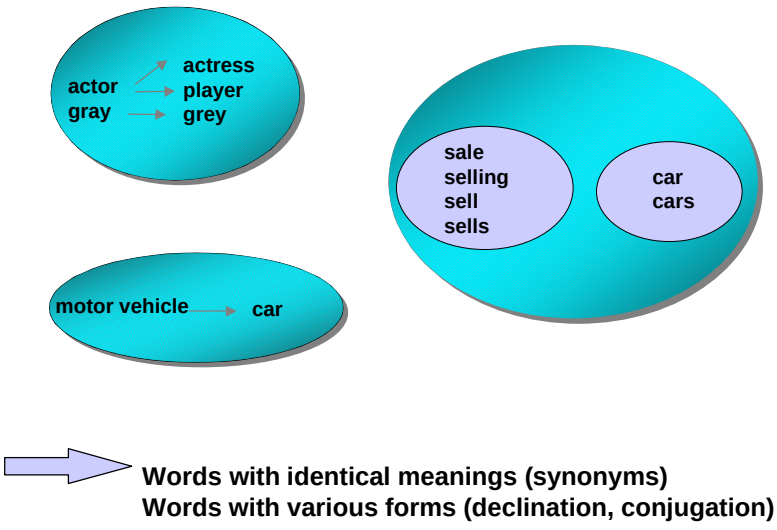

Figure 1 Thesaurus

found using a pure model search. The “baker” has for example be found under the key “*15.81 Manufacture of bread*”.

The Thesaurus

The classification software described here employs a thesaurus supported technology. The basic underlying thesaurus is an ordered and structured collection of words based on the printed edition of the WZ93 cited above. The thesaurus recognizes synonyms and generic and semantic classes. This permits a search according to terms which do not occur in the book version of the systematic. As an example, the words “*car*”, “*motor vehicle”,* “*auto*” and “*automobile*” were combined into one synonym group. “Trade” are headers for “wholesale” and “sale”. When searching for trade with *“Trade of textiles”* the system shows among others the possible combinations “*Wholesale of textiles”* and “*Retail sale of textiles*”. Besides the synonyms, different spellings of one term *(“gray”, “grey*”), convenient abbreviations (“*ws*” for “wholesale”), male and female forms *(“waiter”, “waitress*”), regional differences in dialects or speech *(“taxi”, “cab*”) and so on are depicted. Moreover, because of the ordering of word stems, the system is to a large extent indifferent to conjugation and declination forms (“*produce”, “production*”) as well as singular and plural forms *(“car”, “cars*”).

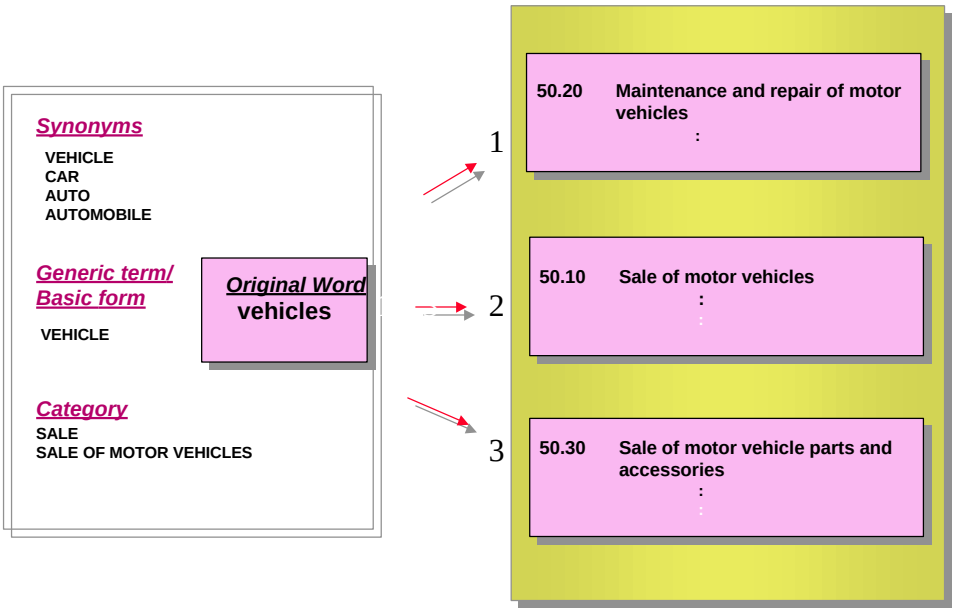

Figure 2 Structure of the Thesaurus

A feature of the system is the word stem analysis of the search term. The words in a search term are formed by an automatic basic analysis of the form, which is based on a morpheme dictionary.

The Search Strategy

How is the search process constructed, which scans the above illustrated thesaurus? The search strategy employed deals with the combined process of a semantic search and the significance of a match. Thus the software searches through the verbal text string entered, searching first for so-called stop words (“*killing”* words) and eliminates them. Stop words are words which have no meaning such as “*the”, “with”, “of”, “still*”, etc. Then

for each word remaining in the text string, the basic word is recovered. Using this basic word form, the real search begins, whereby the terms in a mathematical sense are combined by AND. If no match is found, an internal search begins for single words (OR-combinations) with a resulting significance of match frequency and match combinations.

Figure 3 Search Strategy

Advantages of the Search Strategy

The method described allows ordering colloquial and irrelevant formulations to the correct code. Should an immediate successful search not be possible, the user can achieve a match using a step-by-step process. To do so he can use various search methods: phonetic search, truncated search ("*web**"), significance search, and-or combinations, search within definite segments and search for key words. The system also allows entry through the hierachical structions of the **"**WZ93" with which the user is led.

3.2 The Central Arrangement

From the start, the arrangement was conceived as a client/server sytem with a central server and a universal client. To this end, the software has a convenient web surface for the user and a powerful thesaurus in the server.

At the user's work station, only a standard browser is requried, e.g. Netscape or an Internet Explorer, in order to work with the system. Using a mask which the client downloads from the server, the search query can be entered and then sent via HTTP protocol to the server. The search takes place on the central server in the Bavarian State Bureau of Statistics and Data Processing. For this reason, no software must be delivered, installed or maintained on the user's PC. For this reason, the system is well qualified for employment in Internet and Intranets, which already exist in the offices of statistics in the lands or which are now being developed.

Advantages of a Central Arrangement

In the last years we have experienced a dynamic boom in the economy. New trades and businesses are constantly appearing, such as "*Tattoo Studios*", *Web-Hosting",* "*Call-Center*", etc. The book form of the WZ93 cannot react quickly enough to these changes. Of course no match can be obtained with a first query using classification software, but because of its ability to learn, the next query will result in a positive response. Using a common central and learning data base via internet technology, the quality and the consistancy of the classification for evaluation is quaranteed. Using a central arrangement, different orderings can for the most part be avoided. The problems in ordering described above- the activity "production of tricycles" to "toys" or to "bicycles" is solved by entering the key work "tricycle" into the common, central data base (please refer to the next section).

3.1 The Learning Component

The learning component of the system comprise on the one hand the analysis of the search strategy of the user's query and on the other hand a maintenance component with which new terms can be added online to the data base.

Here the advantage of a central arrangement, which is an essential characteristic of the system, is particularly obvious. Maintenance takes place at one point, namely at the central server in the Bavarian State Bureau of Statistics and Data Processing. Changes in the knowledge base are immediately available to all users.

If the system does not find a term, this is recorded in the database. A specialised coder authorized for this purpose in the Bureau of Statistics can give the term a code and add it to the thesaurus of the data base. This can also take place online via the web interface.

<u>Example:</u>

> *A search is made for the trade "Internet Provider". The term cannot be found in either the printed version or the data base. The specialist determines that the trade can be ordered under* 72.60.2 "O*ther computer related activities". The specialist can enter the new term as an addition to the commentary of the code. With a new search for "Internet Provider" an immediate match is shown with 72.60.2.*

Just as additions are made, so can synonyms be entered into the knowledge base.

<u>Example:</u>

> *A search is made for "Retail sale of cars". The term cannot be found. The term doesn't have to be found neither in the printed version nor in the data base. The specialised coder determines that the trade can be found under "Retail sale of vehicles". The specialist can now add "car" as a synonym to "vehicles". A new search for "Retail sale of cars" will now lead to a correct match "Retail sale of vehicles". With the*

synonym entry a search for “Wholesale of cars” would also lead to the correct match “Wholesale of vehicles”.

An addition set up in this way can be checked parallel online by a specialist of the Systematics Group of the Federal Bureau of Statistics - that is the national level (Germany) and not the regional level (Bavaria) and if necessary corrected or rejected. Editorial management is solely the responsibility of the Federal Bureau of Statistics, which as described above is also responsible for contents and systematics of the “WZ93”. The Federal Bureau of Statistics processes the recommendations of additions suggested by the lands and decides whether a recommended term can be entered into the list of key words as a code or whether a new synonym should be added.

The technical management of the process is solely in the hands of the Bavarian State Bureau of Statistics and Data Processing. It maintains the software and operates the central server.

4. Application and Practical Experience

The classification software “WZ93-Thesaurus” has been successfully employed in the Bavarian government system since 1998. In the state of Bavaria, the system is used besides the Bavarian State Office of Statistics primarily by municipal offices for trade and commerce. Via Internet, the bureaus of statistics in the other federal states and the German Federal Bureau of Statistics are connected nationwide.

Using this process, new paths in electronic communication and cooperation between the statistical offices of the lands and the German Federal Bureau have been laid with the aim that all participating bureaus in the lands work together with a single central classification server. For a long time, this failed due to poor performance of public networks and the problem of security (access and secure servers via public nets, user authorization, etc.). For this reason a few of the participating bureaus in the lands use their own intranet server with a local copy of the thesaurus. In the meantime with the aid of a cryptoprogram, a secure access via the internet to the Bavarian government net is possible so that a single central classification server can be used nationwide.

5. Performance characteristics

The existing classification server accomplishes the following performance features:

- Possibility of a quick search for terms in connection with the trade coding and their precise ordering to the WZ93 codes;
- Ability to learn, e.g. the capability to enlarge the data base with new terms, synonyms, etc;
- Ease in installing and learning to use the program;
- Replacement of the medium “book”.

The software completely replaces the printed version ot the WZ93 systematic. More than two thousend entries and synonyms have been added to the knowledge base in the meantime. Each week it is expanded by 40 - 50 new entries.

The accuracy rate of a match is between 80 - 90%. A qualitative good result if one considers that the users of the system resort to using the system for difficult cases, that is when the code is not already known. At this time, the system handles approximately two hundred queries daily. With the wide use of the above described commercial use in Bavaria, the number of subscribers and accesses will increase obviously.

This means: With the increasing number of users, the knowledge base is expanded and automatically increases the performance of the entire system.

6. Expansion of the System

After the basic technology described above (web-based access, search in the thesaurus with headers, synonyms, etc.) was tested using the “WZ93”, the transfer of the technology to other classification systems no longer presented any basic difficulty. In this way, the systematic register of goods for production statistics, 1995 Edition (abbreviated “GP95”) was conceived and added. The “GP95” is based on the European PRODCOM list (PRODCOM = PRODuction COMmunau taire). For obvious reasons, the “GP95” and the “WZ93” because of their related subject matter could be connected to each other so that, i.e., the successful search for a GP95 key is supplied by the proper WZ93 key, the successful search for a WZ93 key is supplied by the proper GP95 key. This is a real advantage for the user, which the book form cannot offer. In the meantime, frequently used key catalogues such as nationality characteristics, local government index numbers, spelling keys, postal area codes and many more have been entered into the system.
The classification server is being continually expanded and developed. The next project will be the addition of the International Classification of Diseases (ICD).

Technical Environment

The classification server is available with the operating system platforms Windows NT Server 4.0 and with various UNIX derivatives (SINIX, Sun-Solaris, HP-UX). As the database system serves ADABAS with the programming language NATURAL from the German company Software AG.

The classification software described is encapsulated completely. The software can be called up by NATURAL applications using a native interface. JAVA applications recognise the interface as an instance of a java object and integrate the thesaurus in this way.
To enable entrance for various heterogeneous applications within the internet to the “classification server”, the exchange of XML messages using the “HTTP-POST” protocol is in preparation
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Blaise Internet Services put to the test: Web-surveying the construction industry

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1. Introduction

The rapid growth of the Internet offers great possibilities in the field of data-collection, as it is easier, faster, and cheaper to send questionnaires to respondents, and to communicate with respondents via the Internet than using 'conventional' methods.

Statistics Netherlands began experimenting with data-collection via the Internet on a small scale. One experiment, for example, used a mixed-mode design comprising both an ASCII-questionnaire sent by e-mail and a paper version. Despite the fact that a lot of respondents commented on the rather antiquated layout of the ASCII-questionnaire, the results of this experiment were very promising.

Meanwhile the Blaise developers had been working on Blaise Internet Services (Blaise IS), a set of tools to carry out web surveys. The Statistical Department of the Construction Industry was prepared to participate in an experiment with Blaise IS and transformed their survey for the construction industry (sent each month to a panel of companies) into an electronic questionnaire. The method used was 'mixed mode' because respondents could choose between either continuing receiving the paper questionnaire or receiving the electronic version of the questionnaire.

The first part of this paper describes the methodology and the results of the experiment. The second part of the paper will be a more general discussion concerning Web-based interviewing and the use of Blaise IS.

2. Method

All respondents are approached by e-mail. The advantage of e-mail is that it is fast, cheap and that e-mails can be personalised. One can send the respondent information and requests anytime it is thought to be necessary and the respondent can react to the e-mail whenever he wants. E-mail offers a pro-active way of communication with the respondent.

In the experiment respondents could choose between two ways to complete the questionnaire: the off-line mode or the on-line mode. Respondents who indicated they were not able to 'surf' the Internet were sent an e-mail with an ASCII-questionnaire.

In off-line (or scroll-based) mode the respondent opens an HTML-file which comes as an attachment to the e-mail, completes the questionnaire, and presses the submit button. When the submit button is pressed, the browser connects to the Internet address of the Blaise IS server and, after having asked for a username and a password, transmits the data to the database at the Blaise IS server. In off-line mode the respondent can complete the questionnaire without worrying about the cost of being connected to the Internet, but this mode has the disadvantage that the respondent can only see one single HTML-page in his browser. It is not possible, for example, to route through questions or to perform consistency checks (although range checks can be done). Therefore, in off-line mode, the questionnaire must be simple, short, and straightforward.

In on-line (or screen-based) mode the respondent establishes a continuous connection with the Blaise IS server via the Internet. In the content of the e-mail the respondent has received an Internet address (URL) with the location of the questionnaire. The respondent clicks on the hyperlink representing the URL, fills in a username and password, and subsequently the questions are presented on the screen.
In on-line mode questionnaires can be more elaborate than in off-line mode, because it is possible to build in checks and routings.

The third way is to send the respondent an e-mail with an ASCII-questionnaire enclosed in the body text of the e-mail. The respondent answers the questions in the e-mail by filling in 'x' between the brackets of the answer-alternatives. When the e-mail is sent back, the answers to the questions are filtered out automatically using a Manipula-setup. This mode can be used by anyone who has access to e-mail-facilities. No sophisticated programs are required, and the cost of being connected to the Internet is low. The questionnaire is also very easy to design.

[1] The views expressed in this paper are those of the authors and do not necessarily reflect the policies of Statistics Netherlands.

Table 1. Advantages and disadvantages of the used methods

	Off-line	On-line	ASCII
Costs Respondents	++	--	++
Routing	-	++	--
Checks	+	++	--
Layout	+/-	+	--
'Surfing' obligatory?	Yes	Yes	No

The e-mail-addresses of the respondents[2] were collected and those were used to send the respondents their individualised e-mails. The e-mail-addresses were entered in a database by data-typists and were visually checked for errors by project members. In case of doubt the respondents were called to check whether their e-mail-addresses were registered correctly.
The e-mails that were sent to the respondents who could surf consisted of:

- An introductory note,
- The respondent's identification-number,
- The Internet address of the on-line questionnaire as a hyperlink,
- An attachment with the HTML file for the off-line questionnaire, containing four questions, and some additional questions about the experiment itself,
- An attachment with the results of the latest survey, and
- A section discussing problems with both modes.

The e-mails that were sent to the respondents who could not surf consisted only of the ASCII-questionnaire as part of the body text of the e-mail.

Sending individualised e-mails in large numbers.
It would be very time-consuming (and therefore inefficient) to manually write and send all e-mails to the respondents. There are some mail merge programs (e.g. Word), but none off them is really capable of making individualised e-mails *with attachments*. At Statistics Netherlands we came up with a system to do just that. With this system multiple attachments can be enclosed and the body text of the e-mail itself can be individualised (i.e. a unique identification-number). It is even possible to send individualised attachments. This last feature can be ideal for HTML-files containing a hidden field with the identification-number.

Registration and handling of problems
One of the goals of the experiment was to investigate problems that arise with this mode of surveying. Both the respondent and researchers can experience problems with sending, receiving, reading and filling in the questionnaires. To keep count of possible problems a special problem-database was created. This database served two purposes. The first purpose was to record all problems encountered so that in a next phase those problems could be anticipated. The second purpose was to keep track of the respondents that had not been able to send in their data because of the problems they encountered.

Confirmation of receipt
Once all the questions were received by the Blaise IS-server, an HTML-page with a confirmation of receipt was sent to the browser of the respondent. It is also possible to automatically generate a web page with an outline of the answers of the respondent. In this phase we chose to only send the confirmation of receipt and to thank the respondent for his co-operation. In the near future we will include respondent-specific information with the receipt-confirmation.

Processing incoming data
As mentioned before, once the respondent presses the submit button, the data is transmitted to the Blaise IS server and stored in the corresponding Blaise-database. For this experiment there were two databases on the server: one for the on-line-mode and one for the off-line-mode.

The identification-number that respondents had to fill in was used as primary key. At a specific point in time (e.g. at midnight) the databases were emptied and the content was sent to the project group by e-mail. The databases were then extracted from the e-mail and transformed into the desired format. The statistical data were sent to the Statistical Department and the administration-database (receipt-date, off-line or on-line etc.) was updated.

[2] All respondents were participants in an already existing panel. The respondents were invited to take part in the experiment using a form which was enclosed in the paper questionnaire. Questions asked were for willingness to participate, their e-mail address, and their ability to surf the Internet. The respondents were then excluded from the normal (paper) process. The responsibility for the response behaviour of those respondents was passed on to the project group.

One of the problems that can happen with the on-line-mode was that if an error occurs during the answering of the questions (for example if the respondent closes the questionnaire unintentionally), the field in the database with the primary key already has been filled. If the respondent then tries to resume answering the questionnaire, he receives the message 'key already exists'. In the problem section in the body text of the e-mail the respondent was told what to do in such a situation.

The Blaise IS server also recorded extra information like browsers and operating systems used by the respondents. Unfortunately it was not possible to link this data directly to a respondent.

Reminder
One of the advantages of e-mail is that it is very easy and cheap to send messages to the respondents. This is also true for the dispatch of reminders. The survey administration-database kept track of the responses, and with the mail merge programme it is relatively easy to send e-mails to selections of respondents based on information stored in that database. With the statistical department a date for sending the reminders was set (similar to the date the Statistical Department began sending their reminders).

Of course it is possible that the respondent is not able to return his answers because of technical problems. We can not expect the respondent to take the trouble of reporting those problems himself. The project group decided not to send a second e-mail-reminder, but to actually call the respondent to see whether he was experiencing problems with sending the data. In this way we had an extra source of information regarding the used method.

3. Results

3.1. Response

Response to recruitment
The sample-size of the panel of the construction-industry is 1500. 642 respondents replied to the recruitment letter of which 188 were willing and able to participate in the experiment. 149 of the 188 respondents were able to surf the Internet and 39 could only participate with the experiment via e-mail. Some 3% of the respondents who did react were able to participate but were not willing to do so. Those respondents and a small number of companies who did not send back the recruitment letter were called back and asked for the reasons why they did not want to participate. Reasons for not participating were mainly unfamiliarity with the Internet and the fact that the internet-PC was not the workplace-PC (making participating more laborious for the respondent). Other reasons were that respondents preferred the paper version because it is more 'visible' or 'tangible' and because e-mail-facilities were not available.

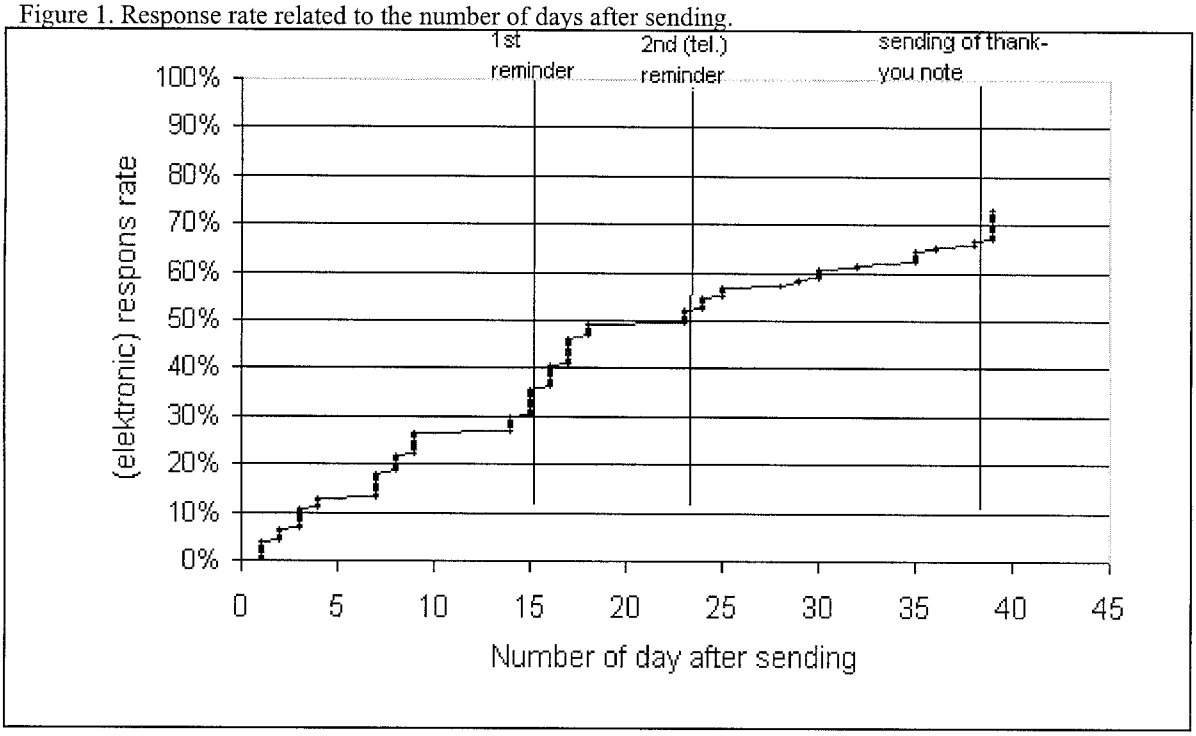
Processing of the e-mail-addresses
The e-mail-addresses were manually entered into a database. From earlier experiences we learned that this process is error prone. For this reason all e-mail-addresses where visually checked for mistakes by some experienced people. This resulted in some 40 corrected e-mail-addresses. However, one cannot make sure that all e-mail addresses are correct. Two weeks before the actual sending of the questionnaire an announcement letter was sent to all respondents by e-mail. Of those e-mails 24 were returned as a 'bad delivery'. Fortunately one can tell by the nature of the 'bad delivery' what part of the address is wrong. Either the person in front of the '@'-sign is not known (resulting in an error-message from the mail-provider) or the mail-provider is spelled wrong (e.g. hotmal.com), resulting in an error-message from the mail server from which you sent the e-mail messages in the first place.

Despite of that, the correction of the e-mail-addresses took a lot of time; error-messages had to be read, suggestions for corrections had to be made and tried out and in some cases respondents had to be called. When respondents were called, they were asked to send an e-mail to the mailbox used by the project group, so that no more mistakes were possible.

In the end 2 of the 188 respondents could not be reached by e-mail. Those respondents were sent a paper version of the questionnaire.

Response in time
The e-mails were sent to the respondents the May the 3rd. At the end of June 137 of the 186 respondents had completed the questionnaire. This response (74%) is higher than the response to the paper version at the same point in time (70%). The rate at which the electronic questionnaires were returned during those two months varied over time (figure 1). Ten days after the e-mails were sent, the response came to a standstill. After the reminder was sent (15 days after the first e-mail) the response rate climbed, but again came to a standstill after 20 days. The 25th day the reminders by telephone began, which caused a slight increase in the response. The third event that caused a climb in response was the 'thank-you' e-mail, which was sent to all participants.

Figure 1. Response rate related to the number of days after sending.



EMBED

Response per mode

As mentioned before, the e-mails were sent to the respondents in three different ways. The first way was the ASCII-version for those respondents who were not able to surf the Internet and therefore only could participate in this way. The second way was the e-mail in which the address of the on-line questionnaire was presented first and the attachment for the off-line questionnaire second, the third way being that the off-line-mode was presented first and the on-line-mode second. The group of respondents that was able to surf the Internet was split into two groups and those groups were then sent the second and third version, respectively.

Upon receiving the completed questionnaire it was possible to detect what kind of mode (off-line/ on-line) the respondent had used. We expected that the group who had received the first version (on-line before off-line) would tend to use the on-line version and vice versa. The results, however, indicated that there was no effect from the order in which the modes were presented. About the same number of respondents who had received the on-line version first used the on-line-mode as the respondents who had received the e-mail with the off-line-mode presented first. A small number of people who had trouble sending in the off-line or on-line-mode (for example because they had indicated by mistake that they could surf the Internet) were sent the ASCII-version of the questionnaire.

3.2. Browsers and operating systems.

The Blaise IS server is capable of recording what kind of operating system and browser the respondents are using. This information can be very important for the further development of the Blaise IS software. It also gives an indication whether developers can aim at users with a more sophisticated browser (for instance capable of handling Java) or still have to take into account the users of older versions of browsers.

It turned out that most respondents (70%) use MS Internet Explorer 4.0. The remaining respondents (30%) are accounted for by the Internet Explorer versions 3 and 5 and Netscape versions 3 and 4.

Regarding the operating systems the domination of Microsoft is also clear. 93% of the respondents (or to be more precise 93% of the 'hits') use either Windows 95/98 or NT. 6% of the respondents use 'other' operating systems (e.g. Mac, Linux). 1% of the users still rely on Windows 3.x.

3.3. Experiences of respondents

The first additional question asked in the questionnaire concerned the time needed to complete the questionnaire. The second was the number of people needed. The third and most important question was whether the respondent had any suggestions regarding the method used.

The time needed to complete the questionnaire turned out not to differ from the time needed to complete the paper version. The average time needed for answering the four questions was nine minutes for both the paper and the electronic version. It is possible however that it takes some time for the respondents to get used to this new electronic mode (there were even some respondents who indicated this) and that in the future this mode will be faster compared to the paper mode.

There was also not much difference in the time needed to complete the questionnaire between the three electronic modes used. People who used the on-line version were the fastest (8.8 minutes) and those who used the off-line-mode were slowest (9.1 minutes). Whether this had to do with the fact that being off-line is cheaper compared to being on-line is unknown.

The average number of people needed to fill in the electronic questionnaire was 1,32. This does not differ much from the number of staff needed for the 'paper' mode (1,30).

3.4. Suggestions from respondents

The question for suggestions resulted in highly usable suggestions from the respondents. The suggestions differed between the modes used.

The ASCII-questionnaire

The ASCII-form resulted, as expected, in reactions concerning the layout of the questionnaire. Respondents were somewhat concerned that they could easily 'edit' the body text of the questionnaire. Also people first had to press the 'reply' button before they could enter their answers which led to some confusion.

The on-line questionnaire

The on-line questionnaire also led to several suggestions. First of all respondents expected a 'form-like' layout of the questionnaire. The on-line version presents one question on each HTML-page that is sent by the Blaise IS server. Respondents expected that the electronic questionnaires would resemble the well-known order-forms that can be found throughout the Internet or some imitation of the paper questionnaire. Respondents also indicated that it took more time to complete a questionnaire in this mode compared to the paper mode. The average time needed to complete the on-line questionnaire did not support this reaction, but it is conceivable that pressing the 'submit' button and waiting for the next screen with the next question may appear to be very time-consuming.

Another remark concerned the lack of an option to make a hard copy of the questions and the answers that were filled in by the respondents. Because of the one-question-a-page approach the respondents do not have an overview of the answers given and apparently that is what they want.

Finally respondents complained about the fact that they did not know what the relevant period was for the questionnaire.

The off-line questionnaire

The suggestions regarding the off-line questionnaire mainly concerned some operational problems. Similar to the on-line questionnaire respondents could not see the month they had to report about. A very small number of respondents (3) had problems connecting to the Blaise IS server, and one respondent reported that his browser had security problems while connecting to the Blaise IS server.

Finally some people wanted to save their answers, which is not possible with the current browsers.

3.5. Problems of and with respondents

Not only the questionnaires resulted in reactions of respondents. Respondents with questions or reactions regarding the method used, sometimes contacted members of the project group by telephone.

During the phase in which respondents were called to remind them they had to return their answers they were also asked whether the respondent had experienced problems with the use of the electronic questionnaires. Those remarks were systematically registered and assessed by the members of the project group and were very useful.

The first day after sending the e-mails, respondents contacted us saying that they could not log on to the Blaise IS-server for both the off-line as well as the on-line-mode. Respondents received an 'authorisation failure' on their screen and did not get access to the Blaise IS server. Respondents were also pretty sure they had used the correct password. It became apparent that the username and password on the Blaise IS server are case-sensitive. The respondents had received their username and password in capitals and the server only accepted lowercase letters. In the reminder we informed the respondents who had not sent in the answers yet, that the username and password had to be typed in lowercase.

A small number (8) of respondents did send their off-line (HTML-) questionnaire back to us via e-mail. A problem that can occur is that when people send in an HTML-file containing fields by e-mail, they think that the fields that they send are filled with their answers. Unfortunately this is not the case. Anything a respondent enters in a field of an HTML-file is lost when it is saved or when it is sent by e-mail. So an e-mail is received from a respondent with an empty HTML-questionnaire.

It is not exactly known why HTML-files are sent in by e-mail. Basically, when a respondent hits the 'submit' button, the browser looks for the Blaise IS server and when it is found the answers are put into the database of the server. There is no intervention of or interference with any e-mail facilities. The reason of the problem might be that respondents who indicated they could 'surf the Internet' in reality were only able to send or receive e-mails. When the (Internet) browser fails to connect to the Internet the respondent may decide to send in the HTML-file using e-mail. However, the respondents we called indicated that they had not done such a thing. So the reason for this problem is not exactly known.

The name of the contact person of the company was not mentioned in the e-mail. The reason for this was that the name was not mentioned in the paper questionnaire either and not all names in the database were in a very usable format. Not mentioning the name of the contact person resulted in problems. Some e-mail-addresses are very general (although not more general as a 'real-life address'). Addresses like info@kocakola are probably read by more than one person and not all of them are qualified or willing to fill in a CBS-questionnaire. Some e-mails were returned with the question for which person this e-mail was intended. When respondents were called to remind them of the questionnaire some of them with a more general e-mail address (like info@… or sales@…) even indicated that they had never seen the e-mail.

Some respondents indicated that they had had some technical problems. Those problems mainly concerned either their Internet service provider or their own internet-infrastructure. It is obvious that a growing number of people is actively switching its uses of Internet (from a passive to a more active role) and one can not escape the fact that sending the e-mails can take place during such a transition period.

One of the main reasons why people were late in sending the answers to the questions was that the data that were asked were not yet known. The questions concerned the month of April and were of a specific nature. The questionnaires were sent May 3rd and the reminder May 17th. Respondents indicated that they did not have not the relevant data available on such a short notice. In the future it may be possible to send respondents a reminder on the date they have the requested information available (which can be based for example on response-dates from the last two months).

Telephone contact with non-respondents showed that a small number of people considered the method to be too laborious. They indicated that they wanted to receive the paper version again and that they had no interest in this way of electronic data-collection. Another reason for respondents to switch back to the paper version was that their computer-infrastructure was not ready for this way of completing questionnaires yet. In total some 13 respondents indicated that they wanted to receive a paper version of the questionnaire again instead of an electronic one.

Electronic non-response vs. paper non-response
As mentioned earlier the response of the electronic questionnaire was slightly higher compared to the paper version. There was some concern, however, that this group consisted of respondents that had a lower percentage of non-response anyway because they were intrinsically more motivated. After all, they had signed up for the experiment. Fortunately the response-percentages from the past did not indicate this. In the past this group had a response-rate after two months of 73%. This is even slightly lower than the 74% the electronic method yielded.

Operational problems
It turned out that there were very few operational problems at Statistics Netherlands. Most of the work concerned the correction of the e-mail-addresses. The processing of the incoming data also took some time, but there were no real problems while processing the data. The whole process can easily be automated after which the magical 'one press on the button' will do the job.

4. Conclusions and recommendations

This experiment aimed at four aspects of electronic data-collection with the use of Blaise IS and e-mail. Those four aspects were getting the survey to the respondent, experiences of the respondents with the web survey, response-behaviour and the handling of the incoming electronic data.

Generally speaking one can say that electronic data-collection with the use of e-mail and Blaise IS works very well. With e-mail the respondent can receive the questionnaire in a pro-active way. Respondents do not have many or serious problems with the electronic questionnaires, the response is somewhat higher and faster and the data can easily be processed (with 'one click on a button') into the database of the Statistical Department.

Nevertheless some problems became apparent and some aspects of the methodology used certainly could be improved. These aspects and problems will be assessed here and some recommendations will be made.

Getting the survey to the respondent
Originally the e-mail-addresses as entered into the system were incorrect in one-third of the cases. Entering and improving e-mail-addresses is very laborious. This can be averted by asking the respondents (on a paper questionnaire) to send an e-mail to the researchers, who then directly import this e-mail-address into the survey administration database.

The e-mail is not always delivered to the right person. E-mail-addresses such as 'info@… or sales@…' are not really suitable for getting the right e-mail to the correct person. In such cases it is advisable to merge the name of the contact person into the e-mail.

Experiences of the respondents with the electronic questionnaires
Some people made comments on the layout of the ASCII-questionnaire (as expected). People who received the ASCII-questionnaire are not able to surf the Internet, so there are limits to what can be displayed on the screen of the respondent. In the future those respondents may be sent a more sophisticated questionnaire via e-mail.

Respondents made comments on the layout of the on-line questionnaire. They expected a form-like questionnaire and because of the one-question-a-page approach it also may look like it is time-consuming.

Users of the off-line questionnaire had no comments regarding the layout. The off-line questionnaire had some operational problems however. Some of the questionnaires were sent back via e-mail, resulting in lost answers. Respondents had to be called to request for another attempt (using the on-line or ASCII-mode).

Some respondents considered the method used more laborious than the paper version. Probably this is related to the fact that not all respondents are accustomed with the use of the Internet. Especially with the smaller companies in the construction industry it is not very likely that the respondent spends a complete day behind a computer-screen. Those respondents have to get more used to the use of electronic questionnaires. Some respondents do not have an 'internet-PC' readily available on their desk and will have to go to another desk in the office, probably have to locate the person that is capable of operating the internet-PC and subsequently look for the relevant data. In such cases remarks regarding the time used are not surprising.

Response behaviour of respondents
The more contact-moments with the respondent, the higher the response. The response rose after each e-mail that was sent to the respondent. Even the message that the server would be shut down (after three months) resulted in response. Of course one does not want to saturate the respondent with e-mails, but a well-planned reminder strategy can result in higher response rates. Frequent reminders are advisable because e-mails have a tendency to 'sink down' from the screen (because more e-mails are received by the respondent and the e-mail-program can only display a limited number of e-mails).

In the reminder sent via e-mail no HTML-questionnaire or on-line-address was included. If the respondent has accidentally deleted his e-mail, he is not able to send in the answers to the questionnaire. Sending a reminder with questionnaire offers one opportunity less for non-response.

Processing the incoming data
Data from the ASCII-questionnaires had to be entered manually into a Blaise-database. From earlier experiments we know that this can be done automatically.

Technically speaking it is possible to process the data of the on-line- and off-line questionnaire with 'a single click on the button'. Both administrative and statistical data can be automatically updated. This offers great opportunities for fast and efficient data processing. No serious problems occurred regarding the integration of paper and electronic data. Administrative data for the paper and electronic mode could also be tuned very well.

To summarise, with a growing number of respondents using the Internet, data-collection via the Internet is becoming more interesting every month. Electronic data collection via the Internet offers the possibility of faster and more efficient communication with the respondent, as compared to the more traditional methods. A mixed-mode approach seems to be the best way to start collecting data via the Internet.

With Blaise IS it is possible to convert existing questionnaires into Internet questionnaires. Sending those questionnaires via e-mail as an attachment or as an internet-address offers a pro-active and relatively easy way to collect data via the Internet. Respondents do not encounter serious problems with the method used, although the on-line- and ASCII-questionnaire do not live up to the expectations of respondents, who apparently want a 'real electronic form'. Some improvements regarding addressing of the respondents can also be made. Response can be improved by sending more or better-timed reminders. The incoming data can easily be processed into the database of the Statistical Department, making a more efficient statistical process feasible.

In short, data-collection via the Internet, using Blaise IS and e-mail works very well.

5. Designing Web-based questionnaires

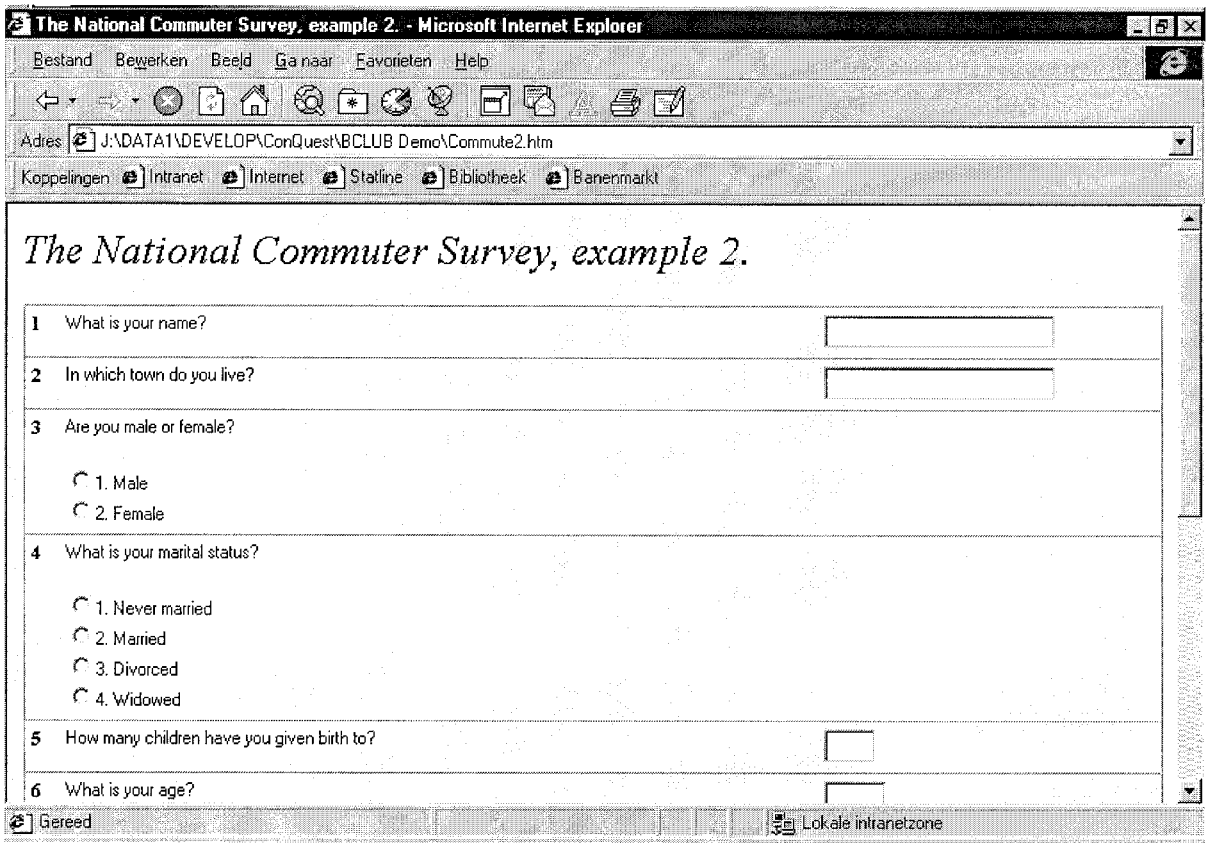
Blaise IS is a useful tool to contribute to the aim of Statistics Netherlands: a transition of paper questionnaires to self-administered electronic forms. With this first pilot we have tested the technical possibilities of Blaise IS only. Little attention was paid to the layout of the generated HTML pages and the usability. Although there is a lot of knowledge about the design principles of paper questionnaires and questionnaires for CASI (Computer Assisted Self Interviewing), these principles do not apply to CAWI (Computer Assisted Web Interviewing) automatically. In fact, there are few scientifically developed and validated design principles for Web-based questionnaires (Tedesco, Zukerberg and Nichols)[3].
In future developments of Blaise IS we have to pay much more attention to the layout of the generated HTML pages and the usability. In this second part of the paper we want to address some design and usability issues we encountered while carrying out the pilot survey:

- Presentation of a Web questionnaire.
- Navigation through the electronic form.
- The logic of the electronic form.
- Electronic form versus Internet application.

In the following discussion we define a Web survey to be a survey which is filled in with the help of an Internet browser and which uses the World Wide Web to transmit the collected data to the statistical organisation.

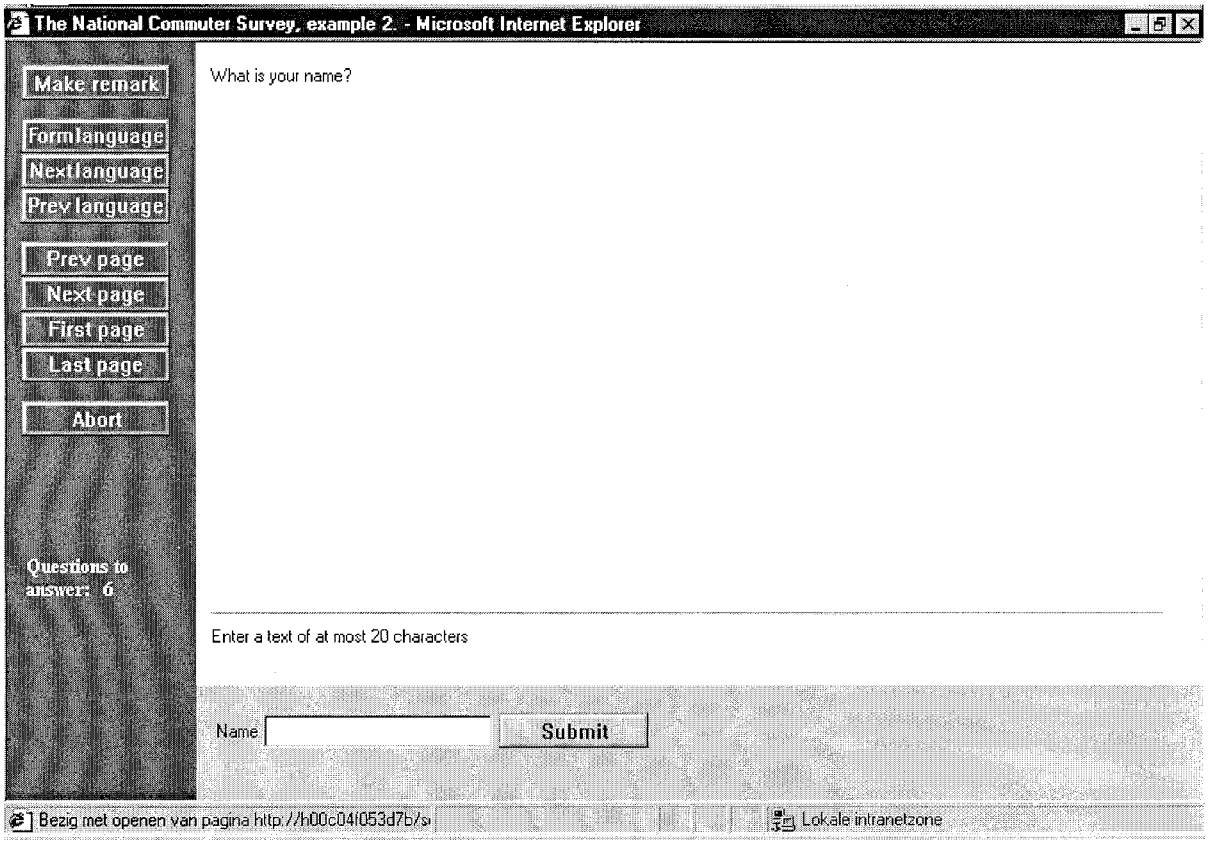
Presentation of a Web questionnaire
There are basically two different ways to present a Web survey:
- A so called 'scroll-based' form: one (HTML) page which contains the complete questionnaire; Blaise IS implements this presentation with the HTML Generator. See figure 2 for an example of a scroll-based presentation.
- A so called 'screen-based' form: sections of the questionnaire (one or more questions) are presented on the screen in a number of sequential windows; Blaise IS implements this presentation in its on-line mode (but one question per screen only). See figure 3 for an example of a screen-based presentation.

Figure 2. SEQARABICExample of a scroll-based presentation.



[3] **Heather Tedesco, Andrew L. Zuckerberg and Elizabeth Nichols** (1999), "Designing Surveys for the Next Millenium: Web-based Questionnaire Design Issues", ASC International Conference 1999

Figure 3. SEQARABICExample of screen-based presentation.



Navigation through the electronic form

Navigation through a scroll-based form is only possible by scrolling through the page. A respondent can use a pointing device or the TAB-key to navigate to a question. Respondents should not be advised to use the TAB key, because handling of the TAB- key differs for each browser and the cursor will move to hyperlinks and images also. If a questionnaire becomes large, not all of the questions are visible. In that case a respondent might get lost in the form. However, we think that if the number of questions is not too large a respondent is able to find his way in the questionnaire.

Navigation through a screen-based form is only possible with some kind of menu to access the subsequent screens with questions. Navigation within the screen should be no problem, but navigation to a next or previous screen can be a problem, especially if the respondent does not understand the function of the menu.

If we do not take into account the possibility of automatic routing it seems that using a scroll-based form should be given preference to the screen-based form. Nevertheless, if the questionnaire becomes too large navigation is difficult in both presentations. Further research is necessary to find a measurement (e.g. the number of questions) for the optimal size of a Web questionnaire.

Blaise IS supports both presentations, but the screen-based presentation supports one question per screen only. Several respondents in the pilot addressed this lack of more questions per page in the online version. It is obvious we have to pay more attention to this fact. We will return to this subject in the next paragraph.

The logic of the electronic form

We distinguish three levels of logic in an electronic form:

- The form tests the validity of the response type (alphabetic, numeric, etc) and checks whether the given answers are inside the valid domain of the questions.
- The form includes a validation mechanism to check the consistency of the form and reject inconsistent answers and it incorporates auto-filled and auto-calculated fields.
- The form contains a skip pattern where progress through the questionnaire depends on the response to previous questions, the so-called routing.

Response type and domain checks.

We think every electronic form should at least contain a domain check of the given answers. Because of the chosen technology to realise a Web questionnaire it is always possible to implement a response type and domain check using Javascript. Blaise IS meets this requirement.

Consistency checks and routing.
Applying consistency checks is highly desirable and a skip and branching pattern is an essential part of a CASI system. Strictly speaking we want the full functionality of ordinary CAI tools. But, implementing a checking and routing mechanism is very complex and the result can be a large piece of software. To use it in Web-based questionnaires it must be transparent for all computer platforms. With the current state of the technology, Java seems to be the only programming environment that meets this requirement. Whether the checking and routing mechanism resides on the server or will be transmitted to the respondent as a Java applet will in this case not be a topic for discussion anymore.
The checking and routing mechanism of Blaise IS is based on the Wintel implementation of the Blaise Data Entry Program (DEP). Consequently, it can only be executed at the server side or by installing an ordinary Blaise DEP that is enhanced with a World Wide Web transmission module at the respondent's computer when this computer is running at least Microsoft Windows 95.

Utilising routing in a scroll-based form has to be discussed. We think it is not preferable because a respondent might get lost in the form if the focus on the form changes frequently and the leaps are large. This problem can be avoided in a screen-based presentation by choosing an intelligent layout, which corresponds to the skip and branching pattern. Further usability testing must make out our proposition.

To discuss the usage of consistency checks we have to distinguish between static and dynamic checking. In our opinion dynamic checking should not be used with scroll-based forms. Again a respondent might get confused or annoyed if error messages pop up frequently while filling out the form. Furthermore a respondent might get lost in the form if correcting the errors results in jumping to a lot of fields to correct the inconsistencies. Before finishing the form the static check should be invoked automatically. However, the designer of the questionnaire should take into account that very complex consistency checks might confuse the respondent. Dynamic checking should be no problem in the screen-based presentation because this resembles almost an ordinary data entry program, which has proven its usability in practice.

Electronic form versus Internet application
When we introduce Web-based questionnaires we have to think about the backgrounds of the respondents we have in view. Are they familiar with CASI applications or did they use paper forms until now? In the latter case we think introducing Web-based questionnaires by electronic forms is preferable. Presenting a scroll-based form resembles the paper form as much as possible. When introducing Web-based applications we should proceed with caution. The presentation of a Web-based CASI application will be screen-based. A well-designed menu is necessary and the application should respond instantaneously to user actions with for example dialogs. In other words the Web-based application should not differ from an ordinary CASI application.
The Blaise IS HTML Generator generates HTML files which are electronic forms. Apart from the layout that leaves room for improvements, we think the nature of the HTML forms is sufficient to present short, not too complex, questionnaires. The on-line mode of the current Blaise IS version is only the first step in the evolution to the final goal: A Web-based application, which is a fully-fledged CASI tool.

Recapitulation
When designing Web-based questionnaires we have to consider that they can be navigated easily by end-users. Especially in the case of end-users that are survey respondents with little or no experience with computers or the Internet, a self-administered Web-based questionnaire should be designed to be both easily understood and easily completed. The above mentioned issues should be taken into account. The first version of Blaise IS mainly focused on the functionality and less focused on the usability. Besides the enhancement of the functionality, the usability of the Web-based questionnaires has to be one of the guiding principles for future developments of Blaise IS. We should not fall into the trap of utilising a new technology simply because it is new or because we want to stay at the 'cutting edge'.

ON THE USE OF XML IN THE BLAISE ENVIRONMENT

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1. Introduction

XML is the Extensible Markup Language. It was developed in 1998 to cope with a number of restrictions of HTML, the language to design Internet sites. Initially, XML may have seemed like it was all just typical software industry hype. It would be the future of all data manipulation and data transmission, and therefore be the answer to the ultimate question of life, the universe and everything.

After a few years now, it has become clear that XML is no hype. It turned out that XML is much more than a potential successor of HTML. It is used as a tool for platform independent data exchange. Moreover, XML has turned out to be very useful for describing data in a very structured way. Therefore, it is playing an increasingly important role in the world of data and meta data. Various developers in all parts of the world are working on statistical meta data systems based on XML. These developments hold as promise of more standardisation of, or at least easier interaction between these meta data systems.

This paper explores a potential role for XML in the Blaise System. It concentrates on the meta data aspects by showing how the current Cameleon tool could be replaced by a new one based on XML. Section 2 gives a general introduction into XML. It also shows how information in an XML file can be manipulated using tools like XSL (Extended Style sheet Language). Section 3 describes how XML could play a role in the Blaise environment. It describes how Cameleon can generate XML files containing question meta data. Once such an XML file is available, there are several approaches of manipulating the meta data. Examples show how XSL can be used to generate an SPSS setup and questionnaire documentation in HTML format. It is also made clear that new meta data tools can be developed in fairly simple way. This is illustrated by means of a simple example of question documentation browser.

This paper is **not** the blueprint for the future of Blaise. It is only meant to trigger some discussion about possible future developments. And it shows that XML may be an important player in this field.

2. About XML

2.1. What is XML?

XML is a markup language. A markup language defines markup rules. Markup refers to anything included in a document that adds a special meaning to it or provides extra information about it. A markup language defines a set of rules that declare what markup constitutes, and exactly what the markup means. Three types of markup can be distinguished:

- *Stylistic markup* indicates how the document is to be presented. For example, it can instruct to present text in boldface or Italics, to use a specific font, etc.
- *Structural markup* gives information about the structure of a document. For example, it can instruct a piece of text to be handled as a section heading, or a paragraph.
- *Semantic markup* gives information about the content of the data. An example is a markup that declares a piece of text to be programmer's comment that is not to be printed or displayed.

XML is just one example of a markup language. Other examples are SGML and HTML. SGML (Standardized Generalized Markup Language) was developed in the late 1960's. Its purpose was to describe markup languages, by allowing the author to provide formal definitions for each of the elements and attributes of his markup language. Therefore, SGML is a meta-language. It is a language for describing languages. At the time, SGML was one of the competing meta-languages. However, it was its offspring HTML, which caused it to become more popular than the others.

SGML is a very powerful meta-language. The price paid for this power is complexity. The language has many features that are rarely used. It is difficult to interpret a SGML document without the definition of the markup language used. This definition is kept in a *Document Type Definition* (DTD). The DTD contains all language rules. The DTD has to be sent with, or included in, the SGML document so that custom created elements can be understood. Markup languages created by SGML are called *SGML applications*.

HTML is the language used for making web sites. It was originally an SGML application. It describes how information is to be prepared for the World Wide Web. HTML is just a set of SGML rules. In the case of HTML, the DTD is stored somewhere in the browser (e.g. Netscape Navigator or Internet Explorer). As a language, HTML is only a fraction of the size of SGML, and it is easy to learn. This quickly made it very popular.

HTML uses *tags* to markup a document. Examples of these tags are:

```
<B>This text will be displayed in boldface</B>
<H1>This text is a primary heading</H1>
<P>Treat the text between these tags as a paragraph</P>
```

Although HTML is now used at a very wide scale, the language has its limitations. Two of the most important ones are:

- HTML has a fixed set of tags. It is not possible to create new tags that can be interpreted properly by others.

- HTML focuses on presentation. The tags are used to describe how information is to be displayed by the Internet browser software. The tags do not carry any information about the meaning the text they enclose.

SGML does not have the drawbacks of HTML. However, SGML is very complex. The major players in the web browser market have made it clear that they have no intention of fully supporting SGML in their browsers. This caused moves to be made to create a simplified version of SGML capable of marking up documents according to their content. This development was supported by the World Wide Web Consortium (W3C). The result was XML (Extensible Markup Language). Like SGML, XML is also a meta-language. It is not a fixed format language like HTML. Users can create their own tags, and these tags can describe content.

HTML is mainly used to describe how information is to be displayed. XML is different. It is used to describe the structure and meaning of a document. Formatting of XML documents is described in a separate document, called a *style sheet*. Because XML describes structure and meaning, an XML document can be seen as a data file, on which processing instructions can be carried out. The data can be used and re-used across different computer platforms and in different applications. Therefore XML is gaining popularity as a data storage format.

Instead of using style sheets, there are also different ways of formatting information contained in an XML document. Microsoft offers (as part of Internet Explorer version 5) a DLL file containing an interface for parsing XML documents. This DLL can be used in a Delphi, C++, or Visual Basic environment to develop dedicated applications.

Using style sheets to format the information has a number of advantages. First, different style sheets can be used on the same XML document to present the same information in different ways. Second, style sheets offer the possibility to format XML documents from different sources in the same way. Therefore, it promotes standardisation. And third, style sheets allow for easy transformation of one XML document into another.

XML has also raised interest in the statistical community, in particular in the area of meta-data. An example is the ADDSIA project, financed by the Fourth Framework of the European Union, see Bi and Murtagh (1998). XML is used in this project to described the meta-data for the statistics on economic indicators. Another example is the DDI, the Data Documentation Initiative. This is an initiative of the international social science community of researchers and archivists to develop a standard for a code book describing variables in social survey data files, see the web site *http://www.icpsr.umich.edu/DDI/codebook.html*. Another application of XML as the TADEQ project, see Bethlehem (1999) or visit the project web site *http://neon.vb.cbs.nl/rsm/tadeq*. TADEQ is a tool to document electronic questionnaires, like generated by the Blaise System. It uses XML to store the execution tree of an interview.

2.2. Tags and attributes

To develop an XML application, three or more components are required: The Document Type definition (DTD), the actual XML file containing the information to be processed, and one or more style sheets (or a dedicated software tool to parse an XML document). These components are described in some more detail using an example of a Blaise questionnaire documentation. The documentation describes the questions in a Blaise data model. The data model has a name and a descriptive text. Each question has a name and a text. Furthermore, the position of the question in the data file is documented. For each different question type (open, closed, numeric), the relevant information is recorded. The XML file for this example could look like displayed in figure 2.2.1.

Figure 2.2.1. An example of an XML file

```
<?xml version="1.0"?>
<!DOCTYPE DataModel SYSTEM "blaise.dtd">
<!-- ?xml-stylesheet type="text/xsl" href="blaise1.xsl" ?-->
<DataModel>
  <ModelName>Commut</ModelName>
  <ModelText>The Commuting Survey</ModelText>
  <Question Qname="Name">
    <Qtext>What is your name?</Qtext>
    <FilePos First="1" Last="20"/>
    <Open Length="20"/>
  </Question>
  <Question Qname="Sex">
    <Qtext>What is your sex?</Qtext>
    <FilePos First="21" Last="21"/>
    <Closed Max="1">
      <Item Code="1" Name="Male" Label="Male"/>
      <Item Code="2" Name="Female" Label="Female"/>
    </Closed>
  </Question>
  <Question Qname="Age">
    <Qtext>What is your age (in years)?</Qtext>
    <FilePos First="22" Last="24"/>
    <Numeric Min="0" Max="120" Dec="0"/>
  </Question>
  <Question Qname="MarStat">
    <Qtext>What is your marital status?</Qtext>
    <FilePos First="25" Last="25"/>
    <Closed Max="1">
      <Item Code="1" Name="NeverMar" Label="Never married"/>
      <Item Code="2" Name="Married" Label="Married"/>
      <Item Code="3" Name="Divorced" Label="Divorced"/>
      <Item Code="4" Name="Widowed" Label="Widowed"/>
    </Closed>
  </Question>
</DataModel>
```

Information is enclosed in *tags*. Tags always come in pairs in XML. There is an opening tag and a closing tag. The name of the closing tag is equal to the opening tag, but with a slash added to it. See for example the tags <ModelName> and </ModelName> in the example above. There is an exception to this rule. If a tag pair never encloses any text, one tag may be used, and the tag name should end with a slash. Examples are <Open> and <Numeric> in the example above.
Tags can have so-called *attributes*. These are parameter values included in the opening tag. In the example above, the <Question> tag has one attribute Qname, and <FilePos> tag has two attributes First and Last.
Attributes are a different way of attaching specific values to an element. There is no simple rule about whether information should be specified as the value of an attribute or as text between an opening and closing tag. It is up to the developer of the XML application whether to use tags or attributes for defining structure. For short parameter values, attributes might be preferred. It improves readability of the XML document. Attributes also allow for defining default values of parameters. And if the data consists of nested elements, there is no other way than to used nested tags with information.
The tags <DataModel> and </Datamodel> mark the begin and end of the data model definition. The data model description can be found between the tags <ModelText> and </Modeltext>. This example contains the documentation of four questions. A question definition starts with <Question> and ends with </Question>. The first question is a closed question. The name of the question (LastWeek) can be found as the value of the attribute Qname of the <Question> tag. The <FilePos> tag contains the position of the values of this question in the data file. For closed questions, there is a <Closed> tag, and it contains a arbitrary number of <Item> tags. Each <Item> tag describes a possible answer.
The second question in the example is an open question. Its definition contains an <open> tag with the attribute Length to indicate the maximum length of the answer.
The fourth question is a numeric question. The <numeric> tag contains attributes for the lower and upper bound, and for the number of decimals.

2.3. Document Type Definitions

XML can be used to define two types of documents. They are called well-formed documents and valid documents. A document is called *well- formed* if it satisfies three conditions:

- The document contains at least one element. An *element* is a pair of tags (open and closing tag) enclosing some information;

- The document must contain a *root element*. This is a unique open and closing tag that surrounds the whole document;
- All other elements in the document must be *nested*. There may be no overlap between elements.

The XML-example in the previous subsection satisfies these three conditions.
An XML document is called *valid* if it not only is a well-formed document, but it also has a Document Type Definition (DTD) the document conforms to. This means the document can only contain elements defined by the DTD, and also these elements can only be used in the order defined by the DTD.
It is possible to use XML documents without a DTD, but having a DTD has some advantages. One is that it allows for a document to be parsed and checked, so that errors in the XML file can be detected.
A DTD is a pre-defined structure against which instances of documents can be checked. The DTD was introduced in version 1.0 of XML. Later versions of XML also suggest other ways of defining structure. On is called XML Schema. Here we focus on the use of the DTD. Figure 2.3.1 contains an example of how the DTD for the Blaise question documentation application could look like. Note that this DTD is far from complete because not all the basic field types are covered.

Figure 2.3.1. The Data Type Definition for Blaise

```
<!-- Blaise Data Type Definition - version 1.0 -->

<!ELEMENT DataModel (ModelName, ModelText?, Question+) >
<!ELEMENT ModelName (#PCDATA) >
<!ELEMENT ModelText (#PCDATA) >

<!ELEMENT Question (Qtext, FilePos, (Open | Closed | Numeric)) >
<!ATTLIST Question Qname CDATA #REQUIRED >

<!ELEMENT Qtext (#PCDATA) >

<!ELEMENT FilePos EMPTY >
<!ATTLIST FilePos First CDATA #REQUIRED >
<!ATTLIST FilePos Last CDATA #REQUIRED >

<!ELEMENT Open EMPTY >
<!ATTLIST Open Length CDATA #REQUIRED >

<!ELEMENT Closed (Item+) >
<!ATTLIST Closed Max CDATA #REQUIRED >

<!ELEMENT Item EMPTY >
<!ATTLIST Item Code CDATA #REQUIRED >
<!ATTLIST Item Name CDATA #REQUIRED >
<!ATTLIST Item Label CDATA #IMPLIED >

<!ELEMENT Numeric EMPTY >
<!ATTLIST Numeric Min CDATA #REQUIRED >
<!ATTLIST Numeric Max CDATA #REQUIRED >
<!ATTLIST Numeric Dec CDATA #REQUIRED >
```

The DTD defines for each element what can be put between the corresponding brackets. For example, between the <DataModel> tags one must put one <ModelName> element, followed by an optional <ModelText> element, and one or more <Question> elements. A "+" means that an element must be included one or more times. The "|" between open and closed and between closed and numeric means that a choice must be made between these three elements. The reserved word #PCDATA indicates parseble character data, i.e. plain text. So between <ModelText> tags only character data can appear, and no other elements.
The attribute parameters are described by <!ATTLIST>. The two attribute parameters code and name of <Item> must always be specified, and the parameter Label is optional.

2.4. Style sheets

The Document Type Definition defines the structure of the data, but not how they are to be displayed. This is handled by so-called *style sheets*. A style sheet is a set of rules that declare how a document should be displayed. Style sheets have a number of advantages:

- Since structure declarations are separated from style declarations, the readability of the documents is improved;
- Using different style sheets, it is possible to the display the same document in different ways;
- Using the same style sheet for different documents, it is possible to change the appearance of all these documents by simply changing one style sheet.

Currently, there are several style sheet approaches with respect to XML, the two most important being CSS (*Cascading Style Sheets*) and XSL (*Extensible Style sheet Language*). The specifications of these two languages are by no means fixed yet. They are still under development. CSS has limited possibilities. It is only possible to affect the layout of the document text (font, bold, italic, underline, etc). XSL has more possibilities for influencing layout and adding other text elements.
Figure 2.4.1 contains an example of an XSL style sheet that works with the Blaise question documentation example.
Note that the XSL style sheet is an XML application in itself. The XSL instructions in the example generate an HTML page. All tags starting with xsl: denote special XSL instructions. For example, <xsl:for-each select="//Question" > searches the XML file for each occurence of the <Question> tag. And the instruction <xsl:value-of select="Qtext"/> displays the text between the <Qtext> tags.

Figure 2.4.1. An XSL style sheet

```
<?xml version="1.0"?>
<xsl:stylesheet xmlns:xsl="http://www.w3.org/TR/WD-xsl">
<xsl:template match="/">
<HTML>
<BODY>
<H1><xsl:value-of select="DataModel/ModelName"/></H1>
<H2><xsl:value-of select="DataModel/ModelText"/></H2>

<xsl:for-each select="//Question" >
<TABLE BORDER="1" WIDTH="80%">
<TR><TD><B><xsl:value-of select="@Qname" /></B></TD></TR>
<TR><TD><xsl:value-of select="Qtext" /></TD></TR>
<xsl:choose>
<xsl:when match="Question[Closed]">
<TR><TD>Closed question</TD></TR>
</xsl:when>
<xsl:when match="Question[Open]">
<TR><TD>Open question</TD></TR>
</xsl:when>
<xsl:when match="Question[Numeric]">
<TR><TD>Numeric question</TD></TR>
</xsl:when>
</xsl:choose>
</TABLE>
<P/>
</xsl:for-each>
</BODY>
</HTML>
</xsl:template>
</xsl:stylesheet>
```

The file contains a combination of XML tags and HTML tags, and this makes it a proper XML document. However, note that HTML is somewhat sloppy in the use of tags, and XML is stricter. XML requires a closing tag to be present for each opening tag. Therefore, for each <TD> tag there must be a </TD> tag, which is not required in HTML. Also, empty tags, like <P> must have terminating slash. This is the reason why figure 2.4.1 contains <P/> instead of <P>.
When the XML file is loaded in the browser (Internet Explorer 5) using this style sheet, an HTML page like in figure 2.4.2 is displayed.
Note that this is only a very simple HTML page. Much more useful and effective HTML output could be generated by making use of all the interesting functions that HTML has. One example could be the inclusion of hyperlinks to offer the possibility to jump to other parts of the documentation, or the other documentation.
There are many books on the market, on more and more are published each day. For this paper, Morrison et al. (2000) and Boumphrey et al. (1998). The XML support implemented in Internet Explorer 5 is well documented in Homer (1999).

Figure 2.4.2. An HTML page generated by an XSL style sheet

Commut
The Commuting Survey

Name		FirstPos: 1	LastPos: 20
What is your name?			
Open question			Len: 20

Sex		FirstPos: 21	LastPos: 21
What is your sex?			
Closed question			
1	Male	Male	
2	Female	Female	

Age		FirstPos: 22	LastPos: 24
What is your age (in years)?			
Numeric question	Min: 0	Max: 120	Dec: 0

MarStat		FirstPos: 25	LastPos: 25
What is your marital status?			
Closed question			
1	NeverMar	Never married	
2	Married	Married	
3	Divorced	Divorced	
4	Widowed	Widowed	

3. Use of XML in Blaise
3.1. Languages for meta-data

Blaise was originally designed as a system for capturing interview data. In later versions it developed into an integrated survey processing system. Vital for Blaise is the Blaise language to document meta data in the data model. Blaise also uses a few other languages to manipulate data and meta data. One example is the language used to define Manipula setups. It resembles the Blaise language, but is not completely identical to it. Another example is the language used in the tool Cameleon. Cameleon takes Blaise meta data as input, and produces a description of this meta data in another format. A typical example is a setup file for the statistical package SPSS.

Cameleon meta data transformations are based on instruction files, or so-called Cameleon Scripts. Cameleon uses a dedicated language for defining scripts. An example of such a script can be found in appendix A. This is a script to transform Blaise meta data into an XML file.

Taking into account the growing popularity of XML, one can think of two approaches to consider XML as a means to manipulate Blaise meta data. One is to completely replace the Cameleon Script Language. This may be an option for the long run. Another approach is to offer a Cameleon Script that translates Blaise meta data into an XML file. Then the user has at his disposal all new possibilities for using XML without losing the current functionality of Cameleon. This paper explores the second approach.

3.2. A Cameleon Script for XML

Appendix A contains a Cameleon Script that translates a Blaise meta data file into an XML file. This script is somewhat simplified because it does not cover everything one may encounter in a Blaise data model. Still, it serves its purpose by showing how not too complex Blaise data models can be translated in a fairly straightforward way.

We illustrate our approach by using a very simple Blaise data model. It only has four questions of three different types. The data model is presented in figure 3.2.1.

When the meta data file of this data model is processed by the Cameleon XML Script an XML file is generated. The content of this file is displayed in figure 3.2.2. Note that this figure contains the same information as figure 2.2.1.

Once an XML file is available, it can be used to transform Blaise meta data into a format which can be read by other software. In the following subsections we describe various approaches. Only two transformations are considered: From Blaise into HTML question documentation, and from Blaise into an SPSS setup. Subsection 3.3 shows how to use XSL style sheets from within an HTML environment, and subsection 3.4 describes how the same thing can be accomplished using a simple Visual Basic tool. Subsection 3.5 shows how the XML parser available in Internet Explorer 5 can be included in a dedicated software tool for processing XML information without using style sheets.

Figure 3.2.1. The Blaise data model

```
DATAMODEL Commut "The Commuting Survey"

FIELDS
  Name     "What is your name?": STRING[20]
  Sex      "What is your sex?": (Male, Female)
  Age      "What is your age (in years)?": 0..120
  MarStat  "What is your marital status?":
           (NeverMar   "Never married",
            Married    "Married",
            Divorced   "Divorced",
            Widowed    "Widowed")
 RULES
   Name Sex Age MarStat

ENDMODEL
```

Figure 3.2.2. The XML file

```
<?xml version="1.0"?>
<!DOCTYPE DataModel SYSTEM "blaise.dtd">
<!-- ?xml-stylesheet type="text/xsl" href="blaise1.xsl" ?-->
<DataModel>
  <ModelName>Commut</ModelName>
  <ModelText>The Commuting Survey</ModelText>
  <Question Qname="Name">
    <Qtext>What is your name?</Qtext>
    <FilePos First="1" Last="20"/>
    <Open Length="20"/>
  </Question>
  <Question Qname="Sex">
    <Qtext>What is your sex?</Qtext>
    <FilePos First="21" Last="21"/>
    <Closed Max="1">
      <Item Code="1" Name="Male" Label="Male"/>
      <Item Code="2" Name="Female" Label="Female"/>
    </Closed>
  </Question>
  <Question Qname="Age">
    <Qtext>What is your age (in years)?</Qtext>
    <FilePos First="22" Last="24"/>
    <Numeric Min="0" Max="120" Dec="0"/>
  </Question>
  <Question Qname="MarStat">
    <Qtext>What is your marital status?</Qtext>
    <FilePos First="25" Last="25"/>
    <Closed Max="1">
      <Item Code="1" Name="NeverMar" Label="Never married"/>
      <Item Code="2" Name="Married" Label="Married"/>
      <Item Code="3" Name="Divorced" Label="Divorced"/>
      <Item Code="4" Name="Widowed" Label="Widowed"/>
    </Closed>
  </Question>
</DataModel>
```

3.3. Using style sheets in an HTML environment

An XML application has a tree structure. The tags represent the nodes of the tree. Tags that are nested in other tags represent branches of the tree. In principle, an XSL style sheet does nothing more than transforming this tree structure into another tree structure. The XSL instructions describe which nodes are transformed and how they are transformed.

An example of how XSL can transform XML into HTML was already given in section 2, see figure 2.4.1. The resulting HTML file for the Blaise example can be found in figure 2.4.2.

The transformation into an SPSS setup is somewhat more complex. The XSL file for this is given in figure 3.3.1. To create the setup file, three runs have to be made through the XML file: one to create the DATALIST section, one to create the VAR LABELS section, and one to create the VALUE LABELS section. The <xsl:for-each> instruction implements these loops. It locates each occurrence of the <Question> tag. In the first loop, the values of the attribute Qname of the <Question> tag and the values of the attributes First and Last of the <FilePos> tag are retrieved. In the second loop, the values of the attribute Qname of the <Question> tag and of the <Qtext> tag are retrieved.

The third loop is somewhat more complex. Only information on closed questions is retrieved. This is accomplished by searching for the pattern '//Question[Closed]' . Note that there is another loop nested within the loop. With the instruction <xsl:for-each select="Closed/Item" > all <Item> tags are located within each <Closed> tag, and from the <Item> tags the values of the Code and Label attributes are retrieved.

Note that the last item in the item loop gets a different treatment. This is necessary because for the last value in the VALUE LABELS labels list different output must be generated. This is accomplished by using the tags <xsl:when match="Item[end()]"> and <xsl:otherwise>.

Because blanks in XSL files are ignored, a simple JavaScript function is used to include blanks in the output. The <xsl:script> instruction is used to define this function, and the <xsl:eval> instruction makes it possible to execute it.

Figure 3.3.1. A style sheet for an SPSS setup

```
<?xml version="1.0"?>
<xsl:stylesheet xmlns:xsl="http://www.w3.org/TR/WD-xsl">
<xsl:script language="javascript">
function B(N)
{ var T="                    "
  return T.substring(0, N)
}
</xsl:script>
<xsl:template match="/">

TITLE '<xsl:value-of select="DataModel/ModelText"/>'.
DATALIST FILE='<xsl:value-of select="DataModel/ModelName"/>.asc' /
<xsl:for-each select="//Question" >
<xsl:eval language="javascript">B(3)</xsl:eval>
<xsl:value-of select="@Qname" />
<xsl:eval language="javascript">B(1)</xsl:eval>
<xsl:value-of select="FilePos/@First" />-
<xsl:value-of select="FilePos/@Last" />
</xsl:for-each>
<xsl:eval language="javascript">B(3)</xsl:eval>.

VAR LABELS
<xsl:for-each select="//Question" >
<xsl:eval language="javascript">B(3)</xsl:eval>
<xsl:value-of select="@Qname" />
<xsl:eval language="javascript">B(1)</xsl:eval>'
<xsl:value-of select="Qtext" />'
</xsl:for-each>
<xsl:eval language="javascript">B(3)</xsl:eval>.

VALUE LABELS
<xsl:for-each select="//Question[Closed]" >
<xsl:eval language="javascript">B(3)</xsl:eval>
<xsl:value-of select="@Qname" />
<xsl:for-each select="Closed/Item" >
<xsl:choose>
<xsl:when match="Item[end()]">
<xsl:eval language="javascript">B(6)</xsl:eval>
<xsl:value-of select="@Code" />
<xsl:eval language="javascript">B(1)</xsl:eval>'
<xsl:value-of select="@Label" />'/
</xsl:when>
<xsl:otherwise>
```

```
<xsl:eval language="javascript">B(6)</xsl:eval>
<xsl:value-of select="@Code" />
<xsl:eval language="javascript">B(1)</xsl:eval>'
<xsl:value-of select="@Label" />'
</xsl:otherwise>
</xsl:choose>
</xsl:for-each>
</xsl:for-each>
<xsl:eval language="javascript">B(3)</xsl:eval>.

SAVE /OUTFILE '<xsl:value-of select="DataModel/ModelName"/>.sav'.
</xsl:template>
</xsl:stylesheet>
```

The result of applying the XSL style sheet to the XML file of the Blaise example can be found in figure 3.3.2.

Figure 3.3.2. SPSS setup generated by the XSL style sheet

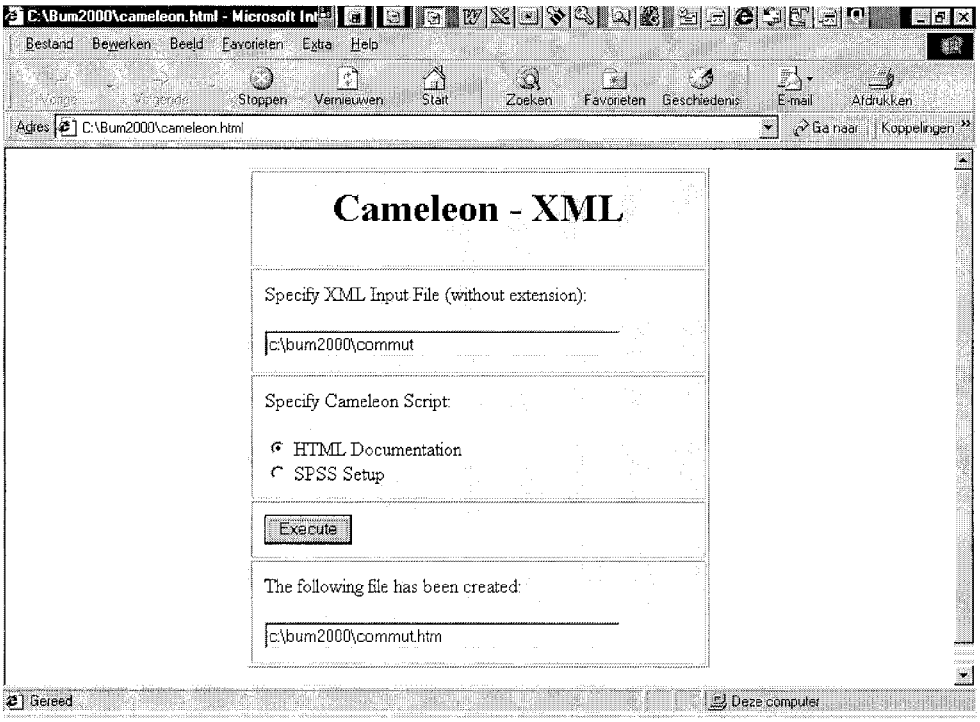
```
TITLE 'The Commuting Survey'.

DATALIST FILE='Commut.asc' /
  Name 1-20
  Sex 21-21
  Age 22-24
  MarStat 25-25
  .

VAR LABELS
  Name 'What is your name?'
  Sex 'What is your sex?'
  Age 'What is your age (in years)?'
  MarStat 'What is your marital status?'
  .

VALUE LABELS
  Sex
    1 'Male'
    2 'Female'/
  MarStat
    1 'Never married'
    2 'Married'
    3 'Divorced'
    4 'Widowed'/
  .

SAVE /OUTFILE 'Commut.sav'.
```

It is rather simple to implement this kind of conversion tool in an HTML environment. Appendix E contains an example of how this can be done. The main part of the work is done by a JavaScript function Transform(). The following fragment contains the core of this function.

```
InFile = document.Form1.InputFile.value + ".xml"
XmlFile = new ActiveXObject('microsoft.XMLDOM')
XmlFile.load(InFile)
XslFile = new ActiveXObject('microsoft.XMLDOM')
XslFile.load(ScrFile)
Output = xmlFile.transformNode(xslFile)
Fso = new ActiveXObject("Scripting.FileSystemObject")
OutFile = fso.CreateTextFile(OutFile, true)
OutFile.Write(output)
OutFile.Close()
```

The first three lines read the XML file. The first line assigns the name of the file as specified by the user on the HTML page to the variable inFile. The second line creates an new XML object. Note that this only works in a browser supporting XML, like Internet Explorer 5. And in the third line the XML file is loaded into the XML object.
The second two lines create another XML object. This time it is used to load the XSL style sheet file as specified in the variable ScrFile. Line six does the transformation. It creates a new XML object Output by transforming the original object and using the XSL instructions. The final lines of this JavaScript fragment see to it that the transformed object is written to file.
When the HTML file of appendix E is loaded into the browser Internet Explorer 5, it will look like in figure 3.3.

Figure 3.3.3. The HTML version of Cameleon



This simple prototype only offers two transformation possibilities: HTML question documentation and an SPSS setup. Of course, it can easily be expanded to include more types of transformations.

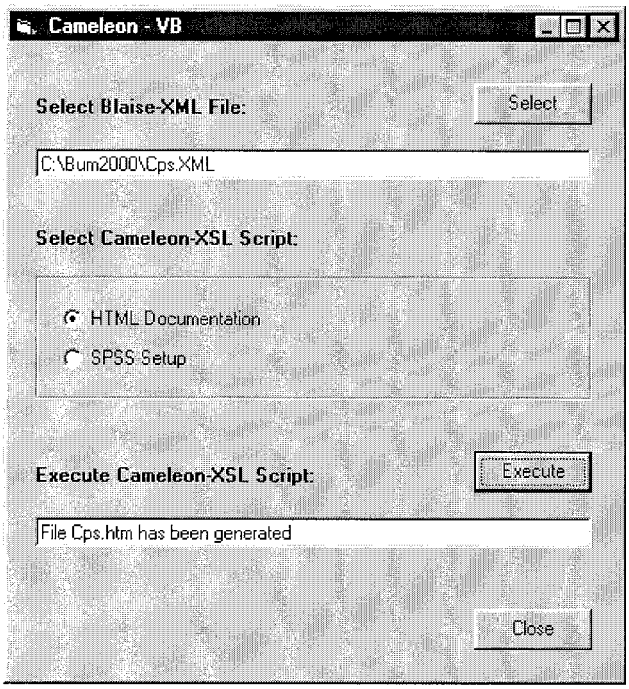
3.4. Using style sheets in a Visual Basic Environment

Implementing a tool like Cameleon in an HTML environment has its limitations. If this is a concern, one can consider implementing it in a real programming language environment. This is illustrated by means of a simple Visual Basic program. The complete code of this program can be found in appendix F. The XML support offered by Internet Explorer 5 is available in a DLL file (MSXML.DLL). This file can be referenced to from within Visual Basic (or other programming languages, like Delphi or C++).
The statement that does most of the work of the VB version of Cameleon is:

```
outDoc = xmlDoc.transformNode(xslDoc)
```

It transforms the XML object in the variable xmlDoc into a new XML object outDoc using the XSL instructions in the XML object xslDoc. The rest of the program code is concerned with the user interface. When this program is run, it looks like in figure 3.4.1.

Figure 3.4.1. The Visual Basic version of Cameleon



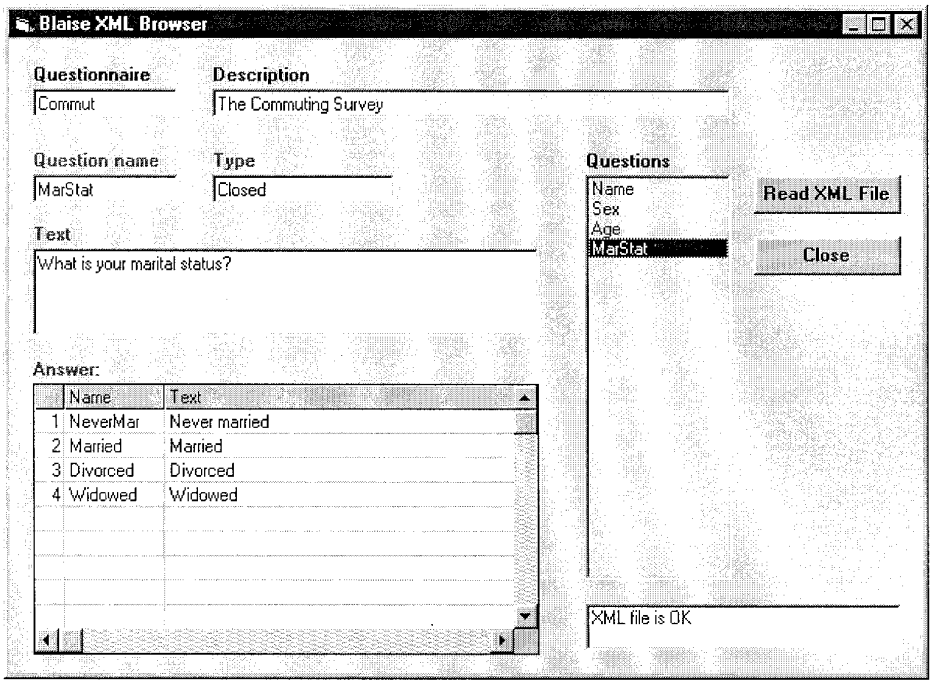
Also here it should be noted this is just a very simple example of a Visual Basic application. It can be extended at wish.

3.5. Parsing the XML tree with a dedicated program

The previous two sections used XSL style sheets to transform the meta data in the Blaise XML into a different format. This approach has the advantage that only XSL knowledge is required for a user to modify existing Cameleon Scripts or to create new ones. The XSL instruction language is reasonably powerful but has its limitations. For example, the result of an XSL transformation is always an XML tree. This prohibits, for example, the implementation of more interactive meta data applications.

There is a different approach possible that does not make use of XSL style sheets. As was mentioned in the previous subsection, it is easy in a programming environment to get access the XML parser that is part of Internet Explorer 5. This parser contains a lot of functions that allow a programmer to process the XML tree in a self-defined way. This approach is illustrated by describing a Visual Basic application that offers an interactive question documentation browser. The complete could of this application can be found in appendix G. When executed this Visual Basic program looks like in figure 3.5.1.

Figure 3.5.1. An interactive question browser



The XML parser sees each tag as an element of the XML tree. Furthermore, the text between an opening and closing tag is considered to be a child element of the tag element.
The XML parser makes available the routine getElementsByTagName to create a list of references to tags with a specified name. The elements in the list are denoted by Item(0), Item(1), etc. So, with the Visual Basic statement

```
Set e = xmlDoc.getElementByTagName("ModelName").Item(0)
```

a reference is obtained to the first occurence of the tag <ModelName>. And the subsequent statement

```
e.firstChild.nodeValue
```

retrieves the value of the first child of the tag <ModelName>, and this is the text between <ModelName> and </ModelName>.
As another example, the list of question names on the right-hand side of the screen in figure 3.5.1 is created with the statements

```
Qlist.Clear
Set eList = xmldoc.getElementsByTagName("Question")
n = eList.length
I = 0
Do While I < n
  Set e = eList.Item(I)
  Set ec = e.attributes.getNamedItem("Qname")
  QList.AddItem ec.firstChild.nodeValue
  I = I + 1
Loop
```

The object eList contains a list of references to all <Question> tags. This list is processes in a while-loop. The variable e points to the current <Question> tag, and ec to the Qname attribute. With ec.firstChild.nodeValue the attribute value (the question name is obtained).
The subroutine DispQuestion displays the characteristics of the current question. Note the somewhat complex way of obtaining the question type. With the statement

```
Set e = eList.Item(I)
```

e points to the current question tag. The first child of e is the <Qtext> tag, the second child is the <FilePos> tag, and the third child refers to the tag indicating the question type (either <Open>, <Closed> or <Numeric>. So, the statement

```
Set e = e.firstChild.nextSibling.nextSibling
```

makes e point to the tag indicating the question type. With e.nodeName the tag text (either Open, Closed or Numeric) is obtained.
Depending on the type of question, certain characteristics are displayed. Note that for a closed question, first a list of references to <Item> tags is built.
The XML parser offered by Internet Explorer has much more possibilities of processing XML file. For more details, see Homer (1999).

4. Conclusion

Support for XML is rapidly growing and more and more XML applications are developed, both inside and outside statistics. Even within the world of Official Statistics we see interesting new XML developments. A good example is the Data Documentation Initiative, which promotes documentation of survey data sets by means of XML. Traditionally, survey data set documentation is a cumbersome, boring and time-consuming activity. If computer assisted interviewing systems are able to automatically generate documentation in XML format, and data archives need documentation in XML format, then future for survey data documentation suddenly looks a lot brighter.
Some experts say XML promotes standardisation. This is only partly true, because everyone can develop its own XML application based on its own language. However, it is certainly true that it is not difficult to transform one XML application into another. XSL is the instrument that does just that. So one could definitely say that XML is the glue that ties everything together.
Is there a future for XML in Blaise? The examples in this paper show that it is not very difficult to add a Cameleon script to the Blaise system that generates XML based on a defined DTD. One step further would be to completely replace the Cameleon Script Language by XML combined with a set of XSL scripts or some other tool able of parsing the XML file.
A little bit more speculative is considering a future version of Blaise that stores its meta data itself in XML format. This may be not such a very wild idea, considering rumours that future versions of MS Word will store text in XML format, and that the next version of Mathtype, the equation editor of MS Word, will store mathematical expressions in XML.

References

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Homer, A. (1999): XML IE5, Programmer's Reference. Wrox Press Ltd, Birmingham, UK.

Morrison, M., Boumphrey, F. and Brownell, D. (2000): XML Unleashed. Sams Publishing, Indianapolis, USA.

Appendix A. Cameleon Script for an XML file

```
[VAR T: STRING]
[OUTFILE:= '.\' + METAINFOFILENAME  + '.xml']
<?xml version="1.0"?>
<!DOCTYPE DataModel SYSTEM "blaise.dtd">
<!-- ?xml-stylesheet type="text/xsl" href="blaise1.xsl" ?-->
<DataModel>
  <ModelName>[DATAMODELNAME]</ModelName>
  <ModelText>[DATAMODELTITLE]</ModelText>
[FIELDSLOOP]
  [IF TYPE = STRING OR TYPE = INTEGER OR TYPE = REAL OR
      TYPE = ENUMERATED OR TYPE = SET THEN]
    [:2]<Question Qname="[FIELDNAME]">
    [&][IF FIELDLABEL = '' THEN]
       [T:= FIELDNAME][ELSE][T:= FIELDLABEL][ENDIF]
    [:4]<Qtext>[T]</Qtext>
    [:4]<FilePos First="[FIRSTPOSITION]" Last="[LASTPOSITION]"/>
    [IF TYPE = STRING THEN]
      [:4]<Open Length="[FIELDLENGTH]"/>
    [ELSEIF TYPE = INTEGER OR TYPE = REAL THEN]
      [:4]<Numeric Min="[LOWVALUE]" Max="[HIGHVALUE]"
                Dec="[NUMBEROFDECIMALS]"/>
    [ELSEIF (TYPE = ENUMERATED) OR (TYPE = SET) THEN]
      [IF TYPE = ENUMERATED THEN]
        [:4]<Closed Max="1">
      [ELSE]
        [:4]<Closed Max="[NUMBEROFCHOICES]">
      [ENDIF]
      [ANSWERLOOP]
        [&][IF ANSWERTEXT = '' THEN]
        [T:= ANSWERNAME][ELSE][T:= ANSWERTEXT][ENDIF]
        [:6]<Item Code="[ANSWERCODE]" Name="[ANSWERNAME]"
                Label="[T]"/>
      [ENDANSWERLOOP]
      [:4]</Closed>
    [ENDIF]
    [:2]</Question>
  [ENDIF]
[ENDFIELDSLOOP]
</DataModel>
```

Appendix B. The XML Data Type Definition for Blaise

```
<!-- Blaise Data Type Definition - version 1.0 -->

<!ELEMENT DataModel (ModelName, ModelText?, Question+) >

<!ELEMENT ModelName (#PCDATA) >

<!ELEMENT ModelText (#PCDATA) >

<!ELEMENT Question (Qtext, FilePos, (Open | Closed | Numeric)) >
<!ATTLIST Question Qname CDATA #REQUIRED >

<!ELEMENT Qtext (#PCDATA) >

<!ELEMENT FilePos EMPTY >
<!ATTLIST FilePos First CDATA #REQUIRED >
<!ATTLIST FilePos Last CDATA #REQUIRED >

<!ELEMENT Open EMPTY >
<!ATTLIST Open Length CDATA #REQUIRED >

<!ELEMENT Closed (Item+) >
<!ATTLIST Closed Max CDATA #REQUIRED >

<!ELEMENT Item EMPTY >
<!ATTLIST Item Code CDATA #REQUIRED >
<!ATTLIST Item Name CDATA #REQUIRED >
<!ATTLIST Item Label CDATA #IMPLIED >

<!ELEMENT Numeric EMPTY >
<!ATTLIST Numeric Min CDATA #REQUIRED >
<!ATTLIST Numeric Max CDATA #REQUIRED >
<!ATTLIST Numeric Dec CDATA #REQUIRED >
```

Appendix C. XSL style sheet for HTML question documentation

```
<?xml version="1.0"?>
<xsl:stylesheet xmlns:xsl="http://www.w3.org/TR/WD-xsl">
<xsl:template match="/">
<HTML>
<BODY>
<H1><xsl:value-of select="DataModel/ModelName"/></H1>
<H2><xsl:value-of select="DataModel/ModelText"/></H2>

<xsl:for-each select="//Question" >
<TABLE BORDER="1" WIDTH="80%">
<TR><TD><B><xsl:value-of select="@Qname" /></B></TD></TR>
<TR><TD><xsl:value-of select="Qtext" /></TD></TR>
<xsl:choose>
<xsl:when match="Question[Closed]">
<TR><TD>Closed question</TD></TR>
</xsl:when>
<xsl:when match="Question[Open]">
<TR><TD>Open question</TD></TR>
</xsl:when>
<xsl:when match="Question[Numeric]">
<TR><TD>Numeric question</TD></TR>
</xsl:when>
</xsl:choose>
</TABLE>
<P/>
</xsl:for-each>
</BODY>
</HTML>
</xsl:template>
</xsl:stylesheet>
```

Appendix D. XSL style sheet for an SPSS setup

```
<?xml version="1.0"?>
 <xsl:stylesheet xmlns:xsl="http://www.w3.org/TR/WD-xsl">
 <xsl:script language="javascript">
 function B(N)
 { var T="                    "
   return T.substring(0, N)
 }
 </xsl:script>
 <xsl:template match="/">

 TITLE '<xsl:value-of select="DataModel/ModelText"/>'.
 DATALIST FILE='<xsl:value-of select="DataModel/ModelName"/>.asc' /
 <xsl:for-each select="//Question" >
 <xsl:eval language="javascript">B(3)</xsl:eval>
 <xsl:value-of select="@Qname" />
 <xsl:eval language="javascript">B(1)</xsl:eval>
 <xsl:value-of select="FilePos/@First" />-
 <xsl:value-of select="FilePos/@Last" />
 </xsl:for-each>
 <xsl:eval language="javascript">B(3)</xsl:eval>.

 VAR LABELS
 <xsl:for-each select="//Question" >
 <xsl:eval language="javascript">B(3)</xsl:eval>
 <xsl:value-of select="@Qname" />
 <xsl:eval language="javascript">B(1)</xsl:eval>'
 <xsl:value-of select="Qtext" />'
 </xsl:for-each>
 <xsl:eval language="javascript">B(3)</xsl:eval>.

 VALUE LABELS
 <xsl:for-each select="//Question[Closed]" >
 <xsl:eval language="javascript">B(3)</xsl:eval>
 <xsl:value-of select="@Qname" />
 <xsl:for-each select="Closed/Item" >
 <xsl:choose>
 <xsl:when match="Item[end()]">
 <xsl:eval language="javascript">B(6)</xsl:eval>
 <xsl:value-of select="@Code" />
 <xsl:eval language="javascript">B(1)</xsl:eval>'
 <xsl:value-of select="@Label" />'/
 </xsl:when>
 <xsl:otherwise>
 <xsl:eval language="javascript">B(6)</xsl:eval>
 <xsl:value-of select="@Code" />
 <xsl:eval language="javascript">B(1)</xsl:eval>'
 <xsl:value-of select="@Label" />'
 </xsl:otherwise>
 </xsl:choose>
 </xsl:for-each>
 </xsl:for-each>
 <xsl:eval language="javascript">B(3)</xsl:eval>.

 SAVE /OUTFILE '<xsl:value-of select="DataModel/ModelName"/>.sav'.
 </xsl:template>
 </xsl:stylesheet>
```

Appendix E. An HTML version of Cameleon

```
<HTML>
<HEAD>
<SCRIPT LANGUAGE="Javascript">
function Transform()
{ if (document.Form1.Script[0].checked)
  { ScrFile = "html.xsl"
    OutFile = document.Form1.InputFile.value + ".htm"
  }
  else
  { ScrFile = "spss.xsl"
    OutFile = document.Form1.InputFile.value + ".sps"
  }
  InFile = document.Form1.InputFile.value + ".xml"
  xmlFile = new ActiveXObject('microsoft.XMLDOM')
  xmlFile.load(InFile)
  xslFile = new ActiveXObject('microsoft.XMLDOM')
  xslFile.load(ScrFile)
  output = xmlFile.transformNode(xslFile)
  fso = new ActiveXObject("Scripting.FileSystemObject")
  outFile = fso.CreateTextFile(OutFile, true)
  outFile.Write(output)
  outFile.Close()
  document.Form1.Result.value = OutFile
}
</SCRIPT>
</HEAD>

<BODY>
<P>
<FORM Name="Form1">
<CENTER>
<TABLE BORDER="1" WIDTH="50%" Cellpadding="10">
  <TR><TD><H1>Cameleon - XML</H1></TD></TR>
  <TR><TD>
      Specify XML Input File (without extension):<P>
      <INPUT Type="text" Name="InputFile" Size="40">
      </TD>
  </TR>
  <TR><TD>
      Specify Cameleon Script:<P>
      <INPUT Type="radio" Name="Script" Value="HTML" Checked>
      HTML Documentation<BR>
      <INPUT Type="radio" Name="Script" Value="SPSS">
      SPSS Setup<BR>
      </TD>
  </TR>
  <TR><TD>
      <INPUT Type="button" Name="Execute" Value="Execute"
       onClick="Transform()">
      </TD>
  </TR>
  <TR><TD>
      The following file has been created:<P>
      <INPUT Type="text" Name="Result" Size="40">
      </TD>
  </TR>
</TABLE>
</CENTER>
</FORM>
<P>
</BODY>
</HTML>
```

Appendix F. Visual Basic version of Cameleon

```
Private Sub EndButton_Click()
  End
End Sub

Private Sub ExecButton_Click()
Dim OutFil As String
If xmlOpen.filename = "" Then
  Exit Sub
End If
Select Case ScriptNum
  Case 0
    xslDoc.Load ("html.xsl")
    OutFil = ShortFileName + ".htm"
  Case 1
    xslDoc.Load ("spss.xsl")
    OutFil = ShortFileName + ".sps"
End Select
outDoc = xmlDoc.transformNode(xslDoc)
Open OutFil For Output As #1
Print #1, outDoc
Close #1
Result.Text = "File " + OutFil + " has been generated"
End Sub

Private Sub Form_Load()
  Scripts(0).Value = True
  ScriptNum = 0
  Set xmlDoc = New DOMDocument
  Set xslDoc = New DOMDocument
End Sub

Private Sub Scripts_Click(Index As Integer)
  ScriptNum = Index
End Sub

Private Sub SelButton_Click()
  xmlOpen.filename = ""
  xmlOpen.ShowOpen
  If xmlOpen.filename = "" Then
     End
  End If
  xmlDoc.Load (xmlOpen.filename)
  If xmlDoc.parseError.errorCode <> 0 Then
    Result.Text = xmlDoc.parseError.reason
    Exit Sub
  End If
  Source.Text = xmlOpen.filename
  ShortFileName = xmlOpen.FileTitle
  ShortFileName = Left(ShortFileName, Len(ShortFileName) - 4)
End Sub
```

Appendix G. Interactive Question Browser in Visual Basic

```
Private Sub DispQuestion(I)
  Dim S, T As String
  Dim J, K As Integer
  Set e = eList.Item(I)
  Set ec = e.attributes.getNamedItem("Qname")
  Qname.Text = ec.firstChild.nodeValue
  Set ec = e.getElementsByTagName("Qtext").Item(0)
  QText.Text = ec.firstChild.nodeValue
  Set e = e.firstChild.nextSibling.nextSibling
  T = e.nodeName
  QType.Text = T
  Select Case T
  Case "Open"
    Grid.Visible = False
    Qanswer.Visible = True
    Set ec = e.attributes.getNamedItem("Length")
    S = "Text of atmost " + ec.firstChild.nodeValue + " characters"
    Qanswer.Text = S
  Case "Numeric"
    Grid.Visible = False
    Qanswer.Visible = True
    S = "Number between "
    Set ec = e.attributes.getNamedItem("Min")
    S = S + ec.firstChild.nodeValue + " and "
    Set ec = e.attributes.getNamedItem("Max")
    S = S + ec.firstChild.nodeValue
    Qanswer = S
  Case "Closed"
    Qanswer.Visible = False
    Grid.Visible = True
    Set iList = e.getElementsByTagName("Item")
    For K = 0 To iList.length - 1
      Grid.Row = K + 1
      Set ec = iList.Item(K)
      T = ec.attributes.getNamedItem("Code").firstChild.nodeValue
      Grid.Col = 0
      Grid.Text = T
      T = ec.attributes.getNamedItem("Name").firstChild.nodeValue
      Grid.Col = 1
      Grid.Text = T
      T = ec.attributes.getNamedItem("Label").firstChild.nodeValue
      Grid.Col = 2
      Grid.Text = T
    Next K
    For K = iList.length To 19
      Grid.Row = K + 1
      Grid.Col = 0
      Grid.Text = ""
      Grid.Col = 1
      Grid.Text = ""
      Grid.Col = 2
      Grid.Text = ""
    Next K
  End Select
End Sub

Private Sub Disp(Text As String)
  Result.AddItem Text
End Sub

Private Sub CloseButton_Click()
  End
End Sub
```

```
Private Sub Command1_Click()
    Dim I, p, n As Integer
    Set xmldoc = New DOMDocument
    Result.Clear

    xmlOpen.filename = ""
    xmlOpen.ShowOpen
    If xmlOpen.filename = "" Then
      Exit Sub
    End If

    xmldoc.Load (xmlOpen.filename)
    If xmldoc.parseError.errorCode <> 0 Then
      Result.AddItem (xmldoc.parseError.reason)
      Exit Sub
    Else
      Result.AddItem ("XML file is OK")
    End If

    QList.Clear

    Set e = xmldoc.getElementsByTagName("ModelName").Item(0)
    MName.Text = e.firstChild.nodeValue

    Set e = xmldoc.getElementsByTagName("ModelText").Item(0)
    MText.Text = e.firstChild.nodeValue

    Set eList = xmldoc.getElementsByTagName("Question")
    n = eList.length
    I = 0
    Do While I < n
      Set e = eList.Item(I)
      Set ec = e.attributes.getNamedItem("Qname")
      QList.AddItem ec.firstChild.nodeValue
      I = I + 1
    Loop
    I = 0
    DispQuestion (0)
    QList.ListIndex = 0
    QList.SetFocus
End Sub

Private Sub Form_Load()
  Grid.Rows = 21
  Grid.ColWidth(0) = 300
  Grid.ColWidth(1) = 1000
  Grid.ColWidth(2) = 8000
  Grid.Row = 0
  Grid.Col = 1
  Grid.Text = "Name"
  Grid.Col = 2
  Grid.Text = "Text"
  Grid.Visible = True
  Qanswer.Visible = True
End Sub

Private Sub QList_Click()
    DispQuestion (QList.ListIndex)
End Sub
```

The internet, Blaise and a representative panel

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30 march 2000

The internet, Blaise and a representative panel

Abstract

For 10 years CentERdata has operated a household panel that is representative for the population in the Netherlands. Recently, the production system has switched to the internet, using Blaise software. It is described how the production system works and how Blaise fits in. Adaptions had to be made to make complex page layout possible when a respondent uses a relatively simple settop box. Two examples of complex surveys are given. The first example is a large and complex financial survey that is repeated every year. The second example is a survey on product innovations which is repeated monthly.

1. Introduction

Collection of household data with electronic means has been a major development during the last 20 years. The most common tool so far is the laptop computer. Interviewers use them to enter the data in the presence of the respondent thus enbling the respondents to correct inconsistencies and statistical agencies to produce reports immediately after data collection. These CAPI (Computer Assisted Personal Interviewing) procedures nowadays are used by many governmental statistical agencies and commercial market reserach firms. With the rise of the internet, however, new ways of household data collection seem to arise: the internet interview. Respondents fill in questionnaires they find on the internet, and mail the data to the address of the data collector. With respect to this practice, several observations can be made.

1. The idea of direct electronic household data collection is not new. CentERdata has carried out such interviews already for more than 10 years, using its own communication channel. The data were collected in a 'telepanel', a panel of households who have a PC (if they don't own a PC, they may borrow from CentERdata). The households fill in a questionnaire every week.

2. Data collection over the internet takes place without interviewers. This makes the design of the questionnaire even more critical than in the case of CAPI. Extra care has to be taken that ambiguity is avoided, that the respondent has all the information he needs (a good help function), that no routing errors are made and that the respondents are motivated to give valid answers.

3. Interviewing over the internet raises the question of representativity. When a questionnaire is placed on a fixed location, waiting for respondents to pass by, there is no way of knowing what the composition of the set of respondents is. The same is true when a questionnaire is sent out to a random group of internet users. Even worse results may be obtained when from a large group of internet users a group is selected that is interested to take part in a survey. The participants to such a survey may have a specific interest in its outcomes.

4. The anarchistic character of the internet makes it possible for virtually everybody to do research on the internet. Household data collection is, however, a discipline that requires talent, training and skills. It is important that it becomes clear which firms have the necessary skills and means to succesfully execute research projects using the internet.

In this paper, we address the aspects which determine the quality of the collected data. The first aspect, selection of respondents, is discussed in section 2. Section 3 deals with executing and monitoring the production process. The technical execution of the interviewing process is the subject of section 4. The data quality is, of course, also determined by how the questionnaire is designed from a substantive point of view. Two examples are given in section 5. Section 6 concludes.

1. A controlled representative panel

CentERdata selects its panel, the CentERpanel, in such a way that the panel is a good cross section of the Dutch population. The selection procedure takes place in two steps.

1. *The recruitment interview*. This is a CATI interview among a random sample of the Dutch population. This is a short interview. Its main purpose is to determine if households are willing to take part in the CentERpanel. Respondents who do not refuse to consider taking part in the panel are moved to a database. In this database their demographic characteristics are stored. In the CATI interview the respondents are questioned, apart from demographics, about a variety of subjects including health, work, victimization and participation to cultural activities. The resulting data, including those which belong to respondents that refuse to partipate in the panel, are used as reference distributions for weighting panel members.

2. *The selection interview*. New potential panel members are selected from the data base. This selection is based on demographic characteristics. Those potential members are selected who bring the distributions of age, income, composition of the household, region, urbanisation and voting behaviour as close as possible to the corresponding population distributions.

In this process, there are three moments on which persons may refuse to participate. In the first place, a person may refuse to participate in the recruitment interview; 62% of the persons which are selected take part in the recruitment interview. At the end of the recruitment interview, respondents may indicate that they refuse to participate in the panel; 52% is willing to consider participation in the panel. Finally, when the respondents are asked to actually become a panel member, 35% of the respondents agrees. Thus, the participation rate is 0.62*0.52*35% = 11%. This may seem a small number, but with respect to the variables mentioned in 2, the panel still is forced to be representative. Moreover, we can compare distributions of the variables in the recruitment interview and the selection interview to the actual panel data. Table 1 shows that the distributions with respect to health and cultural participation are somewhat dissimilar. Of course, by weighting the data, this dissimilarity can be adjusted.

Table 1. Distributions of variables in the recuitment interview, the selection interview and in the panel

	Recruitment %	Selection %	Panel %
buy/rent dwelling			
Buy	72.8	74.1	68.7
rent	25.8	25.2	30.1
other	1.4	0.7	1.2
number of rooms in the house			
1-3 rooms	13.1	12.1	17.7
4 rooms	37.3	42.9	31.8
5 rooms	28.3	27.3	30.9
6 or more rooms	21.3	17.6	19.5
traveling time to work			
>20 minutes	40.7	52.0	49.3
<20 minutes	59.3	46.8	50.7
ill at home last 3 months			
Yes	20.9	21.3	27.0
No	79.1	78.7	73.0
chronic disease			
Yes	18.4	21.1	22.5
No	81.6	78.9	77.5
rating personal health			
1 through 5	6.0	2.9	7.3
6	6.3	5.9	10.8
7	22.6	21.7	27.5
8	40.0	46.9	36.3
9, 10	23.8	22.6	18.1
visited the cinema last year			
Yes	48.6	53.5	38.4
No	51.4	46.5	61.6
No	51.4	46.5	61.6
visited the theater last year			
Yes	31.7	38.7	45.3
Yes	31.7	38.7	45.3
No	68.3	61.3	54.7
No	68.3	61.3	54.7
victim of a burglary			
Yes	16.4	18.4	22.8
Yes	16.4	18.4	22.8
No	83.6	81.2	77.2
No	83.6	81.2	77.2
sometimes afraid at home			
Yes	8.2	8.0	7.5
Yes	8.2	8.0	7.5
No	91.8	92.0	92.5

sometimes afraid on the street			
Yes	9.5	10.8	12.2
No	90.5	89.2	87.8

1. The production process

The newly developed interview system of CentERdata uses the internet for interviewing. The respondents fill in their questionnaires using a website. This interview system makes it possible to follow the steps a respondent takes in real-time. As soon as they respond, their answer is known. The moment they encounter a problem, CentERdata is aware of it. This makes it possible to give online support during a questionnaire. CentERdata aims at a system where almost all of the problems are solved online. This system does not only save costs but is also a great step forward in supporting the respondent.

The system of weekly interviewing is more complex than one might think at first glance. Usually, each week more than one project is run. Sometimes, response is needed on questionnaires of previous weeks by those respondents who lagged behind. This requires an advanced selection system which assigns weekly the right questionnaires to the panel members. This weekly selection now is also made through the internet. The survey research division makes the selection by filling in a form on a website, thus deciding which respondent receives which questionnaires. The selection is saved in a selection database, where all the selections are stored. Some of the background information of the respondents is also stored in a database called the household database. The use of databases makes it possible to make more complex selections. Selections can for example been made on the base of response behaviour, formerly filled in questionnaires, geographical variables, income, number of children and so on. More complex selections can be made in cooperation with the system manager. All the selections (also the selection made by the survey research division on internet) are completed by using SQL-statements on the CentERdata databases.

The answers of the respondents are also stored in databases. The moment the respondent gives an answer to a questionnaire, the answer is stored in an database at CentERdata. This makes it possible to view the results of a questionnaire in real-time. These results can be published to the internet at the same time. It is possible to make a press release the weekend before the questionnaire is held. This press release should then contain a small explanation of the survey and an internet address of the place where the results can be found. CentERdata uses a dynamic way of publishing her information to the internet, so a graphical reflection of the collected data (collected so far) can be made. This way of publishing data is unique. The press or other interested parties can be made aware of the survey before the data collection has even started. They can follow in real time the results building up and use them when they are satisfied that a sufficient number of panel members has responded.

As mentioned before, CentERdata is concerned by the question of representativity. Not all respondents have an internet connection at their disposal. These respondents are provided with a so called settop box. This ‘box’ makes it possible to connect to the internet by using a telephone line, a television and a cordless keyboard. By pressing a button on this keyboard, the connection to the internet is made and the CentERdata questionnaire website appears. Some of the respondents may not even know they are connected to the internet. They are just filling in their questionnaire and after they completed their questionnaire, the settop box is shut down. There is no need to be familiar with the internet in any way to fill in a questionnaire.

2. The role of Blaise

CentERdata uses Blaise for her interviewing. The newly developed Blaise for Internet system makes it possible to make questionnaires through the internet. There are currently three options to fill in a questionnaire.

1. 1 The offline version. With this version a complete questionnaire can be made without a connection to the internet. A connection is made once, the questionnaire is loaded and the questionnaire can be made. After the questionnaire is completed, a connection to the internet is made to send the answers back.

2. The online version. By using this package, a respondent stays online with the internet. A more complex questionnaire can be made by using this version of Blaise for Internet.

3. The last version is a combination of the online and offline version. This version is cost efficient when large parts of the questionnaire are simple, but a few complex lookups or decisions have to be taken.

The HTML code the Blaise for Internet package delivers to a web browser is rather complex. CentERdata experienced a number of problems using the package on the newly bought settop boxes. For example, the Blaise for Internet package uses a version of javascript that the settop boxes couldn't understand. This problem has nothing to do with the quality of the Blaise package. The settop boxes are just not complex enough for the job. This, together with a problem concerning the identification of the respondent while filling in a questionnaire, made it necessary for CentERdata to develop a communication program in between the settop box and Blaise for Internet. The HTML code which is delivered to the communication program by Blaise for Internet is translated into HTML code which is understandable for the settop box and the information from the settop-box is made understandable for the Blaise for Internet package. Nothing was changed to the Blaise package, not by CentERdata and not by the CBS.

The layout of the questionnaire is very important to CentERdata. Our respondents are familiar with a certain layout. By the transition of the former interview system to the Blaise for Internet system, it was our goal to use a rather similar layout. The modelib editor makes it possible to design your own layout with a questionnaire. Due to the problems with the settop boxes and the communication program CentERdata had to build, all the layout elements are now handled in this program. The current layout is illustrated in the following figures

Figure 1. Layout of a SET-question

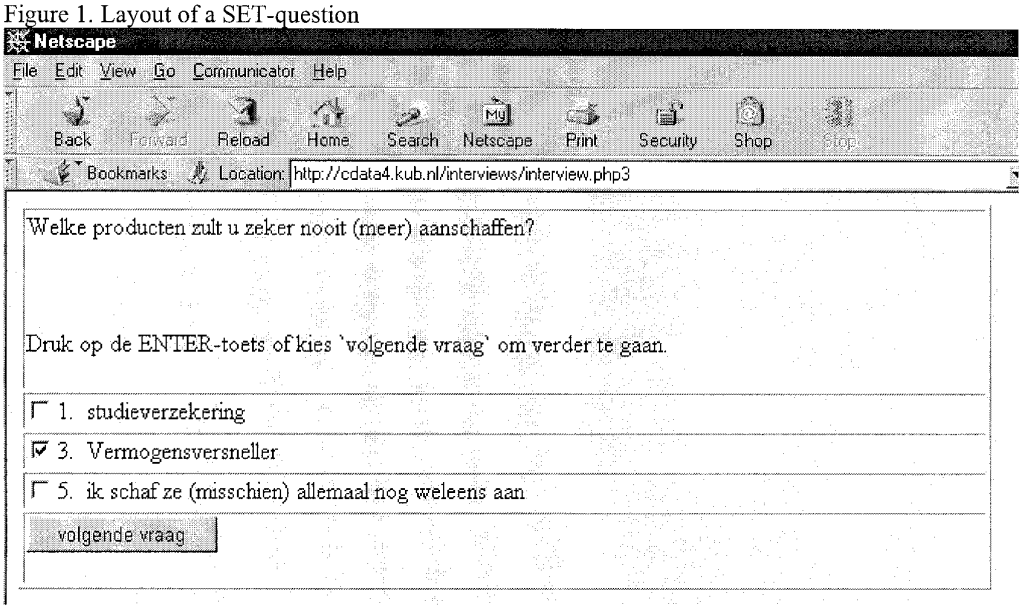
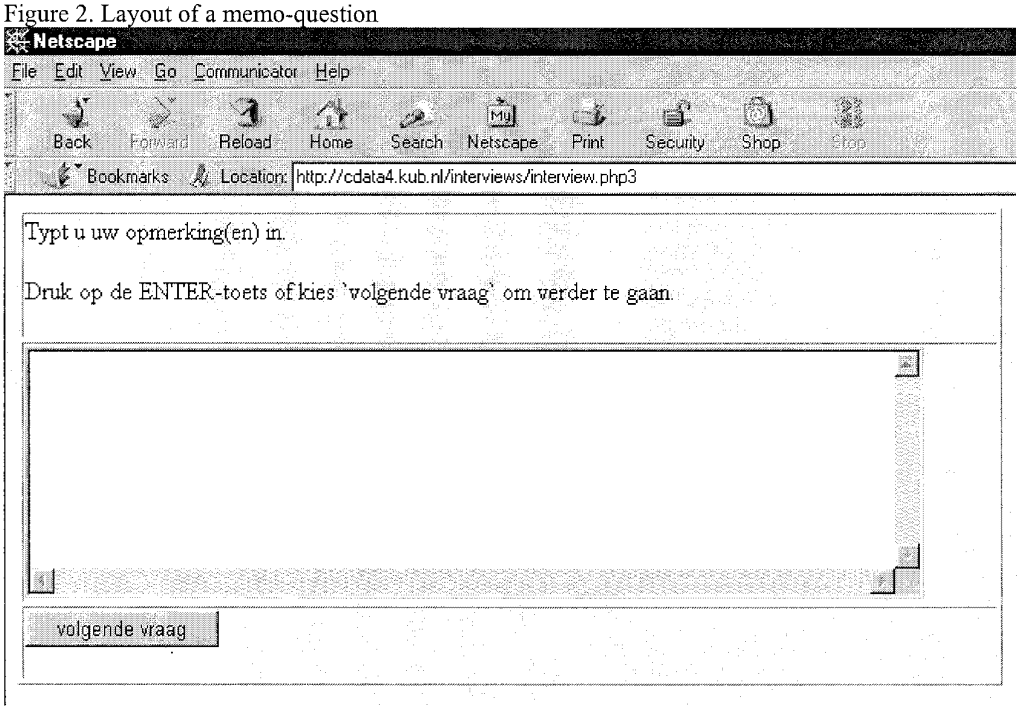


Figure 2. Layout of a memo-question



1. Two examples

5.1 The CentER Savings Survey

The CentER Savings Survey (in short: the CSS) is a panel survey that started in 1993. Each year, financial data are collected with 2000 households of the CentERpanel. The data contain information about work, pensions, accommodation, mortgages, income, assets, liabilities, health, perception of the personal financial situation, perception of risks, and much more. The data are unique because with these data it is possible to research both economic and psychological aspects of saving behavior. The CSS consists of five questionnaires:

Work and Pensions
Accommodation and Mortgages
Income and Health
Assets and Liabilities
Economic and Psychological Concepts

We will focus on the questionnaire on assets and liabilities, the most complex of these five. Assets and liabilities are measured in a very detailed way. Assets are investigated by distinguishing over 20 different asset components. Liabilities are divided into eight components (see table 2). In this questionnaire we assess the total value associated with each asset component, the (financial) institutions, the name of the product, the term, the interest rate, etc. The questions with respect to liabilities are similar.

Table 2. Overview of asset and liability components

assets	
checking accounts	put options bought
employer-sponsored savings plans	put options written
savings accounts linked to a Postbank account	call options bought
savings and deposit accounts	call options written
deposit books	real estate
savings certificates	cars
single-premium annuity insurance policies and annuities	motorbikes
savings or endowment insurance policies	boats
growth funds	caravans
mutual funds or mutual fund accounts	money lent out to family or friends
(mortgage) bonds	other assets
shares	
liabilities	
private loans	loans to family or friends
extended lines of credit	study loans
debts based on payment by installment etc.	credit card debts
debts with mail order firms etc.	debts not mentioned before

In order to improve the quality of the data collection we will pay attention to the following topics

1. the use of a help function to explain financial terms
2. providing overviews
3. using data gathered in earlier waves

5.1.1 Help function

The questionnaire on assets and liablitities contains many financial terms that require explanation to the respondents. Terms like ‘annuity insurance’, ‘single-premium insurance’, ‘endowment insurance policies’, ‘growth funds’ may not all be clear to the respondent. We use HTML anchor tags to provide the help texts. In the Bliase questionnaire we define *local variables* that we will use for *variable text fills*. The local variables contain anchor tags, so that the internet browser will show the financial term underlined, allowing the respondent to click on the financial term and get the help text. In Blaise we need the following code:

```
LOCALS
  TxtGrowthFund: STRING;
FIELDS
  Bank “With which bank or financial institution did you make the investment with your
^TxtGrowthFund?”:
    TBank
  Name “What is the name of your ^TxtGrowthFund?” : Tname;
  Value “How much was the value of the investment with your ^TxtGrowthFund on 31
December 1999?”:
    TEigth9s;
RULES
  TxtGrowthFund:= ‘<A HREF=css.php?state=help&item=‘‘growth fund’’>growth
fund</A>
  Bank
  Name
  Value
```

When filling out the questionnaire, the internet browser will display the text of the question *Bank* as: ‘*With which bank or financial institution did you make the investment with your growth fund?*’. If the respondent clicks the term ‘growth fund’ the internet browser will display the page: *css.php?state=help&item=‘growth fund’*. This page (HTML file) containing the help text is generated by PHP. The file ‘css.php’ may look as follows (we added some extra code for showing overviews which we will discuss later):

```
<?
$HelpArray = array();
```

```
$HelpArray['growth fund'] = "<B>Growth funds</B> are investment funds that do not pay
out interest or dividends, but invest their returns in the fund itself. In this way, no income tax
has to be paid on the returns.";
$HelpArray['annuity insurance'] = "By taking out <B>annuity insurance</B> the insured is



function ShowHelp($arg_item){
  global HelpArray;
  echo $HelpArray[$arg_item];
  echo "<BR><BR>\n";
  echo "<A HREF=javascript:history.back()>Return to the questionnaire</A>\n"
}

function ShowOverview(…){
  …
}

/* MAIN */
echo "<HTML>\n";
echo "<HEAD><TITLE>CentER Savings Survey</TITLE></HEAD>\n";
                    BGCOLOR=\"#D3F4E9\">\n";

switch ($state) {
  case "overview":
    ShowOverview(…);
  break;

  case "help":
    ShowHelp($item);
  break;
}
echo "</BODY>";
echo "</HTML>";
?>
```

5.1.2.Providing overviews

Filling out the questionnaire on assets and liabilities is not an easy task for a respondent. He may easily loose track of the assets that she already reported or did not yet report. It is therefore important to provide overviews. Providing overviews is desirable, but not a straightforward task in the internet version of Blaise. The usual way to construct overviews in

Blaise is to use table questions, but the table layout is not supported in the internet version. Therefore we use PHP in order to provide these overviews. In Blaise the code for a question *Check* that allows the respondent to get an overview, may look as follows:

```
FIELDS
 TableGrowthFunds: TTableGrowthFunds;

AUXFIELDS
 Check "Please click the button and check the growth funds that you reported!
        @/<FORM ACTION=css.php METHOD=post>
        @/<INPUT TYPE=hidden NAME=state VALUE= ""overview"">
        @/<INPUT TYPE=hidden NAME=asset_component VALUE= ""growth funds"">
        @/<INPUT TYPE=hidden NAME=column_header1 VALUE= ""bank"">
        @/<INPUT TYPE=hidden NAME=column_header2 VALUE= ""name"">
        @/<INPUT TYPE=hidden NAME=column_header3 VALUE= ""value"">
        @/<INPUT TYPE=hidden NAME=column1[] VALUE=
""TableGrowthFunds.Row[1].bank"">
         …
        @/<INPUT TYPE=hidden NAME=column1[] VALUE=
""TableGrowthFunds.Row[10].bank"">
        @/<INPUT TYPE=hidden NAME=column2[] VALUE=
""TableGrowthFunds.Row[1].name"">
         …
        @/<INPUT TYPE=hidden NAME=column2[] VALUE=
""TableGrowthFunds.Row[10].name"">
        @/<INPUT TYPE=hidden NAME=column3[] VALUE=
""TableGrowthFunds.Row[1].value"">

        @/<INPUT TYPE=hidden NAME=column3[] VALUE=
""TableGrowthFunds.Row[10].value"">
        @/<INPUT TYPE=submit  VALUE=Show overview>
        @/
        @/Is everything correct?": TYesNo;
```

In the internet browser the question *Check* will appear as:

Please click the button and check the growth funds that you reported!

Show overview

Is everything correct?

The action of showing the overview is laid down in the file ‘css.php’. We define the function ShowOverview as follows:

```
function ShowOverview($arg_asset_component,
   $arg_column_header1, $arg_column_header2, $arg_column_heade3,
   $arg_column1,$arg_column2 ,$arg_column3) {
  echo "These are the $arg_asset_component you reported:<BR>\n";
  echo "<TABLE>\n";
  echo "<TR><TD><B>$arg_column_header1</B></TD>”;
  echo "<TD><B>$arg_column_header2</B></TD>”;
  echo "<TD><B>$arg_column_header3</B></TD></TR>";
 $counter = 0;
 $endcounter = 0;
 while($counter < 10):
   if ($arg_column1[$counter] == ""):
   else:
     echo "<TR><TD>$arg_column1[$counter]</TD>";
     echo "<TD>$arg_column2[$counter]</TD>";
     echo "<TD>$arg_column3[$counter]</TD></TR>";
   endif;
   $counter += 1;
 endwhile;
 echo "</TABLE>\n";
 echo “<A HREF=javascript:history.back()>Return to the questionnaire</A>\n”
}
```

In the internet browser the overview of the growth funds will appear as:

These are the *growth funds* you reported:

bank	**name**	**value**
ABN-AMRO	All Dollar Bond Fund	12345
ING Bank	ING Bank Rente Groeifonds	67890

Return to the questionnaire

5.1.3. Using data that were gathered in an earlier wave.

The CSS is a panel survey where the five questonnaires are administered every year. It is our experience that the respondents do not find it easy to fill out the questionnaires. This is especially true for the questionnaire on assets and liabilities: there is a high burden in filling out all the detailed questions on all the different asset components. Things get even worse for those components that were reported earlier and have changed little (or not at all) since the last time. For those components it seems reasonable to provide the respondent with the data

that they reported earlier and ask till what extend the information changed. In order to include the previous data we read all the previous answers into the ‘external’ *PreviousData*. This is done as follows:

```
DATAMODEL Assets;
USES Assets;
PRIMARY Ident;
EXTERNALS PreviousData : Assets ('previousdata\assets'); {a local path that contains
previous data}
AUXFIELDS
  PreviousDataExists "Previous data available?" : TYesNo;
FIELDS
   Ident: TNine9s;
RULES
  Ident;
  PreviousDataExists.Keep;
  IF (Ident <>EMPTY) AND (PreviousDataExists = EMPTY) THEN
    IF PreviousData.Search(Ident) THEN
      PreviousDataExists:= yes;
      PreviousData.READ
   ELSE
      PreviousDataExists:= no;
    ENDIF
  ENDIF
  PreviousDataExists.SHOW
```

Having previous data at our disposal, we still have to decide on the amount of feedback we want to give the respondent, and on the reactions we allow the respondent to give. In the example below we provide the respondent all available information. Furthermore we allow the respondent either to change all answers, to only change the value of the growth fund, or to state that nothing has changed.

```
TYPE
  TStillOwn =
     Yes_nothing_changed  "Yes, and nothing changed",
     Yes_value_changed  "Yes,but the value changed",
     Yes_more_changed "Yes, but some properties changed",
     No "No, I don’t have it any more");
AUXFIELDS
  StillOwn   "Last time you reported a ^TxtGrowthFund called ^Name with the ^Bank, and you
reported
                  that its value was ^Value. Do you still own it?: TStillOwn;
```

```
FIELDS
  Bank "With which bank or financial institution did you make the investment with your
^TxtGrowthFund?":
    TBank
  Name "What is the name of your ^TxtGrowthFund?" : Tname;
  Value "How much was the value of the investment with your ^TxtGrowthFund on 31
December 1999?":
    TEigth9s;
RULES
  IF (PreviousDataExists=Yes)
  THEN
    Bank:= PreviousData.Bank
    Name:= PreviousData.Name
    Value:= PreviousData.Value
    StillOwn;
  ENDIF;
  IF (StillOwn=Yes_nothing_changed) OR (StillOwn=Yes_value_changed) THEN
     Bank.Show; Name.Show
  ELSEIF (StillOwn=Yes_more_Changed) OR (PreviousDataExists=no)  THEN
     Bank; Name
  ENDIF
  IF (StillOwn=Yes_nothing_changed) THEN
    Value.Show;
   ELSEIF (StillOwn IN [Yes_valueChanged, Yes_more_Changed]) OR
(PreviousDataExists=no)) THEN
    Value;
  ENDIF
```

5.2 The innovation survey

The innovation survey is an example of a set of processes which are followed on a monthly basis. Each process is the introduction of a new product to the market. Consumer behaviour is modeled in the following way. With regard to each of the products the consumer finds himself in one of the following states

0. never heard of the product
1. knows the name of the product and is able to classify the product
2. has some interest in the product (does not rule out the possibility that he may buy)
3. has knowledge of the product (and is able to compare with similar products)
4. has a positive intention to buy
5. has tried the product
6. has adopted the product (buys it on a regular basis); this does not apply to financial products
7. has rejected the product, will never buy it (again)

The flow of the meaasurement cycle is basically as follows:

- when measurements are made with respect to a new product, alle respondents start in the initial state 0 To determine whether the respondent knows a product the following question is asked

  ---

  Hear: "Below you see a list of product names. Of which of these product have you heard and do you know waht product it is? (don't click on it when you know the name but not the product type. You may click on more than one name": SET OF
  (a1 "Life Mortgage,
  a2 "Stock Mortgage",
  a3 "Combination Fund",
  a4 "Termijnkoopsompolis",
  a5 "Linear Mortgage",
  a6 "Education Insurance",
  a7 "Growth Power",
  a8 "Spavings Certificate",
  a9 "European Equity Fund",
  a10 "Clickfund",
  a11 "Saving Stocks",
  a12 "Capital Raiser",
  a13 "Pure Gold",
  a14 "Annuities Mortgage",
  a15 "Fortune Fund",
  a16 "NONE of the above");

  Some of the products are fake products; only three of them are of interest and cause follow up questions when clicked

- in each wave, the transitions from one wave to another are registered. For state 3, knowledge of the product, this question is

  ---

  Know "Do you know in what respects the Education Insurance is different from comparable products?": ARRAY [1..4] OF (no, yes)

- when a new state is entered, the respondents answers questions which are associated to this state. For state 5, trial, the following question is asked
  Buy "Is the Stock Mortgage only in your name or (also) in the name of someone else?": ARRAY[1..4] OF (a1 "only in my name", a2 "(also) in the name of someone else (spouse, family, friends)")

- for each of the products, the states in which the respondents finish the questionnaires are stored; in the next wave (usually one month later), the states are retrieved and serve as a starting point for the interview

```
USES WriteVar 'writevar';
EXTERNALS WriteFile: WriteVar('savenn');
FOR i:=1 TO 4 DO Mod1[i]:= WriteFile.Mod1[i] ENDDO;
FOR i:=1 TO 4 DO Mod2[i]:= WriteFile.Mod2[i] ENDDO;
FOR i:=1 TO 4 DO Mod3[i]:= WriteFile.Mod3[i] ENDDO;
FOR i:=1 TO 4 DO Mod4[i]:= WriteFile.Mod4[i] ENDDO;
FOR i:=1 TO 4 DO Mod4a[i]:= WriteFile.Mod4a[i] ENDDO;
FOR i:=1 TO 4 DO Mod5[i]:= WriteFile.Mod5[i] ENDDO;
FOR i:=1 TO 4 DO Mod6[i]:= WriteFile.Mod6[i] ENDDO;
FOR i:=1 TO 4 DO Mod7[i]:= WriteFile.Mod7[i] ENDDO;
FOR i:=1 TO 4 DO Mod8[i]:= WriteFile.Mod8[i] ENDDO;
```

- The states 6 and 7 serve as terminal states. When a respondent enters state 6 or 7 he will not be questioned about the product again. For financial products, state 5 replaces state 6 as terminal state.

The result of this procedure is a database in which invaluable information is stored about the course of different product innovations. It shows where problems arise in marketing, how communication in different media yields different results, which role the strengths and weaknesses of each product play and at what rates products are adopted by different target groups.

6. **Conclusion**

The combination of new the production system of CentERdata and the programming power of Blaise brings household data collection to the current internet standards, without loosing the long established scientific standards. Key ingredients are

1. a respresentative household panel
2. an interface between Blaise and HTML
3. easy database maintenance with the procedures that come with Blaise

It is to be expected that in the near future, when internet hardware is improved and new and better software is available, internet interviewing will become even more attractive, both for data collectors and respondents.

Session 4

Special Applications in Blaise

Audit Trails or How to Display Arabic Text in Blaise
Leif Bochis, Statistics Denmark

Blaise generator for High speed data entry applications
Pavle Kozjek, Statistics Slovenia

ManiTabs: Making tabulations in Ms-EXCEL with Manipula
Tjeerd Jellema

Blaise and API
Steve Anderson, ONS

Audit Trails Or How To Display Arabic Text in Blaise

Leif Bochis
Statistics Denmark

Abstract

Audit trails is a feature in Blaise 4 which is very useful for - as stated in the Developers's Guide - methodological research of questionnaires, analysis of interviewers' use of the system, debugging of Blaise code and backup/recovery.

The core of the audit trail mechanism is a sort of 'event trigger' where each kind of event causes a call to an external procedure defined in a DLL. These DLL procedures may be programmed to do exactly what may be the actual need for such an audit trail.

Because the audit trail mechanism is implemented in such a general way it allows the programmer to exploit the information from this event trigger in various ways and for various purposes.

This paper describes an example of passing information from the audit trail event trigger to an other program which in turn displays supplementary information in a separate window - in this example field texts and answer texts in Persian for a multi language survey.

Immigrant Surveys in Statistics Denmark

From autumn 1998 to summer 1999 Statistics Denmark carried out series of interviews on a number of studies of immigrants in Denmark.

The largest of the surveys was carried out in a number of steps:

1. An initial pilot study in CATI, in order to test and refine the questionnaire - carried out in October 1998.
2. A CATI survey carried out from the end of November 1998 until June 1999.
3. Supplementary CAPI interviewing in order to raise the response rate for groups difficult to catch by telephone - carried out April to June 1999.

The respondents were a sample from major immigrant nationalities to Denmark from outside Scandinavia, i.e. immigrants and descendants of immigrants from among other countries Lebanon, Iran and Vietnam.

A Blaise III solution

Some of the important questions concerned language skills of the respondents and it was decided that the respondents should be interviewed in Danish if possible, otherwise in their own language if applicable, or in English as a third alternative.

In other words, the interviewers should be able to change interview language at contact, which led to the decision to use Blaise III as the interviewing tool, because of its capability to handle a number of interviewing languages that could be changed on the fly. At the time Blaise 2.5 was the tool used by the interviewing section of Statistics Denmark, but as we had to hire interviewers capable of interviewing in

Danish as well as the relevant languages for this survey, we could start this survey just training these specific interviewers in Blaise III usage.

Blaise 4 was too young to be a realistic alternative at that time.

Because of very short time to develop the instruments, we had no time to prepare our system to use the relevant Dos codepages for the selected language, but by removing some diacritical symbols from the translated texts it was possible to include for example the languages Polish, Serbo Croatian and Somali in the list of languages available on the screen. Arabic, Farsi and Vietnamese, however, had to be read up by the CATI-interviewers from a print-out next to the screen. It was a somewhat awkward solution, but the - quite few - interviewers soon learned to translate on the fly, so the problems with this solution almost disappeared in a couple of weeks.

A possible Blaise 4 solution

At the Blaise Conference in Lillehammer (November 1998 - between the Pilot Study and Real Interviewing), I got a couple of ideas of how to do this in a more professional manner using Blaise 4 Windows. There was too short time after the conference to get a solution ready for the CATI Survey (and to get assured that Blaise 4 was mature), but still some time to get it ready for the scheduled CAPI Survey.

The main goals were :
- get the translated texts in Arabic, Farsi and Vietnamese in a machine-readable form
- get a way to display it on the screen
- get a way to make Blaise display it on the screen

Choosing Arabic Font

Arabic and Farsi are written with the Arabic alphabet - a number of fonts are available on the Internet supporting the number of codepages defined for the Arabic alphabet. The choice was a proportional Windows TrueType Font, which could be used for Arabic as well as Farsi. The chosen font also comprised the Latin alphabet (letters from A to Z).

As some of the questions referred to specific terms it was an advantage that these Danish terms could be displayed as part of the question text.

The disadvantage of the chosen font was the missing of certain characters - such as special hamza combinations.

Choosing efforts

We chose to concentrate on the Farsi questionnaire by several practical reasons.

The Arabic text was not available in a single machine-readable form, so this was dropped.

The vietnamese text was available as a Word document, but after a couple of tries, I gave up converting it to a simple text file. Besides, the Vietnamese respondents were generally well-integrated, so only few of them really needed to be interviewed in Vietnamese.

The Farsi text was available in a format which was possible to get hold of and a quite simple Pascal program could scan the source and convert the contents into a simple text file format that matched the chosen font.

Demands to the conversion program

The conversion program dealt with

- how to manage switching between left-to-right and right-to-left displaying (in some of the field texts or answer texts short explanations in Danish were inserted in the Farsi text)
- the four Arabic presentation forms (the characters are different in shape decided by the position in the word : In the beginning of the word, in the end, between other characters or alone - in Latin alphabets you can compare these presentation forms with upper case and lower case)
- how to convert from an Arabic codepage in the original file into the codepage of the chosen font

With this approach it was possible to get a print-out from the Notepad text editor using the Persian Font, which looked pretty much the same as the print-out from the Farsi word processor the translator used.

Making Blaise 4 Display Arabic Letters

In Blaise 4 it is possible to define alternative fonts to display field texts and answer texts - however: Blaise 4 source files were compatible with Blaise III source files, so Blaise 4 source files are converted to OEM when saved and converted to ANSI when read - I didn't dare to think of how to manage these conversions of text files when applied on characters not defined in the two relevant character sets - and I didn't even dream of how eventually to edit these characters!

So the solution was to use the Audit trail event trigger ...

What is the Blaise 4 Audit Trail ?

A generalized event trigger that leaves the actual event-caused actions to the user-defined functions assigned to the events.

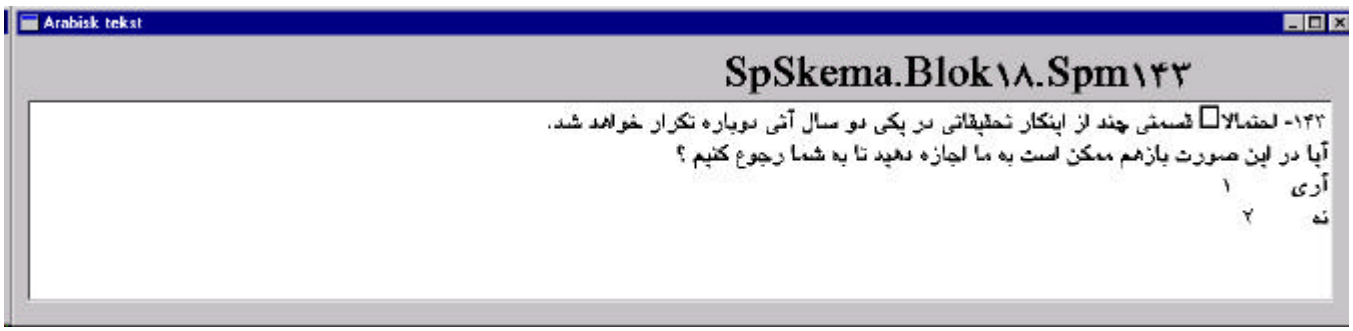
With this approach it is possible to use Delphi to design a supplementary window with a text display control. The proper events triggered causes some text to be displayed through this control.

In this study only three of the defined controls were relevant:

- AuditTrailInitialization, used to initialize the system, i.e. read the Farsi text file into the arrays.
- AuditTrailEnterField, used to display the Farsi text relevant to the proper field.
- AuditTrailFinalization, used to close down the system.

Implementation of a Supplementary Window

The supplementary window should contain a few controls where the most important should be able to display Farsi text, line by line, aligned to the right, using the chosen Persian Font.



We decided to use the built-in standard Rich Text Control. This Rich Text Control is able to display text with a chosen font, alignment, size etc. The advantage of this choice was that we didn't need to develop a tailored text display window so the actual text display control was developed in a very short time.

A text file containing the Farsi text

A few conventions for the text file was decided:

1. Every new field text was identified by a line starting with the characters ###.
2. The characters ### is followed by the full name of the field as it is delivered from the Audit Trail Event trigger *AuditEnterField.FieldName* property.
3. Following a number of lines including the Farsi text, until
4. A new line starting with ### denotes the beginning of a new field.

See example in Appendix I.

The lines of Farsi text was produced by the conversion program automatically in such a way that a text was split after 80 characters (the first space met after character no. 80 produced a line split). It was done this way in lack of a Windows control that was able to display left-directional text and manage line shifts by itself. With a maximum of slightly more than 80 characters per line the Farsi text almost filled the screen width at a 800x600 resolution, and therefore the text could be displayed quite properly by the standard Rich Text Control, using the Persian font and right-aligned.

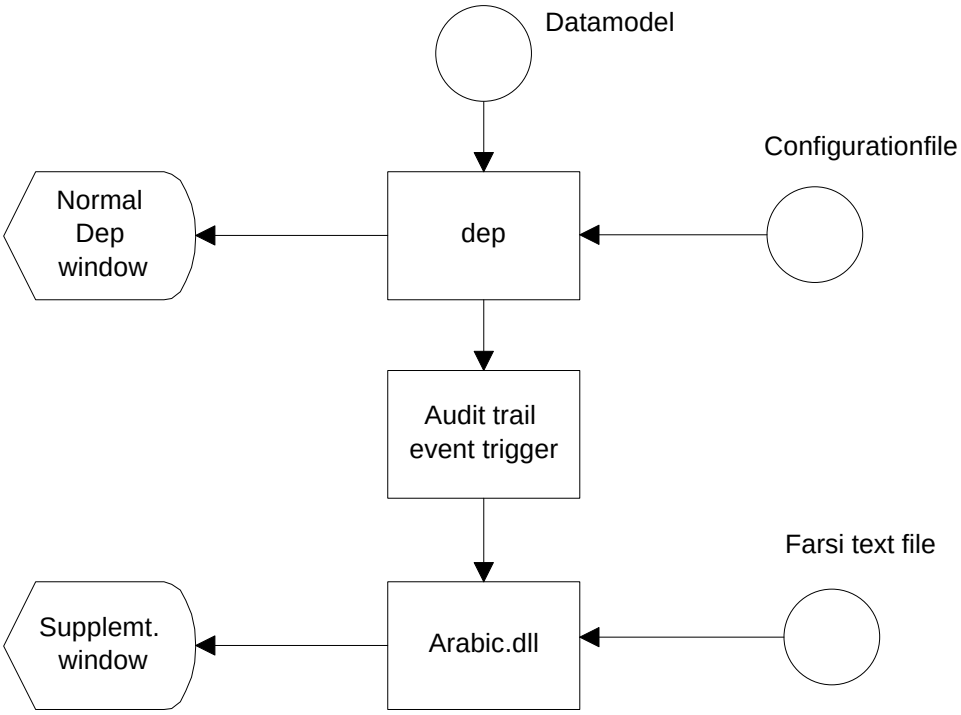
A list of field names were produced by a Cameleon script and were merged into the field texts manually. After this followed some minor editing of the automatically produced field texts.

At the initialization of the 'Audit trail' - *AuditTrailInitialization* procedure - the text file was read into memory in two arrays: One array holding the names of the fields, and the other holding the text lines (in the earlier mentioned built-in Delphi-structure).

When the instrument enters a new field the *AuditTrailEnterField* procedure triggers the name of the field, searches for it in the field names array and - if found - displays the corresponding Farsi text in the Rich Text Control in the Supplementary Window.

The data structure could be more refined, but as it worked very fast in the test, there wasn't really a need for it in this study.

Overview



The Blaise instrument

The instrument was prepared using Blaise III, and while Blaise III and Blaise 4 was able of sharing the datafiles, we left the interviewers the choice of selecting the preferred tool - actually it was a standard installation, so every interviewer had the choice to select either Blaise III or Blaise 4 version.

The three Farsi-speaking interviewers, however, were already used to translation on the fly, so they didn't really need the solution - and in practical interviewing they just carried out using the tool they were used to.

Conclusions

Though the system was not used in practical interviewing, the study showed that it was possible to exploit the Audit Trail mechanism for these purposes, and to make a workable solution that way.

Lot of things could be refined, the DLL could easily be made more general in order to dynamically select a language, a font and a text file - either on request by the user or for the particular user select the proper values from the Registry or Environment variables.

Sparse tries in Blaise 4.3 shows that when there is no OEM-ANSI conversion involved it is possible to fill the text right into the Datamodel source the same way as the other languages, so if the proper text can be represented by a suited font, there is no need to keep it and edit it separate. However, the font selection capabilities of Blaise 4.3 still lacks the property *Alignment.*

Though we probably won't need this way to display Arabic text again, the study was good to get an overview of the large potentials of the Blaise 4 Audit Trail mechanism - and to learn the characteristics of the Arabic Alphabet.

References

Blaise 4.1 Developers' Guide, Chapter 5.6 Audit Trail, pp.282-293

APPENDIX I : Farsi.txt-sample:

###SpSkema.Blok01.Spm01i
ö‘ðÇ÷û‘÷• øöþ¤›‘úõ) ö‘þ¤‘¡ á‘®øÞ ¥ • ë þÌ Ÿ— øü¨¤¤“ ñ‘Ÿ¤Ç î¤‘õ÷• Ç¤‘õ o¤• ÇÞ
ñ‘¨¤• ö‘— þÞ¤“ « ø¬¡ öþÞ ¤ Ç ý• ùõ‘÷ üð¥ ‘—“ ‘õ .Çª ‘“þõ î¤‘õ÷• Ç¤Ç‘ú÷ ü ðÇ÷¥ oøŸ÷ ø(
‘õª «¡ª ‘“ •¤ ù“Ÿ¬õ öþÞ ‘— ô þóÞõ ‘õ •¤ ùî –¨• ù—ê¤ ù¤‘ª • ö ¤ Çùî ôþÞ ù—ª • Ç
.ÇÞõ÷ üõ öþõ®— •¤ ‘ õª öÇ÷‘õ §‘÷ª ‘÷ Š ü—‘ì þÌ Ÿ— ¤‘î øü¨¤¤“ öþÞ ù÷øð øôÞª ‘“ ù—ª • Ç

ü—‘õÇÌ õ –ò• ¸Þ : • – õ¨ì
¥ ‘è Çþ ü õ ö ¥ • ùî ý¤øª î øö‘“¥ o¤‘“ ¤Çñ• ¸Þ Ç÷• ‘“ •¤ ù“Ÿ¬õ ö‘— ù¥ ‘›• ‘“ ö õ
.ô÷îþõ
###SpSkema.Blok01.Spm01
ŒÇ¤þ£ • –¤ø¬ ‘õª ‘“ ù“Ÿ¬õ öþÞ ùî Çþóþõ ü÷‘“¥ ù ù“ -•
• ü“¤ä
, üî¤‘õ÷• Ç
ƒ ü¨þóð÷•
„ ü¨¤‘ê
… ü÷‘—¨úó
† ü—• ø¤î Š ü“¤¬
‡ üŽ‘ þó‘õø¨
ˆ üî¤—
‰ ü“‘›÷• /øÇ¤•
• üõ‘÷—þø
###SpSkema.Blok01.Spm05
ü“û£ õ ‘þøü÷‘“¥ à‘Ÿõ ¥ • ù) ü õø –þóì • í þä¥ › ö‘— öúþõ ¤Ç ‘õª oÇ• ø÷‘¡ / ‘õª ‘þ -…
ŒÇþ—ê¤ üõ ¤‘õª ù“ (
• ý¤
, ù÷
###SpSkema.Blok01.Spm06
.....ÇþÞ‘õ¤ê ¤î£ ‘ê¯ ó Œ–þóì • ô• ÇÌ ù“ ý¤ ¤ ð• -†

APPENDIX II : Delphi program

```
library Arabic;

uses
  SysUtils,
  DepAudit in 'DepAudit.pas',
  Forms,
  Unit1 in 'Unit1.pas'{Form1};

procedure AuditTrailInitialization(const AuditInitialization: TAuditInitialization); export; stdcall;
begin
      Application.CreateForm(TForm1, Form1);
      Form1.Show;
end;

procedure AuditTrailFinalization(const AuditFinalization: TAuditFinalization); export; stdcall;
begin
      Form1.RichEdit1.Clear;  Form1.RichEdit1.Free;  Form1.Close;
end;

procedure AuditTrailEnterField(const AuditEnterField: TAuditEnterField); export; stdcall;
var s: String;
begin
      Form1.FormUpdate(AuditEnterField.FieldName);
end;

{*** dummy procedures, defined for compatibility reasons only ***}
procedure AuditTrailLeaveField(const AuditLeaveField: TAuditLeaveField); export; stdcall;begin end;
procedure AuditTrailAction(const AuditAction: TAuditAction); export; stdcall;  begin end;
procedure AuditTrailEnterForm(const AuditEnterForm: TAuditEnterForm); export;stdcall;begin end;
procedure AuditTrailLeaveForm(const AuditLeaveForm: TAuditLeaveForm); export;stdcall;begin end;

exports
      AuditTrailInitialization     index 1,
      AuditTrailFinalization       index 2,
      AuditTrailLeaveField         index 3,
      AuditTrailEnterField         index 4,
      AuditTrailAction             index 5,
      AuditTrailEnterForm          index 6,
      AuditTrailLeaveForm          index 7;
begin
end.

unit Unit1;

interface

uses
  Windows, Messages, SysUtils, Classes, Graphics, Controls, Forms, Dialogs,
  StdCtrls, ComCtrls, Menus;
```

```
type
  TForm1 = class(TForm)
    RichEdit1: TRichEdit;
    Label1: TLabel;
    procedure FormCreate(Sender: TObject);
  private
    { Private declarations }
  public
    { Public declarations }
    procedure FormUpdate(SpmNavn : PChar);
  end;

const
  MaxEntries = 200;
  MaxTxtLng = 2000;
var
  Form1: TForm1;
  F : Text;
  FeltNavn : array [1..MaxEntries] of PChar;
  FeltIndh : array [1..MaxEntries] of PChar;
  NofEntries : Integer;

implementation

{$R *.DFM}

procedure TForm1.FormCreate(Sender: TObject);
var
   i : integer;
   S : String;
   P1 : PChar;
   atmp : array [0..MaxTxtLng] of char;
   atmp2 : array [0..100] of char;

   function Kopier (st : String) : PChar;
   var
     A : array [0..MaxTxtLng] of char;
     P : PChar;
   begin
      A:='';
      P := StrPCopy(A, St);
      Result := StrNew(P);
   end;

begin
   Label1.Caption := 'Spørgsmålsnavn';
   AssignFile(F, 'farsi.txt');        {* This ought to be defined somewhere else, but never mind now! *}
   reset(F);
   i:=0;
   NofEntries:=0;
```

```
  while not eof(F) do
  begin
    readln(F, S);
    if Copy(S, 1, 3) = '###' then
      begin
        if i>0 then FeltIndh[i] := StrNew(atmp);
        i:=i+1;
        FeltNavn[i] := Kopier( Copy(S,4,Length(S)) );
        atmp :='';
        FeltIndh[i] := atmp;
      end
    else
    begin
      P1:= StrPCopy(atmp2, S + Chr($0D) + Chr($0A) );
      FeltIndh[i] := StrCat(atmp, P1);
    end;
  end;
  FeltIndh[i] := StrNew(atmp);
  NofEntries:=i;
  CloseFile(F);
end;

function FindIndhold (FieldName : PChar): PChar;
var
  i : integer;
  S : PChar;
begin
  S:='';  i:=0;
  repeat
    i:=i+1;
    if StrComp(FeltNavn[i], FieldName) = 0 then S := FeltIndh[i];
  until (i >= NofEntries) or ( StrLen(S) > 0 );
  if StrLen(S) = 0 then FindIndhold := 'Kun dansk tekst til dette spoergsmaal!'
                   else FindIndhold := S;
end;

procedure TForm1.FormUpdate(SpmNavn : PChar);
var Navn : String;
   i : integer;
   P : PChar;
begin
  Navn:='';
  for i:=0 to StrLen(SpmNavn)-1 do
    if SpmNavn[i] in ['0'..'9']
    then
      Navn:=Navn + Chr(Ord(SpmNavn[i]) + $50)
    else
      Navn:=Navn + SpmNavn[i];

  Label1.Caption := Navn;
```

```
  with RichEdit1 do
  begin
     P := FindIndhold(SpmNavn);
     Text := P;
  end;
end;

end.
```

6th INTERNATIONAL BLAISE USERS' CONFERENCE 2000

CORK, May 2000

Blaise Generator for hi-speed data entry applications

by

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1. Introduction

Modern theories of statistical survey processing consider hi-speed ("heads down") data entry mainly as a little bit old-fashioned. In the survey process it's been replaced by recent methods ant techniques, like CAI, EDI and internet data collection. However, in practice many statistical offices still have to deal with hi-speed data entry from paper forms without (or with minimum) data checking at the time of data entry. Usually it is organised on a mainframe platform, but using the systems like Blaise it can be supported on a LAN platform as well.
At the Statistical Office of the Republic of Slovenia there's still a large amount of data entered by a dedicated package for hi-speed data entry on a mainframe platform. The system is out-of-date and need to be replaced, so a new solution on a LAN Windows NT platform was developed. With the new generator (written in Blaise 4 Windows and Visual Basic), end-users can produce (on a basis of paper documentation) hi-speed data entry applications without developer's help.
New solution is based on existing methodology and documentation, and can be integrated in the existing survey process by mixing mainframe and LAN platform. At the same time it sets some basic standards and prepares ground for the redefined survey process that completely takes place on a LAN platform.

2. Reasons for development

Statistical Office of the Republic of Slovenia (SORS) is a centrally organised statistical office. Already early in 70's SORS started to explore the possibilities of building up a statistical system based on registers, and today this strategy is continued.
However, there's still a large amount of survey data collected on paper forms using traditional mailout - mailback method. One reason for relatively large batches of forms is complete coverage of population in many surveys. In some cases it is necessary, in other cases we need to introduce sampling methods. Another reason is growing number of surveys. New developments mainly make use of CAI and EDI methods and techniques, but the major part of surveys (especially from economic area) still report on a paper forms. A part of this data is captured by OCR, and the rest by hi-speed data entry. Although the share of data entered "heads down" is slowly decreasing, a reliable support for that kind of data entry should be obtained.

The existing system DCR 5000 (Data Capture & Retrieval) is a specialised hi-speed data entry software package that runs on the Unisys U Series product line (Unix operating system). The main reasons for replacing the system are: old and unreliable HW equipment, maintenance problems and poor compatibility with the new SORS information system infrastructure, based on a LAN Windows NT environment. A part of the old system was also not Y2K compliant (a rough-and-ready solution was found), so the basic functions of a new system had to be ready by the year 2000, to take over the production in case of Y2K problems.
Since Blaise supports most of SORS new developments on survey data entry, the Blaise system was a logical choice to support the new hi-speed data entry solution as well.

3. Building up the generator

Preparing replacement for the existing system was not an easy task. In general, the new system should support all the functionality of the old solution, and possibly add some improvements. But on the other hand, very small resources were available, and the system should not be too complex.
Development of generator would not be possible without some standards concerning data models. Because of data storing, these standards were taken from mainframe and (although including many restrictions) they were used as a guideline to define generator outputs. When entry is finished, final Blaise database is converted to ASCII and transferred to the mainframe. Since mainframe archiving system has limits in record length, one survey form is usually entered as a set of records of different types.
The old DCR-5000 system is a highly specialised program package and years ago it was integrated in a complete data capture-archiving-retrieval system on a mainframe. Data entrists are used to work on a special keyboards, so with the new data entry solution also the new special programmable keyboards for data entrists were obtained.
There was an important request, that users should be able to produce (on a basis of paper documentation) data entry programs without the intervention of developers. Users were not expected to write code, so generator was the solution. Data entry should be fast, and verification (double keying) must be enabled.

The development of generator began in July 1999, using Blaise 4 Windows (version 4.1) and Manipula for application development, and Visual Basic 5 for development of user interface. There was almost no documentation about the existing application, so a permanent contact with people involved in an existing production process was necessary.
Beside data models for entry and verification, generator produces many auxiliary Manipula setups to support administration and control the process. Blaise and Manipula command line parameters were widely used in development of user interface.

3. Main problems and solutions

One of the main problems was <u>how to help and enable end-user to correctly define data model</u>, following the existing documentation. To support this, a special Blaise data model was defined, where all the survey parameters, fields and specifications are entered. Each entry in this specification model (key is unique survey code and version) defines a new generated data model for hi-speed data entry. There are paper and on-line instructions available to the person who specifies the data model. In our case supervisor (data entry administrator) is responsible for that task.
Next question: <u>how should look the output of the generator -Blaise data model</u>. Generated application can not be (and don't need to be) a complex Blaise instrument. On the other hand, it has to fulfil the general needs of surveys that use hi-speed data entry. Manipula reads the parameters from the specification data model and writes the code for hi-speed entry with the following general structure:

```
DATAMODEL Survey
        FIELDS
                Field_1
                 - - -
                Field_ j
                Record_Type:  1..i
                BLOCK B[1]
                        B1Field_1
                         - -  -
                        B1Field_m
                ENDBLOCK {1}
                         - - -
                BLOCK B[i]
                        BiField_1
                         - - -
                        BiField_n
                ENDBLOCK {i}
        RULES
                Field_1
                 - - -
                Field_j
                Record_Type
                IF Record_Type = 1  THEN   B[1]   ENDIF
                 - - -
                IF Record_Type = i  THEN   B[i]    ENDIF
ENDMODEL  {Survey}
```

With this simple general structure, all data models of surveys that use hi-speed data entry are covered. There are common (form-characteristic) fields on a first level and a number of different blocks on a second level. Each block in a generated model represent a different record type. Final ASCII records, produced by Manipula setup always consists by common fields, field that define form type and a number of fields defined by that form type. Single level data model definition is also supported.

Most of the fields on a form level are usually SORS standard, so their specifications can be pre-defined and imputed. A question was how to enable and support correct entry for the field "record type". This is an important key field for generation of applications, but treated in a very different way in a different surveys. Usually it need to be separated in two fields, to enable correct generation of data entry application. Specifications (type, length etc) for the data fields in blocks are entered into the specification model directly from the survey documentation. There are a few checks included, obtaining correct positions of fields.

Another hard task for supervisor is how to define key fields of generated data model. Due to speed of entry only the secondary keys are defined. Usually the key is composed of sequence or ID number of form, and type of record. In the generator key definition is now supported and facilitated by presenting all possibilities in a closed question.
All the hardest problems for supervisor when specifying data model (like specifying key fields and fields for record type) were additionally explained to the supervisor.

Another problem was verification. Reference files are not a good solution, since response should be immediate. The idea was to put both fields (for entry and verification) in the same data model. There are only entry fields on the screen during the entry session, and only verification fields during verification, which is based on time sequence of entered records. But this approach disables common data base, so in the first step partial data bases (covering one batch of paper forms) are created and verified, and in the second step they are merged in a common Blaise data base of a survey. Verification process added a lot of administration, but seems to be inevitable if the entry is really hi-speed.

Final step is data transfer to the mainframe archiving system, so the rest of the process on mainframe can remain unchanged. Storing ASCII data on a mainframe is certainly not an optimal solution: it

requires additional administration, and a part of information (metadata) is not used. We hope it is temporary (until completely supported on LAN), but until that time it should be automated as much as possible. Job control script for mainframe archiving system is generated on LAN and transferred together with data, so data transfer can be controlled by the end-user as well. This part of a system has only a basic functionality and is still under development.

Hi-speed data entry needs standard screen layout and standard commands. Both was discussed with end-users and prepared in Blaise, using Modelib Editor and DEP Menu Manager. Combining these tools and programmable keyboard, the work for data entrists didn't change very much. With a few exceptions all the main commands have the same keys as before, and all commands are executable without mouse.
Last version of generator uses Blaise 4.3 (build 4.3.2.436) and Visual Basic 5.

4. Preparing data entry application step by step

A new data entry application is defined and generated through VB "development" user interface that integrates all the necessary interactive and batch processes. The interface is used by supervisor -data entry administrator who specifies and generates data entry model. Another, different user interface is prepared for "production" data entrists.

The user responsible for defining data model (supervisor) has to execute the following steps:

- Step 1: Defining a new data model for hi-speed data entry. Supervisor enters all the necessary specifications into Blaise data model for generation.

- Step 2: Generating all applications. Before compiling, generated datamodels for data entry and verification are presented on the screen (Blaise editor), so additional improvements can be made if necessary.

- Step 3: Testing in development environment. Complete process (entry, verification, creating final data set, file transfer to mainframe) should be tested before it is implemented in production.

- Step 4: Transfer of application files to the production environment (different folder on the same server).

Before the production work starts, the application is shortly tested once again in production.

5. First experience

First application in production was one of monthly traffic surveys with only about 1000 records. No serious problems were noticed and there are already some new data models defined. New system was in general well accepted between end users. There are still some problems to be solved with verification, which is more different compared to the old solution. It seems like we succeed to bring it close to the end-user, but on the other hand this made the system more complex and more complicated to maintain. We hope that the "balance" between users and developers tasks is still OK. To leave the process control completely to the users, the administration still has to be improved.

6. Conclusions

In future, hi-speed data entry at SORS should be gradually replaced by recent data entry techniques, which can be better integrated in a modern information systems. But while migrating to a LAN platform and redesigning processes, an efficient solution to support traditional hi-speed data entry is necessary to obtain the statistical production.
What did we get with the new application ? There are some answers:

- functionally seems to be a successful replacement for the old one
- it is flexible and well integrated in the SORS information system (and the future strategy)

- Blaise application development is expanded (not just CAI) - in-house standardisation
- generator can be used to support process, running completely on a LAN platform, so it is an important step in the migration to the new environment
- it could serve as starting point for non-EDP people (or people who learn Blaise) when developing data models
- by adding checks, comments etc. generated data model can be used as conventional CAI application

There are also some negative points: generator became relatively complicated to maintain (due to verification module, special user's needs etc); we still don't know exactly how far we need to go with administration and automation of the process. But in general we believe that our solution is a good choice in the existing situation, and that it will contribute to the development and modernisation of the survey processing system at SORS.

ManiTabs

Making tabulations in Ms-Excel with Manipula

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Abstract

Blaise datamodels and Manipula scripts have long had the capability to call DLL's through the alien procedure interface. The article explores the capabilities of Manipula alien procedures with regards to controlling OLE automation servers. As an example we use a Manipula script that automates Microsoft Excel's PivotTable in order to create cross tabulations.

Introduction

This article will illustrate for you the power and flexibility that you can obtain when you combine Blaise for Windows support for ALIEN PROCEDURES with DLL's that are OLE-Automation controllers. The subject matter is technical in nature as it involves the combination of two programming techniques. However we feel that the potential benefits of the application of the technique make it relevant to a wider audience.

The benefits of the technique are quite clear. In your Manipula/Maniplus scripts you can write statements that control other programs. The control you obtain can be quite extensive. You can transfer data into and out of the target program and you can issue commands to have the target program manipulate the data, or output it.

The technique is particularly relevant to offices that have invested heavily in the use of generic 'Office' software and require reports, tables, charts etcetera to be prepared in products such as Excel and Word, and e-mail communication to be performed by Exchange or Outlook. We list a few examples:

- Sending data as e-mail using Ms-Outlook
- Retrieving data from the e-mail system and placing it into Blaise datasets
- Tabulation of data from Blaise data sets using MS-Excel or SPSS-Tables
- Preparation of Charts using Ms-Excel or SPSS-Chart
- Preparing printed reports or form letters using MS-Word instead of using PRINT-Section formatting

In this article we would like to show you a non-trivial example to illustrate the power of the technique. A particular useful feature in MS-Excel is the pivot table. This allows you to interactively define tabulations on multidimensional data. The pivottable is a good example to illustrate the technique because:

- Ms-Excel is ubiquitous. Almost all statistical offices have standardised around Ms-Office, and each desktop will have a copy of Ms-Excel. Many users will therefore be familiar with pivottables.
- Pivottable are extremely user friendly.
- Pivottables are extremely flexible and allow a high degree of customization.

Before proceeding with the Tabulation example, we first present the two building stones of the technique, Alien Procedures in Manipula and OLE-Automation. For both techniques we include a complete example to illustrate that the actual amount of effort in making these techniques is limited. Because we need to program DLL's, it is inevitable that we present some Delphi (=Pascal) source code. We will only show the essential parts that illustrate the technique as we cannot assume that you are familiar with this development environment .

Alien Procedures

At the heart of the technique is Blaise/Manipula's ability to call Windows DLL programs. DLL stands for Dynamic Link Library. DLL's are pieces of programs that are ready to be called by another program and only loaded when required. The Blaise user manual describes the process of declaring and calling such programs.

You cannot just use any DLL however. The procedures that are exported from the DLL must adhere to a standard interface. The interface is documented and implemented in a Delphi unit file called MANWDLLO.PAS that is distributed with the Blaise system. This basically means that you will need to write your own DLL's in order to use ALIEN PROCEDURES in Manipula. You could write the DLL using Delphi (recommended by the Blaise team) or C++.

You would use DLL's for problems that are difficult or impossible to solve using Manipula alone. You can use these DLL's to provide procedures that provide information about the computing environment, that perform certain complicated statistical operations, or that interface into other programs.

In order to provide you with a simple example of what is involved in using DLL's, below we present the Manipula definition of an ALIEN PROCEDURE that shows a message dialog with three choices, Yes, No, Cancel and returns an integer value. For those of you familiar with MANIPLUS this would provide an extension to the CONFIRM dialog. The DLL is called 'MANIYNC.DLL', and it contains the procedure 'ConfirmCancel'

```
PROCEDURE ConfirmCancelDialog
PARAMETERS
  IMPORT Msg : STRING
  EXPORT iRes: INTEGER
ALIEN('MANIYNC','ConfirmCancel')
ENDPROCEDURE {ConfirmCancelDialog}
```

You would call this procedure in your MANIPULATE section as follows:

```
MANIPULATE
   sMsg := 'Do you want to impute the results (Yes/No) or cancel the process '
   iRes := 0;
   ConfirmCancelDialog(sMsg,Ires)
   Case ires of
   0: Display('Returned Cancel',wait)
   1: Display('Returned Yes',wait)
   2: Display('Returned No',wait)
   endcase
```

The implementation of the DLL requires a little Delphi programming. In defining the procedure in Delphi, you will need to adhere to the definition in MANWDLLO.PAS. If you keep to the definitions, writing the procedure is simple. The GetStringValue and SetIntegerValue procedures are used to move the data into and out of the procedure. The DLLInterface parameter contains all of the information on the various parameters passed to the DLL procedure. If the parameters passed conform to the required information then the parameter values are obtained, and a messagedialog is shown that has three buttons. ([mbYes,mbNo,mbCancel]). The outcome is captured in the variable res, and transformed such that cancel = 0, yes = 1 and no = 2.

```
Procedure ShowYesNoCancelDialog(DLLInterface:TDLLParamsInfo);stdcall; export;
var
   msg : string;
   res : integer;
   dllparam1,dllparam2 : tdllparameter;
begin
   if dllinterface.getparametercount= 2 then
   begin
      dllparam1 := dllinterface.getparameter(0);
      dllparam2 := dllinterface.getparameter(1);
      msg := getstringvalue(dllparam1);
      res := MessageDlg(msg,mtconfirmation,[mbyes,mbno,mbcancel],0);
      case res of
      2: res := 0;
      6: res := 1;
      7: res := 2;
      end;
      SetIntegerValue(dllparam2,res);
   end;
end;

exports  ShowYesNoCancelDialog index 1 name 'ConfirmCancel' resident;
```

Finally the ‘exports’ statement specifies how the showYesNoCancelDialog procedure is made available to the outside world. You can see that it can be referred to by a number (index=1) or by an identifier (‘ConfirmCancel’).

The main point about this example is that the actual work is in setting up the exchange of information between Manipula and the DLL. Fortunately this part is easily standardised. The actual work of showing a 3 button dialog is a single line in the program, using a standard function MessageDlg.

OLE Automation

Automation is part of a technology that used to be called OLE (Object Linking and Embedding) and at present is known as COM (Common Object Model) that has been developed by Microsoft and that is a key part of the Windows operating system. You can have automation servers; programs that perform certain tasks and that provide a COM interface such that other programs, automation clients, can control the execution of those tasks.

During the last IBUC Blaise 4.5 was shown by Statistics Netherlands in beta as an Automation server being controlled by Ms-Excel, the automation client. By programming MS-Excel using Visual Basic for Applications both data and metadata could be extracted from a Blaise data set and to manipulate it using the Visual Basic for Applications programming language available in MS-Excel.

MS-Excel however is itself also an automation server. You can make Excel programmatically perform any task that you can perform interactively. You will need to study the Excel *object-hierarchy* to understand how to achieve particular tasks. The top-level *object* is the application object. In the example below the Excel application object is represented by the v_xls variable. You can see that we refer to cell A1 in the active sheet of the application as

```
V_xls.Activesheet.range[‘A1’].value := ‘Manipula controls Excel!’
```

The process of invoking Excel, opening a workbook, placing some data into a cell and saving the workbook is illustrated in the following code extract:

```
…
try
  v_xls := createoleobject('excel.application');
except
  showmessage('Could not start MS-Excel');
  exit;
end;
v_xls.Visible := True;
v_xls.workbooks.add;
v_xls.activesheet.range['A1'].value := 'Maniplus Controls MS-Excel';
v_xls.activesheet.range['A1'].font.size := 54;
v_xls.activesheet.columns['A:A'].columnwidth := 100;
v_xls.displayalerts := false;
v_xls.workbooks[1].saveas(‘BlaiseFecit’);
v_xls.quit;
…
```

It is taken from our second example DLL (MANIXLS.DLL), which only has a single procedure Makesheet. This procedure invokes Ms-Excel , makes Excel show itself, creates a new workbook, and places a text in the active sheet of the new workbook. After some formatting, it saves the spreadsheet under the name ‘BlaiseFecit.xls’.

To be complete, below is the source code for the Maniplus script that drives the DLL:

```
PROCESS TestExcel

AUXFIELDS
  IRes : INTEGER

PROCEDURE MakeSheet
PARAMETERS
  EXPORTS Result:INTEGER
ALIEN('ManiXls','MakeSheet')

ENDPROCEDURE {Makesheet}

MANIPULATE
   MakeSheet(iRes)
   Display('Invoked excel, returncode ='+str(iRes),wait)
```

Using MS-EXCEL Pivot Table interactively.

Before we start automating tabulations using the PivotTable, it is useful to have an idea what steps are involved in the process of generating tabulation interactively.

We start this process with the generation of an Excel worksheet that contains the data to be tabulated in one of the worksheets. Because there are a few problems in importing Blaise data into Excel that we like to avoid we use a Cameleon setup we developed to load up the data.

Then the definition of the PivotTable can take place. This is actually a four-step process.

- You define the kind of data source
- You define the location and kind of the of the data
- Then you define the tabulation
- Then you define the location of the table in the workbook

To do this most easily you first select the columns that contain your source data, and then you activate the PivotTable command.

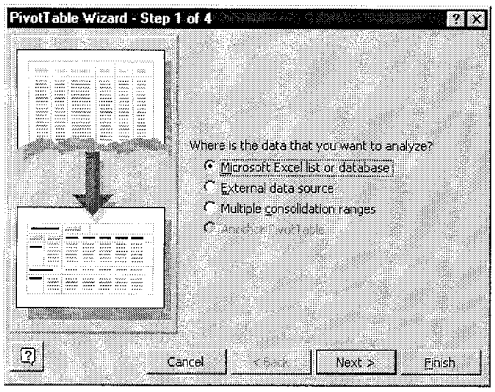


Figure 1 Interactive Pivottable Definition, Step 1

In step one you indicate that the data is obtained from an Ms-Excel list

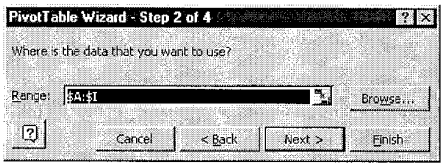


Figure 2 Interactive Pivottable Definition, Step 2

In step two you indicate the location of the data. Because you selected the columns already, this dialog is already filled in.

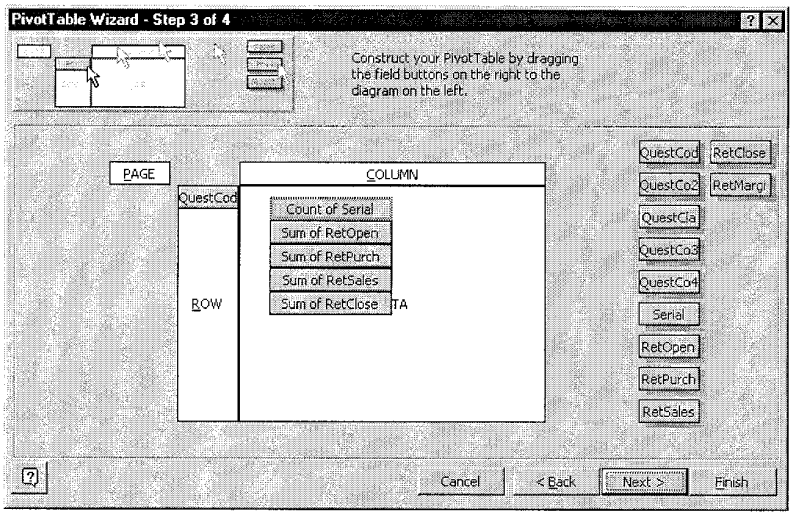


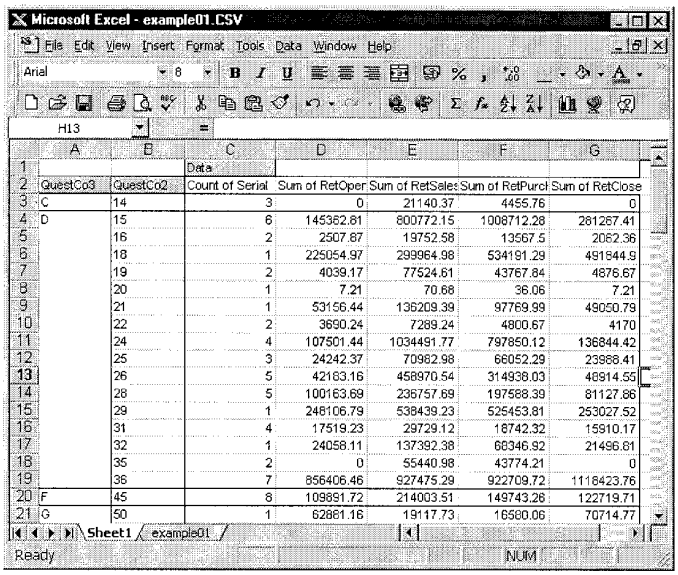
Figure 3 Interactive Pivottable Definition, Step 3

Step three is the most involved. You see a diagrammatic representation of the tabulation, and you see a list of all the fields that are available to you represented as buttons. The process of defining the tabulation is a matter of simply dragging and dropping the fields into the appropriate (Page, Column, Row and Data) areas. Subsequently you can set the properties of each of the fields in the tabulation by double clicking on the fields.

The result of our interactive definition of the pivot table is shown below. You can see that

- the layout of the table reflects our design preference of having the data fields in separate columns

- Each NACE 4 digit code is represented in a separate row, despite the fact that QuestCo3 and QuestCo2 are not enumerated fields.
- the Serial field is counted, not summed



QuestCo3	QuestCo2	Count of Serial	Sum of RetOper	Sum of RetSales	Sum of RetPurcl	Sum of RetClose
C	14	3	0	21140.37	4455.76	0
D	15	6	145362.61	800772.15	1008712.28	281267.41
	16	2	2507.87	19752.58	13567.5	2062.36
	18	1	225054.97	299964.98	534191.29	491844.9
	19	2	4039.17	77524.61	43767.84	4876.67
	20	1	7.21	70.68	36.06	7.21
	21	1	53156.44	136209.39	97769.99	49050.79
	22	2	3690.24	7289.24	4800.67	4170
	24	4	107501.44	1034491.77	797850.12	136844.42
	25	3	24242.37	70962.98	66052.29	23988.41
	26	5	42163.16	458970.54	314938.03	40914.55
	28	5	100163.69	236757.69	197588.39	81127.86
	29	1	246106.79	538439.23	525453.81	253027.52
	31	4	17519.23	29729.12	18742.32	15910.17
	32	1	24058.11	137392.38	68346.92	21496.81
	35	2	0	55440.98	43774.21	0
	36	7	856406.46	927475.29	922709.72	1118423.76
F	45	8	109891.72	214003.51	149743.26	122719.71
G	50	1	62861.16	19117.73	16580.06	70714.77

Figure 4 Interactively Defined Pivottable

All that remains is to save the file as an XLS file in order to preserve the pivot table and to interactively modify the tabulation a little more for a pleasing layout.

Manitabs

The next step is to obtain a programmatic solution to our tabulation needs. The requirements are quite simple.

- We would want to be able to specify the tabulation inside Manipula and Maniplus scripts
- We want to be able to prepare the tables programmatically from within Manipula or Maniplus scripts., and save these as MS-Excel files.

As with many other programs, we will need to transfer the data between Blaise and Excel by means of an intermediate ASCII file. Excel makes importing delimited data particularly easy, therefore you will first need to export the data from a Blaise Dataset into a comma or a tab-delimited ASCII file. You can use the Manipula wizard for this.

Then you will need to write a setup that defines the tabulation. The natural tool for this are Maniplus scripts, although it is possible to define tabulations in the MANIPULA PROLOGUE section as well.

The main ingredient that you will need is the MANIPLUS.INC include file. This include file contains all the definitions of the Alien Procedures as well as a series of auxiliary variables that contain the relevant MS-Excel constant values.

To explain in detail the programmatic definition of PivotTables will lead us too far in the nitty gritty of OLE-Automation. Instead we will show you the MANITABS interface, and explain the crucial keywords that you need in order to programmatically define your own tabulations.

Usage of MANITABS

For the time being MANITABS will only read ASCII data. The user is required to specify the type of separator (comma or TAB separated), and the delimiter character. Because we chose not to complicate matters by involving Cameleon, you will need to specify the field names corresponding to the ASCII file in the Manipula/Maniplus sourcecode. You will also need to specify whether to use the Ms-Excel general format (for numbers) or the text format (for string data). Typically you would use a Manipula setup to prepare an abstract of the data file in ASCII (CSV or TAB separated), and subsequently call MANITABS.

MANITABS has only a few keywords. Because the Manipula DLL interface is implemented as ALIEN PROCEDURES, each MANITABS keyword is a procedure call.

As an example lets take an excerpt from a business survey that contains information on opening and closing stocks and sales and purchases. All of the enterprises are classified at NACE class, division and section level. The NACE codes are implemented as STRING types. Also the Nace section and division level codes have been implemented as a Classification type, and finally the section level codes have been implemented as an enumeration type.

We would like to make a very simple tabulation that shows opening stocks, purchases, sales and closing stock for each activity. The table would look like this:

NACE Section	NACE Division	Count of Units	Opening Stock	Purchases	Sales	Closing Stock
D	22	####.##	####.##	####.##	####.##	####.##
	24	####.##	####.##	####.##	####.##	####.##
….	….					

The source code extract shown below is a typical sequence used for preparing a tabulation.

Specification of input and output

You first specify input and output files:

```
InitializeConstants
aFilePath := 'D:\job\delphi3\xlspivotdll\'
InputFileName(afilepath+'example01.txt')
ExcelFileName(aFilePath+'TABLE01.XLS')
ASCIISeparator ( 2) {comma}
ASCIIDelimiter ( 1) {doublequote}
```

- The Initializeconstants procedure is defined in MANIPLUS.INC. It sets up the auxiliary variables that contain the Excel constants.
- The InputFilename procedure sets name and location of the ASCII file that contains the source data for the input file.
- The OutputFileName procedure sets the name and location of the Excel workbook that contains the tabulation.
- The ASCIISeparator and ASCIIDelimiter procedures establish the type of the ASCII inputfile. As mentioned earlier, it needs to be a delimited file type. You could also use a TAB delimited file.

Specification of file structure and tabulation

Then you simultaneously define the structure of the inputfile, as well as the bare bones definition of the tabulation.

```
Addfield('QuestCode'        ,2,0,0)
AddField('QuestCode02'      ,2,1,2)
AddField('QuestCodeSec'     ,2,1,1)
Addfield('Serial'           ,1,4,0)
Addfield('retopen'          ,1,4,0)
AddField('retpurch'         ,1,4,0)
Addfield('retsales'         ,1,4,0)
AddField('retclose'         ,1,4,0)
Addfield('retmargin'        ,1,0,0)
```

In designing MANITABS we have chosen to limit the number of procedures to a minimum, so there is a single procedure ADDFIELD that defines a field in the input file as well as determines if and how this field is tabulated. The ADDFIELD procedure has four arguments

1. The name of the field. You are free to name the field as you like, as long as it is unique.
2. The format specifier for the data. This is important. Normally Excel will import data in the ‘general’ format (1). This will give erroneous results if you are importing classification codes, as these will be interpreted as numbers instead. Here you can specify that you want such fields imported as ‘Text’ (2). You can also use this parameter to indicate the layout of date fields.

3. The kind of field in the tabulation. Fields can be either skipped (=0), a row field (=1) , a column field (=2), a page field (=3) or a data field (=4)
4. When you have several row fields or column fields it is important to establish the hierarchy between them. For instance if you would like to prepare a tabulation showing both section and division levels of a classification, you would want the section level to be shown is the outer field. You can use the fourth argument to indicate this sequence.

Specification of Tabulation Options

```
Datafieldoptions('serial'   ,0, Func.xlcount,'#,##0'); {count}
Datafieldoptions('retopen'  ,0, Func.xlSum,  '#,##0'); {sum}
Datafieldoptions('retsales' ,0, Func.xlSum,  '#,##0'); {sum}
Datafieldoptions('retpurch' ,0, Func.xlSum,  '#,##0'); {sum}
Datafieldoptions('retclose' ,0, Func.xlSum,  '#,##0'); {sum}
DatafieldOrientation(2)                                {columns}
ExcelVisible(2)
PivotFontSize(8)
PivotFontName('Arial')
```

Finally you can define some tabulation options.

- The DatafieldOptions procedure allows you to specify for each datafield how it should be presented (as a value, as a percentage of the total etcetera), what the aggregation method is (counting, sum, average, maximum, minimum etcetera. Note the use of the Func auxiliary variable to mimics constants), and what the presentation format should be. The chosen format here is no decimals, but with a separator between thousands.
- The datafieldorientation procedure allows you to set whether you would like the datafields to be presented in separate columns (=1) or in separate rows (=2).
- The ExcelVisible procedure allows you to specify whether you want to see Excel build the pivottable (=2) or not (=1)
- The PivotFontname and the PivotFontSize procedures set the font properties of the PivotTable.

Creating the Tabulation

Up until now there ha been precious little activity. We have provided the DLL with all the variable parameters that it needs to control MS-Excel. Excel itself has not been ‘invoked’ as yet.

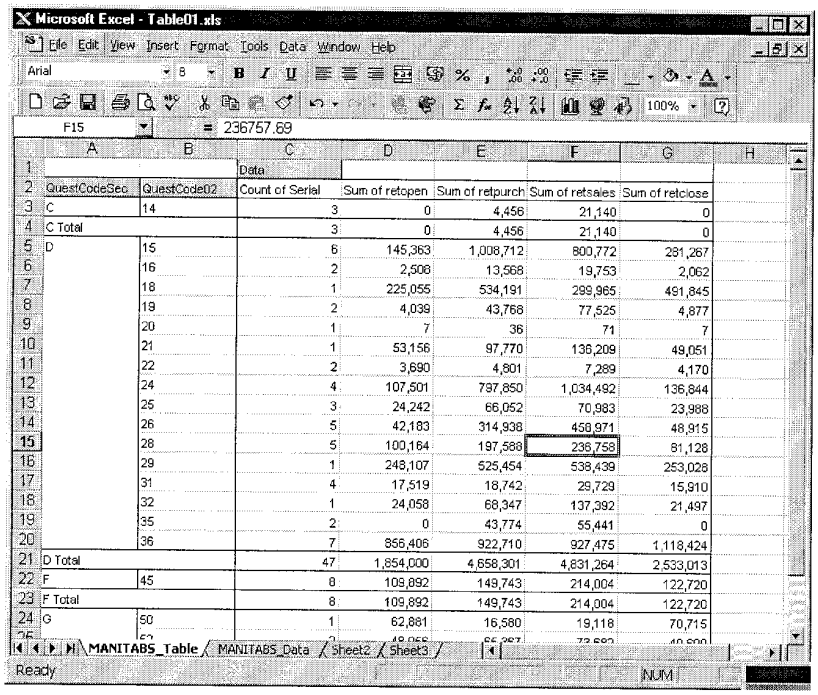
```
Tabulate(iRes)
```

There is a single procedure, Tabulate, that changes all this. The Tabulate procedure will invoke Excel, and issue all the OLE-Automation commands to make Excel prepare the tabulation you have defined in Manipula. Tabulate takes a single parameter, iRes, which should contain the value 0 after Excel finishes. If it contains another value something has gone wrong.

The Clearfields procedure clears the definition from the DLL.

You can use MANITABS in both MANIPLUS and MANIPULA scripts. However MANITABS will feel at home in MANIPLUS scripts, because these do not require specification of INPUTFILE and OUTPUTFILE sections. Also, you might benefit from a CIF set-up that takes a hand in providing you with some additional Metadata, and would write out the fieldnames of the output files for you, as well as any calculated fields you might want to add.

After playing the Manitabs script we find that a pivot table has been prepared that is very similar to our design objective. We have separate columns for each of our data fields, we have succeeded in having the number of enterprises counted, but the other numeric data added together, and we have used a string field as a row field.



	QuestCodeSec	QuestCode02	Count of Serial	Sum of retopen	Sum of retpurch	Sum of retsales	Sum of retclose
			Data				
3	C	14	3	0	4,456	21,140	0
4	C Total		3	0	4,456	21,140	0
5	D	15	6	145,363	1,008,712	800,772	281,267
6		16	2	2,508	13,568	19,753	2,062
7		18	1	225,055	534,191	299,965	491,845
8		19	2	4,039	43,768	77,525	4,877
9		20	1	7	36	71	7
10		21	1	53,156	97,770	136,209	49,051
11		22	2	3,690	4,801	7,289	4,170
12		24	4	107,501	797,850	1,034,492	136,844
13		25	3	24,242	66,052	70,983	23,988
14		26	5	42,183	314,938	458,971	48,915
15		28	5	100,164	197,588	236,758	81,128
16		29	1	248,107	525,454	538,439	253,028
17		31	4	17,519	18,742	29,729	15,910
18		32	1	24,058	68,347	137,392	21,497
19		35	2	0	43,774	55,441	0
20		36	7	856,406	922,710	927,475	1,118,424
21	D Total		47	1,854,000	4,658,301	4,831,264	2,533,013
22	F	45	8	109,892	149,743	214,004	122,720
23	F Total		8	109,892	149,743	214,004	122,720
24	G	50	1	62,881	16,580	19,118	70,715

Figure 5 Tabulation prepared by MANITABS script TABLE01.MAN

Current limitations

Of course MANITABS as presented in this paper is intended as a working illustration of the benefits of the DLL – OLE-Automation technique. It is not a complete tabulation solution. Its most important limitations are currently:

- The need to prepare an ASCII file and specify the field names manually. This can be overcome by the preparation of an appropriate CIF file that reads the Metadata of a Blaise data model.
- The need to import the ASCII data into the Excel worksheet. This limits the size of the data file to around 65,000 records. However it is possible to bring the ASCII data into the pivottable using an ODBC link. This would be somewhat more complicated as it involves th definition of a ODBC data source definition as well as a data base structure (schema) file.
- Each field can only be used once in the pivot table. This is an obvious limitation that prevents for instance the same field being used twice as a data field. You might need this to present percentages as well as total values for instance. (ManiTabs). After you have defined your table in Manitabs you can of course easily add data fields using the Excel pivot table wizard interactively.
- You can specify only one tabulation per Maniplus script, because the script needs to terminate before the MANIPLUS.DLL is released and Ms-Excel is properly exited
- Because we use so-called 'late binding' in our OLE Automation controller DLL it is only possible to prepare tabulations with the English language version of MS-Excel. This is because the German, Dutch, French and other so-called 'localized' versions of MS-Excel use translated keywords for the various objects in Ms-Excel that are being controlled by Manitabs.
- The current MANITABS does not support datasets of more than 65000 records because we store the data in the worksheet itself. This is however not a limitation of MS-Excel Pivottable. You can establish ODBC datalinks to ASCII files, or you can distribute your data across various workbook pages to accommodate more cases. Pivottables are limited only in the amount of memory that you can give it. MANITABS could be reprogrammed to support either option.

A digression on Abacus

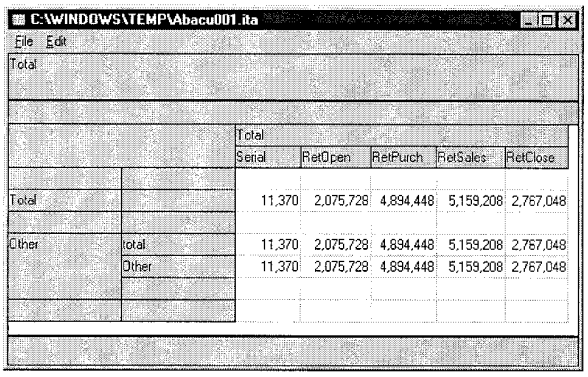
You might well ask why we would invest time and effort in developing a tabulation tool (or at least an interface into a tabulation tool) because Statistics Netherlands provides just such a tool for Blaise users. It is called Abacus.

As long as Abacus has been around it has been always somewhat separate from the other Blaise tools. I imagine an important reason for this is that it always was a completely interactive tool whereas the other Blaise products are programming tools requiring users to write datamodels and manipula set-ups.

Abacus has the great advantage over other tabulation tools that it understands Blaise metadata. It is therefore possible to prepare tabulations without having to create intermediate ASCII files. As we mentioned earlier, this is necessary for using Manitabs. Furthermore the process of defining tabulations in Abacus interactively is easy.

On the other hand Abacus seems to have a number of aspects that make it a less flexible package than you might wish. One important feature of Abacus is that it expects the row and column fields to be of an enumerated data type. If your row or column fields are of any other type all of the data is will be aggregated together in a single category, "Other". This is a disadvantage for Blaise users who have implemented classification types or external lookups with classification codes implemented as string type in their datamodels and would like to tabulate these.

Looking back at our earlier example datafile Example01.~bd Abacus would prepare the following tabulation.



C:\WINDOWS\TEMP\Abacu001.ita

File Edit

Total

		Total				
		Serial	RetOpen	RetPurch	RetSales	RetClose
Total		11,370	2,075,728	4,894,448	5,159,208	2,767,048
Other	total	11,370	2,075,728	4,894,448	5,159,208	2,767,048
	Other	11,370	2,075,728	4,894,448	5,159,208	2,767,048

Figure 6 Output of Abacus on example01.~bd

Notice that all row field values are grouped together in the category "Other". Also notice that the values reported for the serial datafield are different from our earlier report. Abacus only calculates counts when you omit datafields and it sums the datafields if you specify data fields in the tabulation.

In order to have this tabulation the way I presented it earlier is possible after redefining the datamodel and after the introduction of an enumerated type for the NACE section level codes, and another enumerated type for the NACE division level codes. In order to have counts and totals in the same tabulation it is necessary to define a new field in the datamodel and fill it with ones (1). This has been done this in the datamodel Example02.BLA.

Example02.BLA starts of with two extensive defintions for enumerated types tQuestCodeSecEnum and tQuestCodeDivEnum, as shown below. With regards to tQuestcodeSecEnum we completed the enumerated field definition with descriptive information, and for tQuestCodeDivEnum we did not.

```
MANIPULATE  {Transform string data into enumeration}
case QuestCodeSec of
  'A' : QuestCodeSecEnum := SecA
  'B' : QuestCodeSecEnum := SecB
  'C' : QuestCodeSecEnum := SecC
  'D' : QuestCodeSecEnum := SecD
  … {some codes later}
  'Q' : QuestCodeSecEnum := SecQ
  endcase

  case QuestCode02 of
  '01' : QuestCode02Enum := Div01
  '02' : QuestCode02Enum := Div02
  '05' : QuestCode02Enum := Div05
  '10' : QuestCode02Enum := Div10
… {many codes later}
  '72' : QuestCode02Enum := Div72
  else
    QuestCode02Enum := DivUnknown
  endcase
  Counter := 1;
  OutputFile1.WRITE
```

Subsequently you would need to write a translation Manipula script that translates each individual value for the row and column fields into an enumerated value. Below we show you a typical extract for a manipulate section that recodes string data into an enumeration. It relies on a CASE/ENDCASE statement for each of the translations. We did not attempt to set up an enumeration and recode the four-digit NACE class codes as there are around 450 of those. Also notice the introduction of a

```
DATAMODEL Example02 "Example with enumerated fields and dummy counter  field"

TYPE
  tQuestCodeSecEnum =   (SecA (1) "Agriculture",
                         SecB (2) "Fishery"  ,
                         …  {many codes later}
                         SecQ (17) "Extra territorial organizations" )

  tQuestCodeDivEnum =   (       Div01 (1)   "Agriculture Hunting and Related",
                                Div02 (2)   "Forestry and logging",
                                …{many codes later}
                                DivUnknown (99))

FIELDS
   QuestCode    "NACE 4 digit Activity code"             : STRING[4]
   QuestCode02  "NACE 2 digit Activity code"             : STRING[2]
   QuestCodeSec "NACE Section level code"                : STRING[1]
   QuestCode02Enum  "NACE 2 digit Activity code as enumeration" : tQuestCodeDivEnum
   QuestCodeSecEnum "NACE Section level code as enumeration"        : tQuestCodeSecEnum
```

‘Counter’ field that obtains the value 1 in order for us to be able to include counts and totals in the same tabulation.

In Figure 7 below we show you the outcome of this tabulation. Notice that Abacus substitutes the category text for the category identifier (the section codes). Abacus does not print the category values.

C:\WINDOWS\TEMP\Abacu001.ita

File Edit

Total

		Total				
		Counter	RetOpen	RetPurch	RetSales	RetClose
Total		61	2,075,728	4,894,448	5,159,208	2,767,048
Mining	Div14	3	-	4,456	21,140	-
Manufacturing	Div15	6	145,363	1,008,712	800,772	281,267
	Div16	2	2,508	13,568	19,753	2,062
	Div18	1	225,055	534,191	299,965	491,845
	Div19	2	4,039	43,768	77,525	4,877
	Div20	1	[illegible]7	36	71	7
	Div21	1	53,156	97,770	136,209	49,051
	Div22	2	3,690	4,801	7,289	4,170
	Div24	4	107,501	797,850	1,034,492	136,844
	Div25	3	24,242	66,052	70,983	23,988
	Div26	5	42,183	314,938	458,971	48,915
	Div28	5	100,164	197,588	236,758	81,128
	Div29	1	248,107	525,454	538,439	253,028
	Div31	4	17,519	18,742	29,729	15,910

Figure 7 Output of Abacus after recoding

Conclusions

This paper set out to illustrate the power that the Alien Procedure/OLE-automation-DLL technique offers you. For this purpose we developed a proto-type tool, MANITABS, that allows you to define tabulations in Manipula scripts and prepare these tabulations in Ms-Excel. These tabulations, although programmatically defined, have the advantage of being completely open to interactive editing. The MANITABS therefore offers the best of both worlds, programmatic definition of tabulations and full user interaction with the underlying data.

In comparison with Abacus the method presented in this paper has some advantages. In particular enables you to include string, integer and classification data types to be included as row and column fields in tabulations. It also allows straightforward mixing of aggregation functions (Count, Sum, Stdev, Average, Max, Min). Pivottable's ease of use in modification of existing tabulations is quite superior. Finally it provides you with tabulations directly in MS-Excel format. Also, although we define the tabulations in Maniplus code, the resulting tables remain totally user configurable.

Abacus on the other hand has the important advantage of being able to access Blaise datafiles and metadata directly. It also has an elegant way of dealing with array questions. These advantages are mitigated somewhat because you are required to redefine your datamodel and write Manipula scripts to provide support for non-categorical data in tabulation row and column fields.

It is interesting to compare the Alien Procedure/Ole-Automation technique with the upcoming open Blaise architecture. In sofar as we know (We are not privy to any information about OBA, other than that which has been announced by SN) OBA will make Blaise into an automation *server*. This will allow anybody with more than a passing interest and knowledge of both Blaise and a second development environment (C++, Visual Basic, Delphi) to develop *applications* or *tools* that *control the Blaise system*. If you have invested on the other hand on learning Blaise and Manipula syntax, you may want to be able to control (parts of) other applications using the Manipula language or extensions thereof. Therefore the techniques outlined here are *complementary* to OBA.

On a final note, we were quite pleasantly surprised at the speed with which the MANITABS.DLL could be developed. Much of the facilities that Microsoft made available in Pivottable could be made available in Manipula within three days of work, and yield a tool that does not compare unfavourably with an already established tool, Abacus. The main point of the paper is that the Alien Procedure/OLE Automation approach is a high productivity approach. It can be quite gainfully harnessed to resolve other areas in which you might wish to extend the fundtionality of the Blaise system to suit (your) users needs.

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Session 5

How Survey Organisations use Blaise

Around Blaise Surveys at Statistics Netherlands
Marien Lina, CBS

Blaise in European Community Household Panel of Statistics Italy
Alessandra Sorrentino, ISTA

The process of Making a new CAI operation in Statistics Norway
Hilde Degerdal, Statistics Norway

Five years experience with CAI and Blaise
Fred Wensing, ABS

Around Blaise-surveys at Statistics Netherlands

A new ship for a voyage to the Mixed Mode Archipelago

Marien Lina
Blaise support
Statistics Netherlands

Introduction

In 1998 and 1999, all Blaise surveys at Statistics Netherlands were converted to Blaise for Windows. Around the questionnaires and Cati management, a variety of software applications were active for survey management and administration. These applications are in part inconsistent and old-fashioned. The Data input division for Person and Household Surveys of Statisics Netherlands searches for a new system to replace the available variety of tools. All surveys should be able to supply consistent information to this system. Increasing demands on flexibility (for example, combining mixed mode with multiple waves) ask for one integrated system. This paper aims to outline the shape of this integrated information system for managing the survey process at Statistics Netherlands.

This project of developing a new management system for the survey process is still in preparation. Needless to say that the final project may differ from the ideas below, taken from the draft version of the project plan.

Blaise Island in the past century

In the past century Statistics Netherlands has been developing Blaise. The developments went fast. In the eighties there were merely tools for data entry and cleaning forms. In the early nineties Blaise was in use on laptops for the Dutch labour force survey. At Statistics Netherlands, this was the starting point of computer assisted interviewing. At that time the main focus was on computer assisted interviewing itself. At Statistics Netherlands software development for survey research concentrated on the Blaise data entry program: the part of the software that enabled to show question texts on screen and to arrange the order of the questions in a flexible routing mechanism.

In 1989 the Cati-management system has been added. An increasing demand for information asked for larger samples, new surveys and more frequent panel interviews. Apart from CATI-management, other features at that time (Abacus, Manipula, Bascula, Set-ups, Conversions, Coding, Form manager) are not really integrated in Blaise but they were a bunch of independent “tools” placed in a sub-menu of Blaise 2.5. Tools were added to Blaise incidently if there was time to develop a new functional tool for somebody who asked for it. The most important tool around Blaise at that time was Manipula. In the past 10 years Blaise III and 4 have introduced Maniplus and a more consistent language definition for Blaise and Manipula.

CATI island in the past century

On Cati Island there are about 100 interviewers. They work in shifts. The CATI-calling centre at Statistic Netherlands has 54 chairs.

The survey procedures at the CATI call centre are well structured when it comes to handling appointments, non-response and the status of a call. Many credits here for the Cati-call management system. The history files supply standard information, enabling a structural approach of dial results. For example, for monitoring the performance of the interviewers are retrieved from the history files. Management information (time consumption for calling and time in between) from the history files is used for planning interviewers capacities. This kind of small investigations were not performed on a structural base, mostly using Manipula (or home made Pascal routines). Apart from the data in the Cati management administration there was no big administration. The supervisor has a simple (Blaise III like) menu to create overviews of the Cati-surveys (per interviewer, per day or survey period). Non-Response reports are edited manually. Data from the Cati-management system Tools for coding, converting and finishing data were developed outside Cati-island. The advantage of the cati-management system was that the information about Cati in the interview data is uniform.

CAPI island in the past century

For CAPI there are about 550 interviewers in 80 districts around the country. They all have a laptop with a modem at home. They contact field work managers at Statistics Netherlands directly.

There is no Blaise standard CAPI-management system (like the CATI-management system). Outside Blaise a interview administration produces standard tables. It includes ‘reasons for non-response’ tables from the viewpoint of the data collection department. The figures may differ from the non-response definition for the survey from a statistical viewpoint. The non-response classification in EA is merely arranged to give account of proper handling of visiting addresses by the interviewers.

Additional tools have been developed outside Blaise. They cover CAPI-management (like CATI-management) but also tools for data communication, the status of an interview, processing visit records and for keeping the salary-records. These CAPI tools have been developed completely separated from the tools for CATI.

Despite an increasing CATI share, CAPI remains an important input source for statistical analysis. The old tools work together as a solid machine, at least, if they are handled correctly. However, many of the tools for CAPI management ask for manual interventions, are survey dependent, old-fashioned and therefor they ask for replacement by a more consistent Capi-management system.

The Survey Bay

At Statistics Netherlands, organising and executing the field work for the surveys is the task of GEP or “Gegevensverzameling; Enquetering Personen” (in English: “Data collection; Person Interviews”). GEP consists of 70 staff-members persons. They supervise and execute the survey process. Each survey has its own process manager. They guide and monitor the whole process: maintaining the questionnaires, training interviewers, collecting data, coding, quality control, planning and data delivery. The interviews are performed with Blaise.

The organisation of the GEP-staff roughly is devided into CAPI and CATI-surveys. A closer look shows that survey procedures are different for every survey. This asked for survey-dependent protocols. In this sense each survey has its own boat to get the Blaise data from Cati- and Capi-Island. For example, the nature and the amount of finishing jobs (coding, quality control and data delivery) depends on the survey. In the past special help-tools and procedures have been developed for specific surveys. These individual tools are based on a diversity of DOS-applications (Blaise 2.5, Paradox, Pascal, Cobol). The applications needed frequent maintenance.

The rowing boats to Cati Island

For each Cati-survey there is a “rowing boat”. The boat delivers the sample data, and if necessary a new questionnaire, external files, or even a new Blaise version to Cati-Island. Afterwards the rowing boat picks up the interview data (including Cati-management data), updates statuses of interviews, creates some non-response figures, determines the destination of a record and does some administration on board. The procedures on board imply many manual interventions. If someone disturbs the cadence there is a big problem to transport the data from wave to wave. The boat usually manages to get the data safely to the Survey Bay.

The old vessels to Capi Island

A lot of CAPI-management is still done manually. An increasing amount of data collection asked for a new system around Blaise, reducing error caused by manual actions. In the nineties there were four sub-systems around Blaise that managed a part of the required functionality around a survey. Together they form the system called “SPEER”. The sub-systems are:

SPIL (System to Perform dataInterchange with Laptops). This system has been designed to bring sample data to the laptops of the CAPI interviewers at home.

LIPS (Laptop Informationsystem for Personal Surveys).
This system is on the interviewers’ laptops to start datacom, load interiews, make visit reports, remarks and send completed interviews back to the office.

COBS (Computer assisted data manipulation)
This system has been designed for automated data manipulations after the interview data returned at Statistics Netherlands (for example for coding).

EAS (Interview Administration System)
This system keeps track of the status of an interview task. The survey managers use the system to check the response figures. It is also used for the pay-roll of the interviewers. This system has been changed and adapted to meet the needs of different surveys. The result was merely a number of different management systems than one standardised system.

The old system has many loose boats and ships, drifting somewhere in the ocean. Nevertheless also in the current system, automated sub-procedures (such as keeping the pay-roll) and fixed protocols ease management and supervisors. To call this

system a fleet of old vessels is not meant to be a disqualification of its design or the expertise and/or the many investments of its builders. Until today these boats are still on duty and they still succeed to deliver the load they have to.

The exploratory drilling rig called POLS

Until now there is not a consistent system to direct the boats of the fleet in the right direction. As already mentioned each survey has its own management and there was no drive to a uniform approach. In fact every Cati / Capi and Cadi (sub-)survey was an island. This has been changed when the Life Situation Survey (POLS) came alive. POLS was the start of a new approach in which all surveys were regarded as one entity. POLS combined three important surveys (about medical care, life conditions and legal protection) in one system.

For those surveys uniformity in the interview organisation and administration has been reached. However, the three surveys have in common that the observation unit is a person and that for each address only one person has been selected in the sample. The whole system around POLS has been designed for the situation where only one person of a household was questioned.

Unfortunately, other surveys (for example the EBB (labour force survey) and the PAP (a survey about private car use) do not fit on the POLS platform. They have other sample units (households and companies) and may imply multiple observation units per sample unit (persons and license plates). So to say, the drilling isle was too much restricted to one situation, not flexible enough and there was a need for a new ship.

Currently the system meets the point where innovation is required. Changes are needed to improve the handling of mixed mode surveys, stratified sample units (persons in households), panel management and consistency in administration and organisation.

Searching for a new vessel.

To gain the profits of new technology in Blaise 4, one new ship should replace the old fleet. The aim is a new parameter- and menu-controlled system that can handle all relations between CAPI and CATI, suitable to load and carry all survey designs and minimising maintenance. The aimed system includes:

- handling complex survey designs
  - combining different interview modes (Cati, Capi, Casi, Cadi)
  - combining different sample units (households, persons, addresses, license plates)
  - handling data flow from wave to wave in panel surveys

- standardisation
  - consistent procedures for survey supervisors and interviewers.
  - standardised procedures to deliver data to the statistical departments
  - uniform administration for all surveys.
  - compatible data and standardised blocks for non-response treatment

- Version control (data models, questionnaires, external files, Blaise versions) and documentation.

- Windows orientation, optimising use of available ADO components.

A model for a new ship: The body.

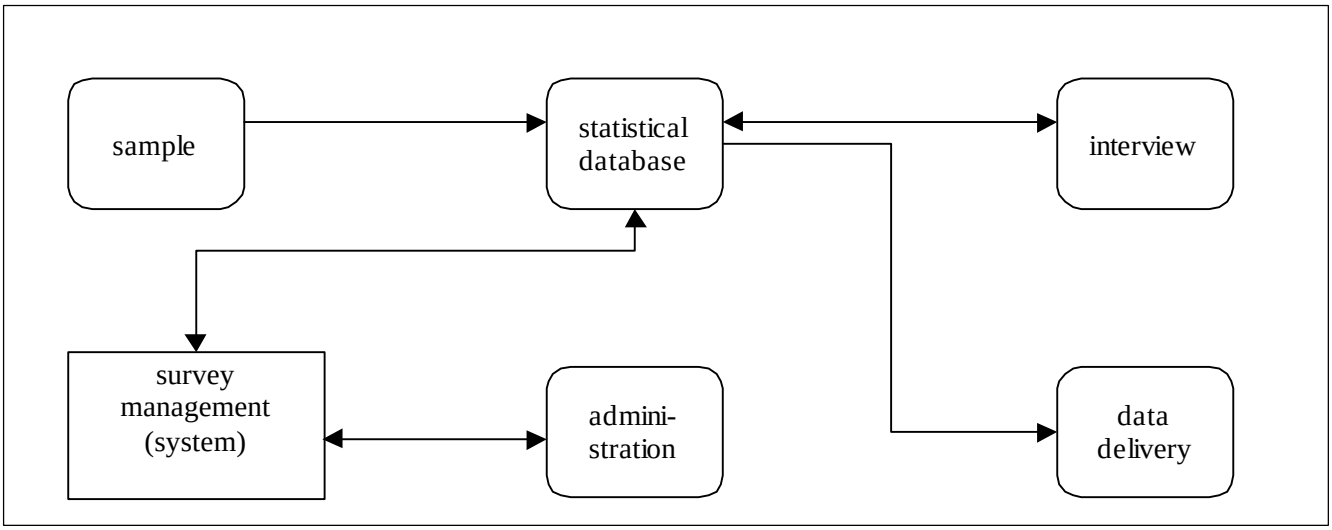
This model shows the main flow from sample to data delivery. This model focuses on the essential process in general terms: to keep the survey going. Many sub-processes are reduced to one here.

The main purpose of system is to combine:

1. controlling the information flow between panels and modes and the statistical database
2. keeping the records of the complete person and household survey administration of Statistics Netherlands.

The system keeps track of the survey process between sampling and data delivery and manages the subsequent steps to be taken.

Figure 1. Simple process model of the survey organisation.



The *sample* is the input of this process model. The output of the of the model is the *data delivery* process.

Data from the sample are directed to a *statistical database*. The database keeps information from the sample and the interviews. The statistical data include keys to link to the administration. Each sample unit that enters the database gets a status. This status is kept and updated in the *administration*.

If records are sent to the *interview* process, the interview will be carried out and the results (completed forms, reports) are updated in the statistical database (data).

The co-ordination of the whole process is done by the *survey management (system)*. The brackets indicate that a part of it may be automated. The survey management system is the wheelbox of the process. For each survey, there is a blueprint of the steps to take for the sample unit before a record it is ready for data delivery. The flow to specific surveys and waves is controlled by these blueprints and the status in the administration.

The survey management system systematically:
1. Checks if there are changes in the statistical database to update the status of records in the administration.
2. Activate sample units for interview or data delivery based on the updated status in the administration.

Based on information from the administration and the statistical database the management determines the next step for each record. This may be the *interview* process or *data delivery*.

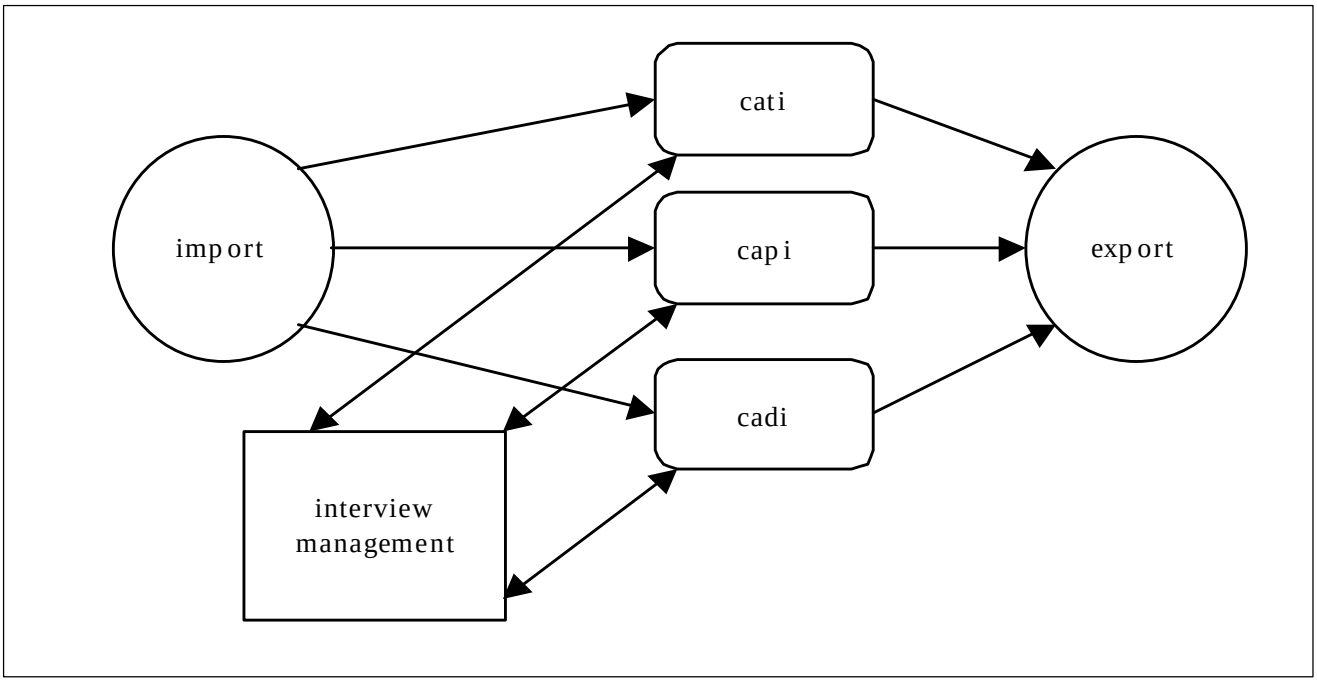
The interview process

The process model above is the general process model for the main stream of interviewing data. The decision to activate the interview process is carried out by the survey management system. The organisation of moving between the statistical database and the interview process is more complicated.

Depending on the survey, codes are supplied with the interview record, controlling the route (i.e., to which questionnaire, wave, interview mode, interview period, version control, check on external data, Blaise version). The system will have to allow for different sample units (person, household or others). Until now much of the decisions are done “manually”. The new approach is to automate the decision rules as much as possible.

No matter how complicated the decision rules are, they are made in advance. The decisions are taken outside the interview process. The interview process is reduced to IMPORT the records in a standard way, to direct them to the proper interview mode (Cati, Capi or Cadi), do the interview and EXPORT them back to the statistical administration.

Figure 2. Process model of the INTERVIEW process.

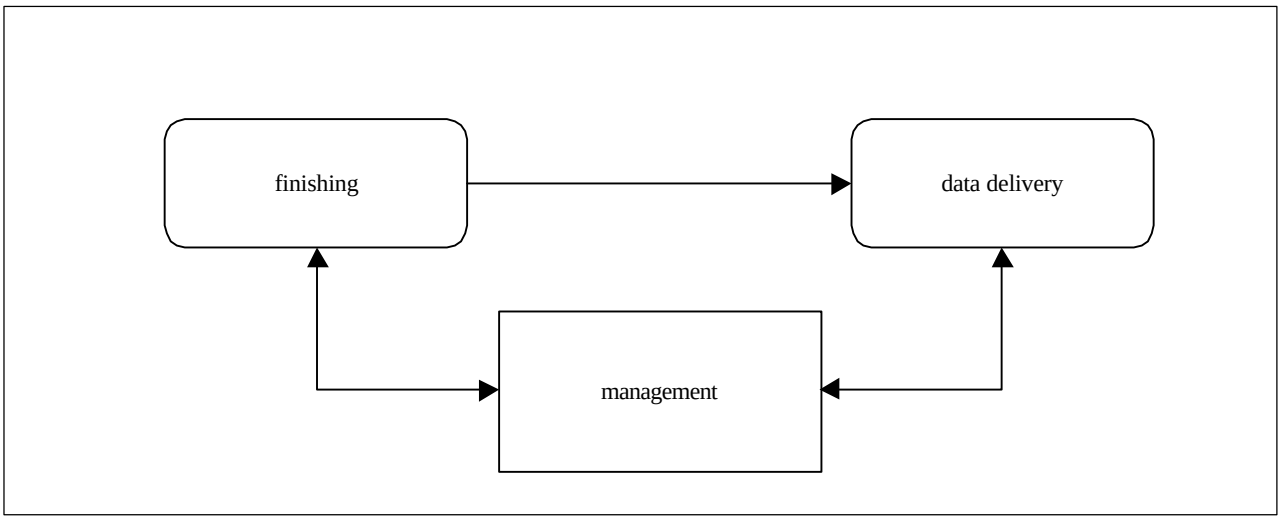


All information exchange with the statistical database passes the IMPORT or the EXPORT module. This ensures uniform data handling. The interview management in the person of a CAPI- or CATI supervisor keeps having an active roll. The supervisor continuously checks if the “interview machine” is working properly. They manage the scheduler for the interviewers. If an interviewer is absent the interview manager takes care for replacement. If there is a problem with the system they report it to the survey management.

Data delivery

The data delivery process in the first model implies two processes: *finishing* and *data delivery*.

Figure 3. Process model of the data delivery process.



Before data are directed from the statistical database to the client, there is a *finishing process*. The number of finishing jobs and their nature depends on agreement with the client (the statistical departments). This finishing process may include coding jobs (for example education and kind of job), cleaning data, quality control of the data and computation of derivations.

The data delivery does not necessarily have to be reduced to the interview records. This may also imply other information (such as the visit reports, remark files, history files, survey reports).

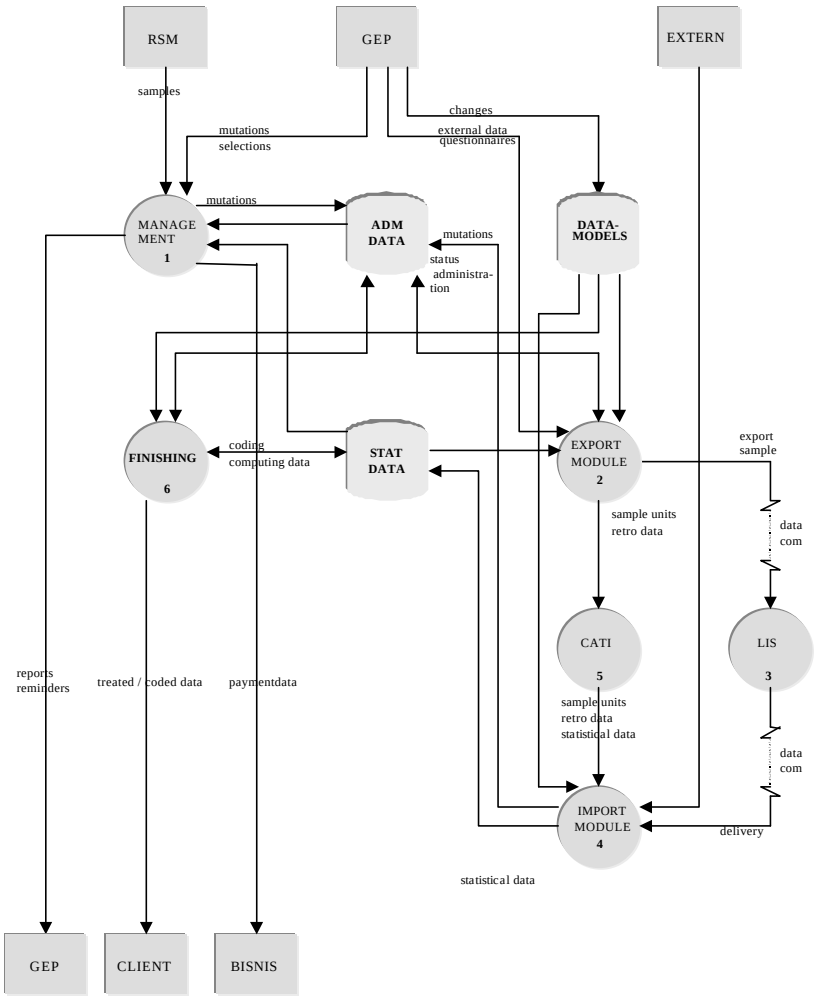
Automated administration

In the previous figures, there is only one line to the administration. The Survey management updates all information in the administration. In fact, the plan is to automate the flow of information to the administration. To reduce the amount of arrows in the figures all of them have been left out.

The Blueprint of the ship

The models above have been put into one complete blueprint. Each survey is supposed to fit in this model.

Figure 4. Draft version of the process model



This process model implies more than the simple models mentioned earlier. There is more detail in this model, nevertheless, this is a draft version.

RSM is the department delivering the input of the system: the sample. This is the only relation of RSM to the system. GEP is the department in charge for survey management. Added in this model is the GEP input in the process, for example, datamodels, mutations on them and mutations on administration data. At the centre of the system the *administration* (SQL-based) and the *statistical database* (Blaise based) can be recognised.

Standardising Import and Export to Capi and Cati Island

On the right side of the figure the IMPORT and EXPORT module link records from the statistical database to the interview process (CATI and CAPI). LIS is the system for CAPI.

Data from interviewers are imported solely by the import module. Similarly, data to transmit to the interviewers must always pass the export module. The EXPORT module takes care for exporting sample data in empty interviews to CAPI and CATI and the IMPORT module takes care for importing completed interview forms into the statistical database and the administration. Using only the modules for import and export ensures that it happens on a standardised way. If for a certain survey the interviewing job is put out to an external enterprise, also the data to and from these EXTERNAL interviewers should pass the import and export modules.

Overall survey management

GEP manages the whole survey process. Part of the system will always ask for manual interventions. If there is a change in any corner of the system, GEP is involved. If the system is out of order GEP organises a repair. For example, when a data communication problem occurs between interviewers and Statistics Netherlands, necessary interventions are controlled by GEP.

The checklist for the ship

A lot of details often are forgotten. This is why a checklist has been made. In fact it concerns too many details to make it an amusing story. Here is just a small part of it.

Survey organisation

- Creating and distributing interview materials (letters, answer cards, panel cards, removal cards)
- Re-distributing returned untreated sample units.
- Reminding interviewers and possible respondents
- Automatic computing analyse fields from values in basic interview fields.

Preparing datacom and Cati

- Preparing and installing the required questionnaires (including Cati system and external files)

Software on the Laptop: LIS, the Laptop Information System enables:

- Importing sample data (unpacking, error handling, log-file sent back to Statistics Netherlands)
- Checking completed interviews for datacom

Planning

Until here is where the project got so far. The plan is still to be finalised. The project aims to start in May 2000 and is planned to be finished at the end of 2001. The current planning of this draft project plan speak about 11 FTE years (not engaged yet).

Credits

Credits go to the project managers and advisers Theo Huijs, Antoon Hogervorst and Frans Kerssemakers for their information about this project.

BLAISE IN EUROPEAN COMMUNITY HOUSEHOLD PANEL OF STATISTICS ITALY

Alessandra Sorrentino, ISTAT, ITALY

USE OF BLAISE IN ISTAT

The presence of Blaise in Istat dates back to year 1994.
Some CADI and CAPI application, even dealing with complex questionnaires, have been developed.
Salary and Wage Structure Survey, Small Enterprises Survey, Italian Household Budget Survey and European Community Household Panel made use – and some of them still use - Blaise System.
Interesting studies regarding, for example, the Italian Household Budget Survey - an important monthly survey - have been conducted on comparison between Blaise controlled data-entry and traditional data-entry (almost without check). Some consideration about this matter:

- 25% time increases during Blaise controlled data-entry. On the other hand this is a natural consequence of this new methodology concentrating on data quality rather than on acquisition speed;
- however this increase in time for acquisition, results in a decrease in time for manual revision of questionnaires;
- moreover Blaise user interacts with this new way of working and seems to be more interested in his job.

Blaise version 2.5 has been used until 1996. Between 1996 and 1997 Istat bought Blaise III licence that simplified the realization of cross-sectional and longitudinal check programs.

A quite user-friendly language represents one of the most interesting Blaise features even if the user is not a skilled software developer. This feature is one of the reasons for its diffusion.
Many surveys are carried out in Istat, but the data-entry is usually performed externally by private companies, with the help of other software. Certainly this is one of the reasons of restricted diffusion of Blaise system in Istat.

Best way for exploiting Blaise system features is to design a controlled data-entry application; in Istat, however, we managed to obtain many other advantages, by means of computer aided revision and edit.

EUROPEAN COMMUNITY HOUSEHOLD PANEL - ECHP

The most demanding Blaise application in Istat is the one concerning the European Household Panel (ECHP).
The ECHP is a yearly survey carried out in States members of European Community. Eurostat had planned this survey and coordinates the activity of different European Countries.

The first Wave started in 1994 and the surveys are going on till 2002.
The models collect questions about work, income, properties, residence, training and education, health, migration and other social indicators concerning household and his members.

The feature of the panel technique is that the interviews are carried out on the same sample of persons and households every year. This allows, after the first year, to analyse the evolution of the sample, from different points of view.
Through a longitudinal comparison of two or more waves or a cross-sectional study between data collected in the 14 countries involved, it is possible to single out social and economic characteristics of Countries, becoming a part of a European context.

CAPI EXPERIMENTATION IN ECHP

The department of methodological studies in Istat has carried out a little CAPI experimentation regarding ECHP survey with Blaise programs. Some interviewers together with Istat employees have interviewed about a hundred of the households using a notebook.

It has been the first CAPI experimentation in Italian Statistical Institute and the outcome was successful both for the positive reaction of households and the good quality of data collected.

At least 50% of households have showed interest in using a notebook.
However this mode of conducting the survey results too expensive without a good network of interviewers (depending on Istat and equipped with notebook) covering all the national territory.

BLAISE IN ECHP SURVEY

On the basis of four standard models sent by Eurostat to Community Countries Members, three Italian models have been prepared (each one with its one record type), keeping the same information in a different format. This adjustment for the Italian social-economical reality has been essential to allow the interviewed households to understand and answer to questions.

The three models are:

1. Household Register is a basic instrument of operational control in the ECHP, collecting information about number of household members, the coding of interview result, the relationships between the individuals and demographic information.

2. The Household Questionnaire contains information about migration, income and economic situation of household.

3. The third and more complex model is the Personal Questionnaire. Each member in the household aged 16 years or more is interviewed. The individual model collects detailed information on each person's economic activity and income, instruction, health and a large number of other variables.

Blaise 2.5 has been used for the first and second waves (1994 and 1995). This version has allowed simple management and automatic counting of dirty and clean records, but this has involved restrictions in datamodels linkages.
Because of the complexity of this surveys, the high number of questions, the longitudinal follow-up year by year both the mass of data and the possibility of mistakes increases and, consequently, the number of checks to implement.

The passage to Blaise III, between 1996 and 1997 gave way to an easier and exhaustive development of checks, carried out either in respect of previous years or current year data.
Thanks to Statistics Netherlands the passage to new release was not a problem.

Our Statistic Institute did not buy Maniplus licence, that had allowed a personalization in procedure. In order to make a user-friendly application, we prepared simple Dos screen in third and fourth Waves (1996 and 1997), and a Visual Basic application for two last waves (1998 and 1999).
As described before, in ECHP survey Blaise in not used as a data-entry system – except the CAPI experimentation - but for the following phase regarding computer aided revision and edit.

Procedure steps in ECHP are listed below:

1. DATA-ENTRY BY EXTERNAL COMPANY

Until 1998 recording of compiled models is carried out by a specialized data-entry company, free to use any software for data-entry. This company also carried out a minimum number of checks.
Data-entry concerns about 7000 households for a total of 30000 questionnaires (7000 Registers, 6500 Household questionnaires, 15000 personal questionnaires).

2. COUNTING RECORDS AND KEY CHECKS USING SAS

Records are stored on a PC Pentium II Hard-disk.
First step on rough data is the count of questionnaires ordered by geographic region.
By means of Sas language double keys are checked out.

3. LOADING DATA AND CHECKRULES USING MANIPULA

Six PC Pentium II are available for this work.
By means of a LAN different users can access data at the same time.
After storage 'Check rules' step starts.
Manipula provides the conversion from Ascii to Blaise format and marks the incorrect records.
We perform batch data processing at evening or nighttime, because data checking in this step could take a large amount of time.

Manipula processing performs the following actions:
- pointing out the range errors;
- pointing out the route errors;
- pointing out the incompatible values among variables of current wave (cross-sectional checks);
- pointing out the incompatible values between current wave variables and previous wave ones (longitudinal checks).

Check programs contain two types of incompatible errors (hard and soft errors):
- If the user doesn't correct the error the record remains dirty and data-entry could be inhibited: this is a hard error.
- if the user decides that the variable is correct he can close the message box relevant to the error and retain the original variable value (but the record hereafter will be considered as clean): this is a soft error.

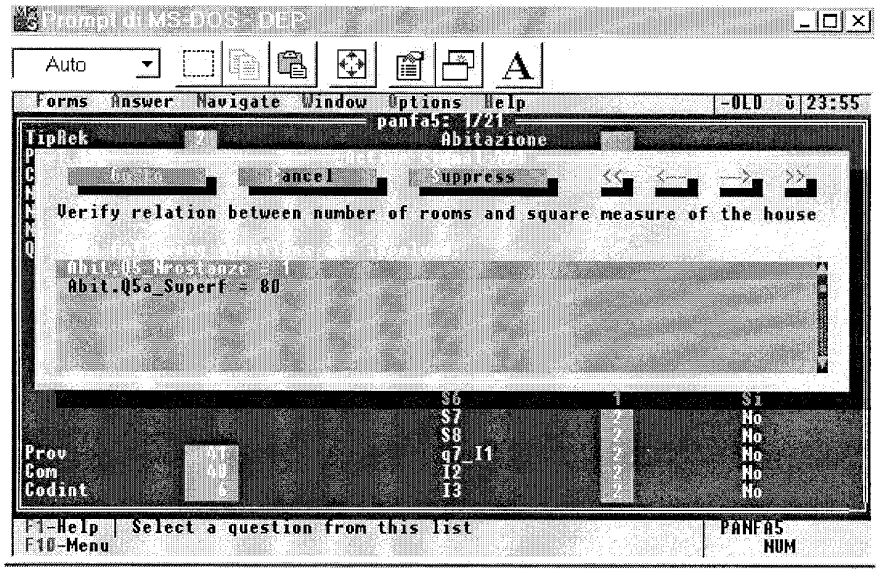
To improve data query performances during checking, different 'datamodels' containing 'NACE', 'ISCO' and countries code are linked to current wave questionnaires.
'Datamodels' containing previous years variables are also prepared.

4. COMPUTER AIDED REVISION AND EDIT USING BLAISE

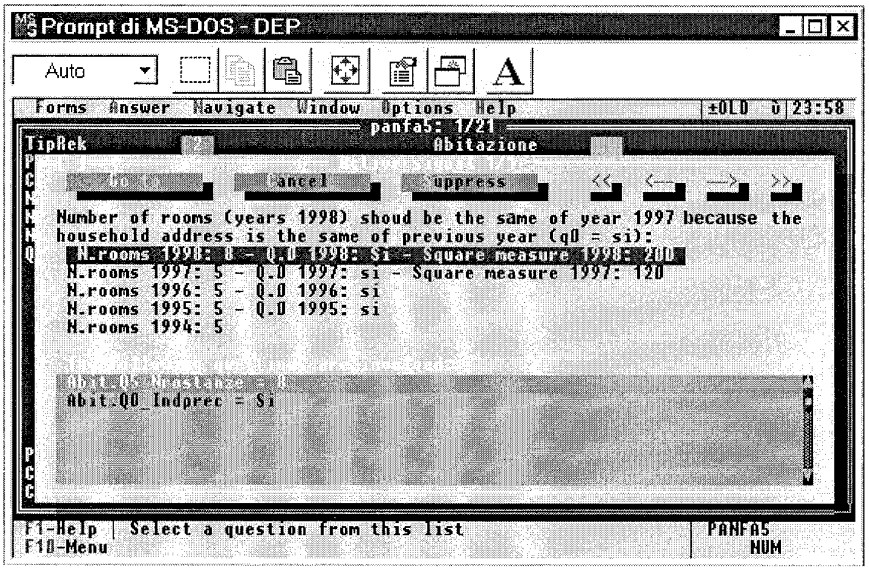
Computer aided data correction is a successive step after Manipula 'checkrules'.
Check plan considers incompatibilities between different variables of current year (cross-sectional check).
Moreover, some variables from previous years data files, are extracted and linked to current year data (longitudinal check); links between current year variables and code files has been made as well.
To avoid system overloading during this phase of correction, only selected variables from previous year have been extracted.
Comparison between data belonging to different waves is necessary in a panel survey.
The main feature of a panel consists on the longitudinal dimension. This means that some variables could be in contrast with the same variables in the previous years of the survey. While what is needed is that outcome be coherent with the past waves
Each data resulting in contrast with assigned constraints is enlightened (to enlighten) as a mistake and a relevant message box appears on the screen. On this message box, even the variables involved in the error, appear.

Some examples of checks here below:

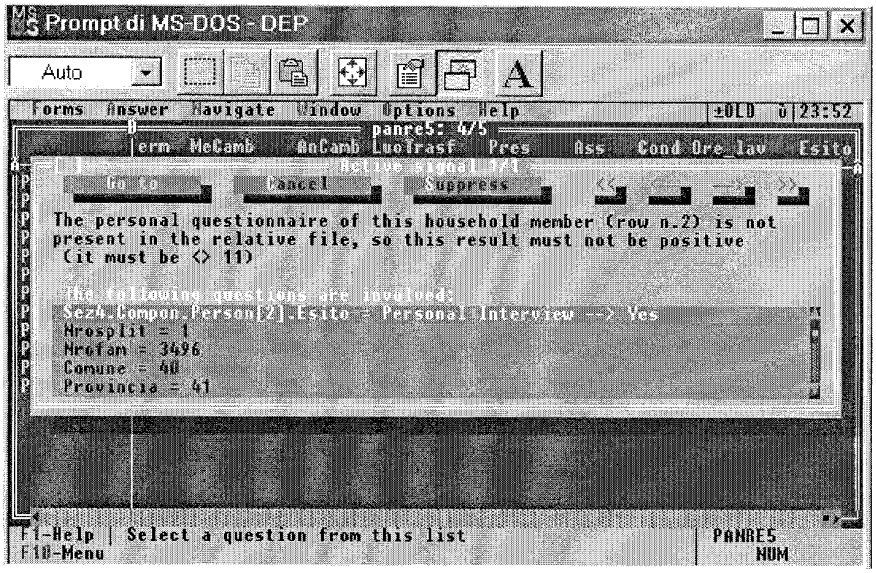
- Household Questionnaire: relation between the number of rooms in the house and its square measure is incompatible:



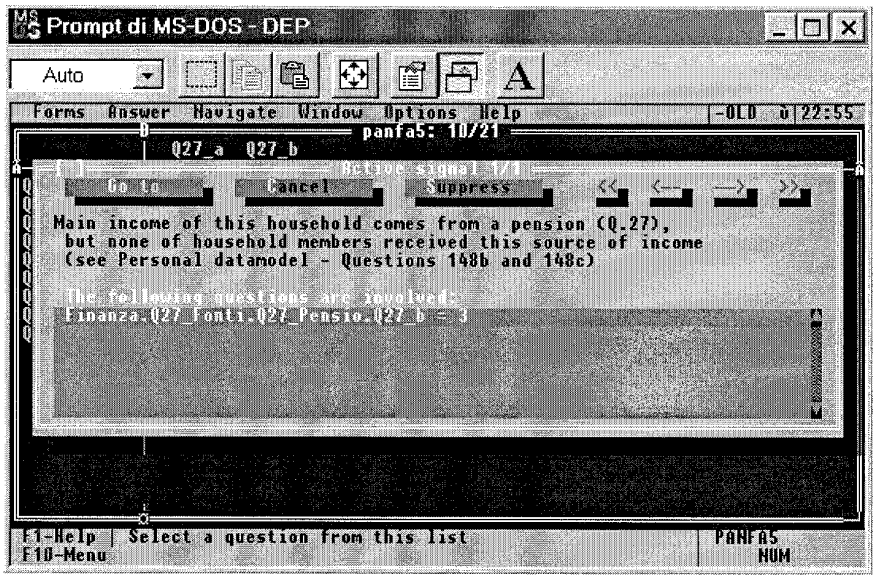
- Household Questionnaire: the number of rooms in the house is different from the number of rooms in previous year. The household, however, lives at the same address. An explicative message shows the answers for all previous waves: the user can decide which is the best answer.



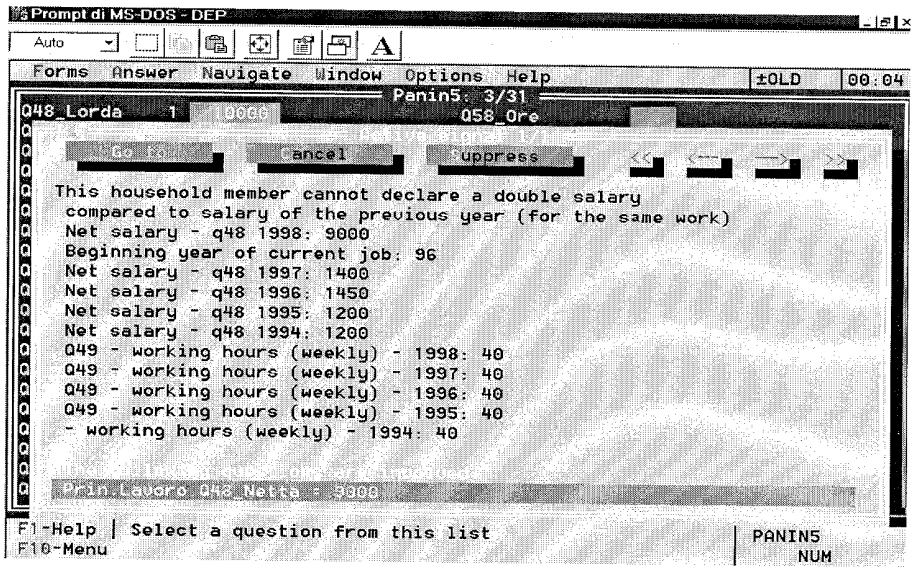
- Household Register: even though in household register is declared that two personal questionnaires are filled in, there is only one personal datamodel. Blaise requires to verify the number of existing paper model:



- Household Questionnaire: the application links some information from household questionnaire (main source of income coming from pension) with some other information from the personal questionnaires (source of income). Error arises because none in the household receives a pension indeed.



❖ Personal Questionnaire: the interwieved person has declared too large amount of salary compared to the amount for the previous years (obviously for the same work). This is an example of longitudinal check:



The following table summarizes some information concerning datamodels and error types for Wave 5 – 1998:

Datamodel	Program rows	Questions Number(1)	Fields	Error Type **A**(2)	Error Type **B**(3)	Error Type **C**(4)	Total Error **A+B+C**	Automatic Correction
Register	1755	20 + 13	400	4	12	59	75	19
Household	1261	45	120	11	3	25	39	47
Personal	3420	202	400	18	16	177	211	75

(1) - Question number for Register: 20 questions concerning household + 13 questions for each household member.
(2) - Error type A: pointing out of the errors arising from linking variable values contained in other models for current wave or code files.
(3) - Error type B: pointing out of the errors arising from linking variable values from previous waves.
(4) - Error type C: pointing out of the errors arising from inconsistency between variable values within the same datamodel.

5. WORKING IN DOS AND VISUAL BASIC

To make user-friendly the Blaise III application we prepared simple Dos form for Wave 3 - 1996. This Dos menu is designed by means of Dos batch programs.

In short the Dos menu allows:

- direct access to selected datamodel, without passing throw the main Blaise menu;
- automatic activation of certain data-entry mode (Data Editing Mode);
- clean and dirty records counting;
- conversion from Blaise to Ascii format;
- automatic data saving on floppy-disk.

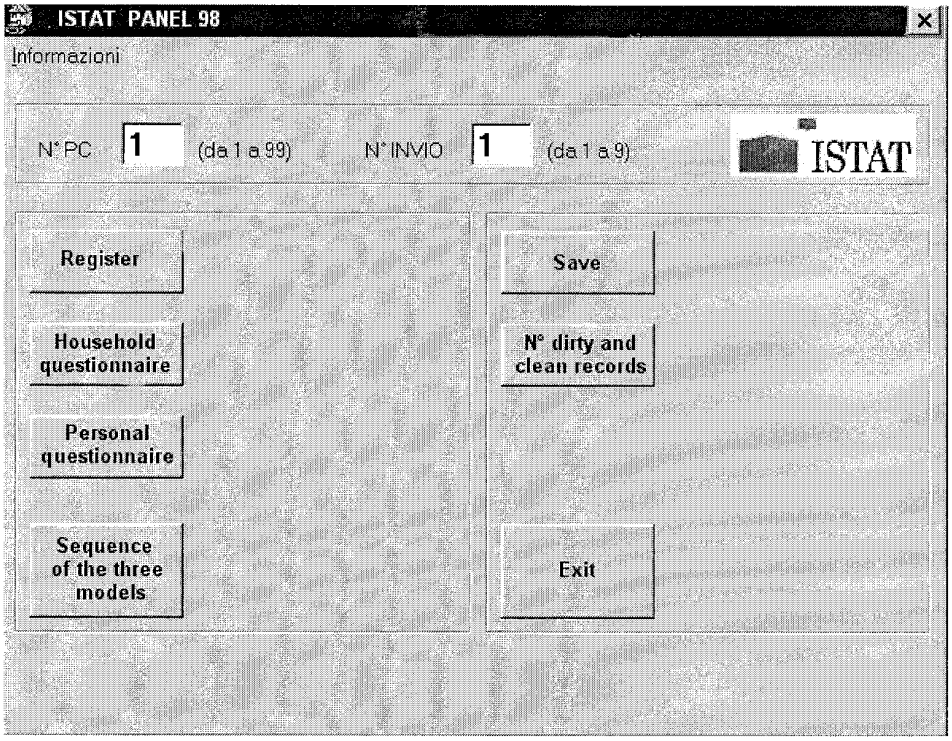
Moreover, a very useful feature that we have used, is the possibility to change easily data-entry mode. For example, Data Editing Mode facilitates navigation in datamodels, even if there are hard type errors.

In our department revision and edit is organized in geographical areas and each employee works on a particular area. This means that a global counting of dirty records was a nonsense. That's why we prepared other Dos Bat files, managed by a Visul Basic application.
This application allows a record counting selecting a given area (provincia). So each user is able to check the number of the record that he has cleaned so programming his work timetable.

Visual Basic application allows the following functions:

- one ore more questionnaires selection;
- saving of data on others PC's;
- clean and dirty records counting;
- recording of a file (log) containing the number of records cleaned and the dates in which this count was required;
- exit.

Visual Basic application, that manages described query, is showed down:

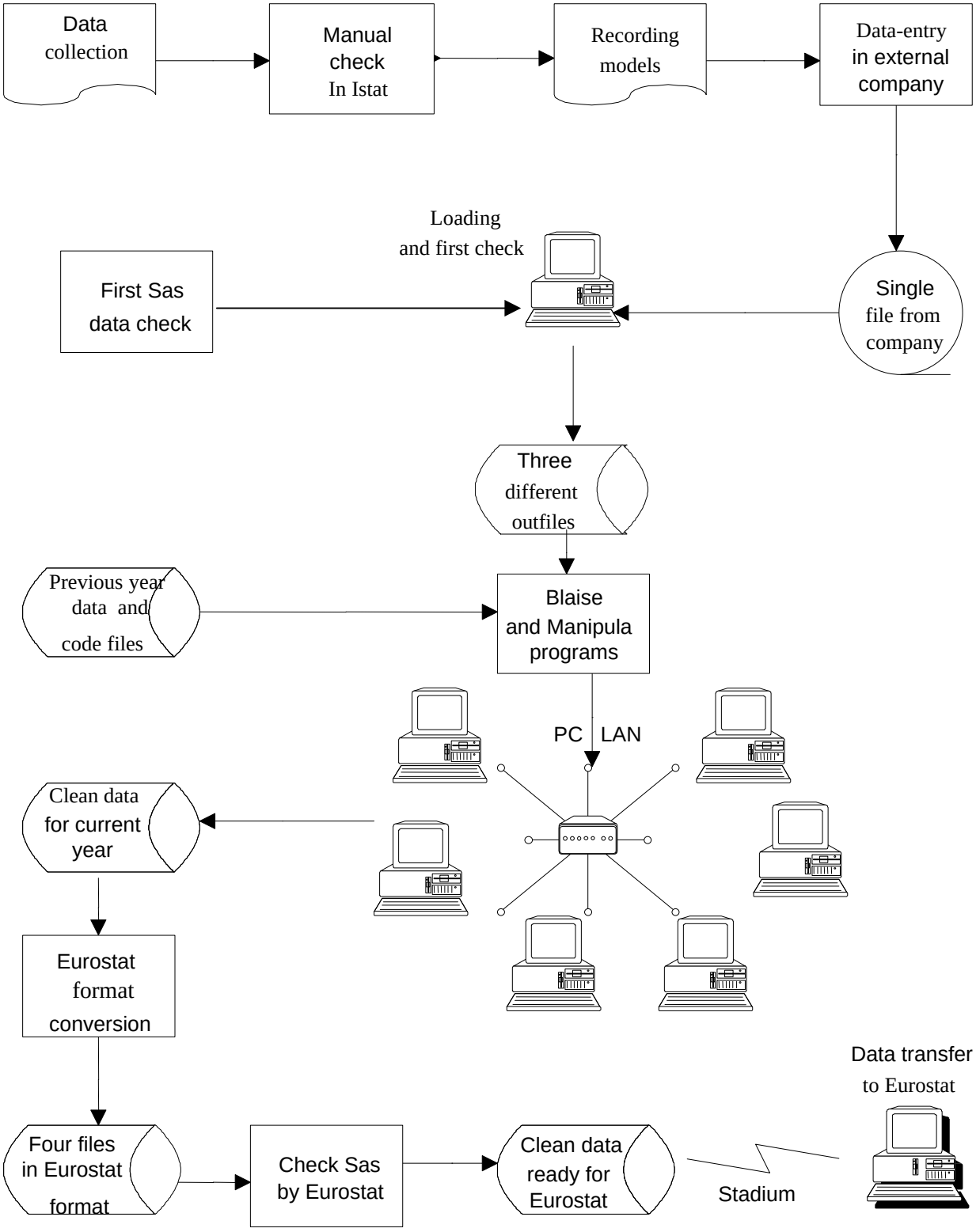


6. EUROPEAN DATA FORMAT CONVERSION USING COBOL AND SAS

Once Blaise data correction on Italian format is performed, record types are converted in four Eurostat record types, by means of Cobol and Sas language. Output data are submitted to Sas checks written by Eurostat. Basically these checks account for relationships among individuals, structural errors (i.e. incoherence between two models in the same wave), plausibility (checks on variables – for example income, pensions, mortgage – between two different waves) and so on.
Although the error checklist by Eurostat is large enough, we thought to enlarge this list by adding our own Blaise error codes.

At present we are also thinking to improve automatic editing using appropriate software tool, such as Scia.
Scheme of Panel steps survey (from 1994 to 1998) here below:

FLOW-CHART OF PANEL PROCEDURE



QUALITY INDICATORS

Since Blaise does not count the total errors for each datamodel, but gives only total number of clean and dirty records in a file, for a better understanding of what type of error it is and its frequency, we completed the records (in Blaise format) by inserting error codes at the end. In this way it is quite simple to get statistics about the errors.
The table shown below – as an example – is calculated on a sample of 500 households. The example regards the household questionnaire only:

Error Code	Error Frequency	%
CBF001	10	2,81
CBF002	10	2,81
CBF006	26	7,30
CBF010	1	0,28
CBF011	81	22,75
CBF013	1	0,28
CBF017	6	1,69
CBF019	3	0,84
CBF020	10	2,81
CBF023	1	0,28
CBF024	3	0,84
DBF001	43	12,08
DBF003	1	0,28
DBF004	2	0,56
DBF005	1	0,28
DBF008	1	0,28
DBF009	75	21,07
DBF011	12	3,37
SBF001	9	2,53
SBF002	6	1,69
SBF003	2	0,56
SBF004	2	0,56
SBF005	11	3,09
SBF008	38	10,67
SBF010	1	0,28
TOTAL	356	100,00

Code C…: cross-section error type.
Code D…: automatic correction.
Code S… : structural error type.

Analysing this table allows the researcher to have a feedback to operate on questionnaire formulation or on more instructions to the interviewers.

FUTURE DEVELOPMENT OF BLAISE IN ISTAT

For the 6th Wave of ECHP (1999) we decided to perform controlled data entry using Blaise III release.
At present we are planning to pass to Blaise IV release for Wave 7 (2000).
We are also examining the possibility to carry out an important survey, such as Italian Labour Force Survey, making use of Blaise IV Capi mode.

CONCLUSIONS

In this paper the experience of Statistics Italy using Blaise has been presented, with a particular attention to European Community Household Panel.
Blaise III has become an integral part of Panel survey processing methodology, helping (by designing the appropriate datamodels) researchers to understand how to improve questionnaire and easing the checking phase too.
This document shows also the good properties of Blaise III, Manipula and Visual Basic as tools for a rapid application development.

Thanks to:

Sara Mastrovita and Pierpaolo Massoli for the active collaboration in paper translation;

Stefania Macchia for studies on Italian Household Budget Survey and CAPI experimentation on ECHP;

Sandro Baldanza for Visual Basic application;

Concetta Pellegrini for Flow Chart of Panel Procedure.

Alessandra Righi, Giuliana Coccia, Stefania Macchia and Giulio Barcaroli for comments on paper.

The process of making a new CAI-operation in Statistics Norway

Hilde Degerdal
Statistics Norway

In 1994 we implemented our first CAI-operation in Statistics Norway. It turned out to be quite successful. We did not have to make any changes in the solution for five years. In this paper I will describe the changes done in 1999, and how we organised the work.

At the beginning of 1999 the procedures and the hardware were almost the same as those we started with in 1994. It was an old server (Pentium 60/32 MB) running under NT 3.5, and 150 laptops, mainly Toshiba 1910 (486/4MB), running under Windows 3.1. We used Blaise 2.5, and for the communication part, Microsoft Mail with some modifications.

It was all growing quite old-fashioned and laptops broke down more and more often.
Both the interviewers and the staff in the office suffered from the lack of a good case management system. “The Data Inspectorate and the protector of privacy in Norway” has very strong restrictions for operations of this kind, and accordingly, they would not appreciate our solution by then. And finally we had the ghost of Y2K. It was obvious that we needed to do something.

What to renew?

We decided to make a complete new CAI-operation. Some choices were easy to make, and one of the easiest ones was to go for Blaise 4 Windows.
To change from Blaise 2.5 to Blaise 4 Windows meant that every questionnaire had to be rewritten and the data management for the surveys had to be rebuilt to fit the new data input.
Our old operation had very poor case management systems both in the office and out on the laptops. Consequently, these were really areas for improvement.
The interviewers report their time lists in a system built up as a Blaise questionnaire. This questionnaire had to be rewritten.
Another task in this area was to build up one updated register with all necessary information about the interviewers, to be used for all purposes.
One of the major tasks was to purchase the required hardware. This was of course also the most expensive part.
The most complicated part, however, was to build up a convenient and user-friendly communication solution, which still met the restrictions of “The Data Inspectorate and the protector of privacy in Norway”.

Organisation of the project

The old CAI-operation was built up, and was an application running inside the Division for Sample Surveys. We aimed at building the new system in such a way that it was to be seen as a part of Statistics Norway’s total IT –structure. It was necessary to pick resources from the whole organisation to build up this new CAI-operation.
To understand the composition of the groups developing the new system it is necessary to have an Organisation map of Statistics Norway (figure 1)

We built up an organisation with working groups for each of these main areas.

- Implementation of Blaise 4 Windows
- Taking care of influences on the surveys that are continually conducted
- Case management system
- Necessary changes in payment and personnel management of the interviewers
- Hardware purchase
- Communication solution

Statistics Norway

Chairman of the Board						
Director General						
Department						
Economic Statistics	Social Statistics	Industry Statistics	Research	Administrative Affairs	Coordination and Development	Unit without department connection
Division						
National Accounts	Social and Demographic Research	Business Register	Public Economics	Budget and Accounting	Division for IT	International Consulting
Environmental Statistics	Population and Education Statistics	Income and Wage Statistics	Resource and Environmental Economics	Personnel Administration	Statistical Methods and Standards	
External Trade, Energy and Industrial Production Statistics	Health Statistics	Primary Industry Statistics	Macro-economics		Information and Publishing	
Economic Indicators	Sample Surveys	Transport and Tourism Statistics	Micro-econometrics			
Public Finance and Credit Market Statistics	Social Welfare Statistics	Data Registration				
Labour Market Statistics	Population and Housing Census	Construction and Service Statistics				
Office						
Administration	Administration	Administration		Joint Services, Kvgr		
IT	IT	IT		Joint Services, Oslo		

Fig 1

The participants in the groups were mainly picked from different divisions in Statistics Norway, according to the task of the group. We could not find any person inside Statistics Norway with the knowledge of making a communication solution meeting the strong restrictions demanded. If someone had the knowledge, they were not idle to do it. It was generally a lack of IT-resources in-house because there were several other Y2K-related projects running in Statistics Norway as well. Therefore we had to hire some consultants for this task. We ended up by hiring two consultants from the company Computas AS.

A steering committee was established to keep an eye on the process and use of resources.
The steering committee consisted of the leaders from

- The Division for IT
- The Department for Social Statistics
- The IT-office of the Department for Social Statistics
- The Administration-office of the Department for Social Statistics
- The Division for Sample Surveys

A representative for the consultant's agency also attended the meetings of this group. The meetings were kept quite regularly, once a month during the period of May to December 1999.

Of course we wanted to develop the new operation in cooperation with the users.
We put together a reference group, consisting of 7 interviewers, one representative from the division of Labour Market statistics, and 1-2 representatives from each of the different groups in the division of Sample Surveys. Members of this group were summoned when they were needed for discussing matters in the working groups.

The working groups and their tasks

Implementation of Blaise 4 Windows

We wanted to develop our competence in Blaise 4 Windows in an efficient way. We hired an instructor from the company Names to give a course in Blaise 4 Windows. He stayed a week in April last year. He pointed out the main issues in the new software. By having a course like that we also gained of getting a dedicated week for training.
We wanted to use the opportunity to make the questionnaires for various surveys more similar than they used to be. Therefore we made a template for questionnaires with standards for layout and a set of administrative variables. We also built up a sort of a question library for background variables. Concerning layout, it was obviously even more necessary with standards in Blaise 4 Windows, with all its possibilities for colours, fonts and so on.

We needed new coding lists for use in the new Blaise questionnaires as well. The list of professions also had to be converted to the International Standard Classification of Occupations (ISCO-88). The old one was built on an older standard, and a number of newer profession titles were lacking. The list was made by picking data from the Labour Force Survey, different registers and the Population Censuses, totally 4 260 cases. Professional coders in Statistics Norway had coded these. It was also made a coding list of municipalities, and a couple of others regularly used lists.

In this group mainly persons from the Division for Sample Surveys took part.

Surveys conducted continually

- Labour force survey
- Household budget survey
- Survey on dwelling and rent

These surveys are always running. It was an important task to avoid them suffering from the changes caused by the switchover. Of course it was necessary to rewrite the questionnaires for the Windows version. As the reception system for the data from the Labour Force Survey could not handle any changes in the data structure, it had to be handled very carefully.

The plans for implementation of the new operation meant that it was no distributed interviewing going on in January 2000. All interviewing for the continuous surveys had to be handled with extraordinary CATI-operations in the office.

A working group was appointed for each of the surveys. They consisted of persons from the Division for Sample Surveys and persons from the divisions with the thematic responsibility for each of the surveys, which are the Division for Labour Market Statistics (the LFS), the Division for Social Welfare Statistics (Household budget survey) and the Division for Economic Indicators (Survey on dwelling and rent).

Case management systems

In the office
We needed a good tool for management of interviewers, surveys, questionnaires and interview objects. It should be a tool for preparation, distribution and delivery of interview objects as well as reception. The management system should also be a tool for supervision during the period of data collection. The field staff wanted a suitable tool for supervision of the interviewers' work, a possibility to locate an interview object when wanted, and a system making it possible to redistribute interview objects from one interviewer to another. The system was built up in Oracle. (For more details on the solution, see Thomas Hoel’s paper "Central and local survey administration through communicating data systems”)

On the laptops
We wanted to build up a user-friendly solution to handle the installation, information, appointments and return of data for the respondent on the interviewers' laptops. The solution should be an improvement seen from the interviewer’s point of view, in that they should have as much information as possible about the respondent in advance. The old operation had no possibility of handling appointments across the surveys. This was absolutely wanted. Since this tool should handle Blaise data, it had to be

written in Manipula/Maniplus (For more details on the solution, see Thomas Hoel's paper "Central and local survey administration through communicating data systems")

The groups developing these systems consist of staff from the IT-office in the Department for Social statistics and persons from the Division for Sample Surveys.

Payment and personnel management of the interviewers

In parallel with our project there was another project going on, handling personnel management and wage system in Statistics Norway generally.
One of the main tasks for our group was to make a new Blaise questionnaire for the CAP-system (Computer Assisted Payment). The data from this questionnaire, it means data of working hours and other expenditures in connection with their work, is handled in a separate system before it is forwarded to the central governmental wages system. This system had to be renewed, as a consequence of changes in input, as well as in output.
There existed several registers and databases with personnel information on the interviewers for various purposes. We aimed at building up one updated register with all necessary information.
The changes made by the other project lead to a solution where all the personnel information was kept in a separate network. This decision made it impossible to reach our goal of one register.
Still we have no complete register with all the information that we want to have about the interviewers, for use in our division.

This group was staffed from the Administration-office in the Department for Social statistics, the IT-office in the Department for Social statistics and the Division for Sample Surveys. We did also cooperate with people from the central Department of Administrative Affairs.

Hardware purchase

Some of the newer laptops that were in use could have been upgraded. However, it was desirable to have screens handling the resolution of 1024 * 768 pixels, both for the application for case management (made in Maniplus) and for the Blaise questionnaires.
That meant that we had to replace all the laptops. Beside the economic point, we set great store on the ergonomic points. We ended up with Toshiba Satellite, 4090. It is a model with Celeron processor, 400 MHz, 64 MB Ram and a 14.1" TFT-screen.
As we had not employed new interviewers during the year of 1999, we had a vacancy of 20 jobs at the end of the year.
It meant we needed to buy 130 of the laptops. They were delivered equipped with network cards.

Another task in the same area was to take care of the process of switching the analogue lines by the interviewers to digital ones. The interviewers installed the necessary equipment themselves. Routers were purchased for all the interviewers. The routers also had analogue ports, making it possible to use the old equipment in the transitional period. The interviewers still use analogue phones.

Of course new servers and central routers were also needed for the new operation.

This group was mainly staffed with persons from the central unit, Division for IT.

The communication solution

This is of course the most critical part in any distributed CAI-operation. And with the strong restrictions it was quite a challenge to build a good solution here.
We wanted an ordinary mail program. This was a feature in our old CAI-system, and we had learned to appreciate this way of communicating with the interviewers.
Of course we needed programs at the laptops making it possible to

- collect the data for return to the office
- install a new questionnaire
- install respondents (initial and additional)
- upgrade and retrieve files.

The solution should also offer a possibility for the interviewers to reach the database in the office, in order to

- pick up new questionnaires or other updates
- pick up new respondents
- deliver data

- update the status in the database

The data transmission are of course encrypted. We needed firewalls and built up a structure as scratched in figure 2.

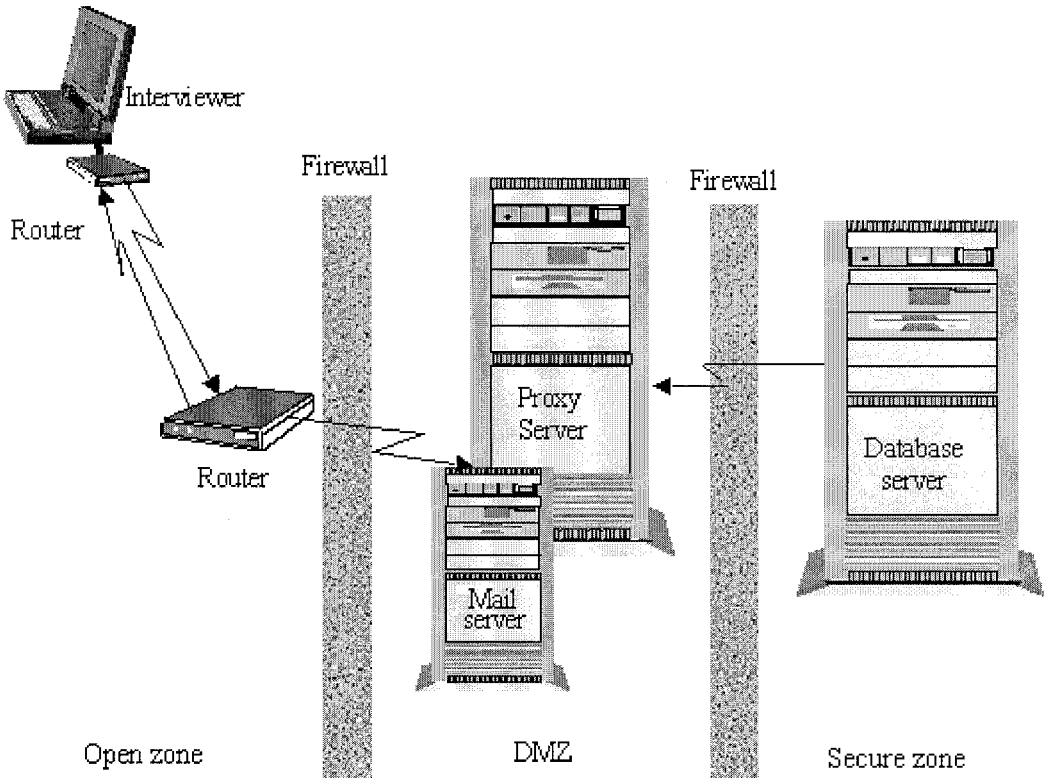


Fig 2

The greatest challenge was, however, how to meet the requirement from “The Data Inspectorate and the protector of privacy in Norway” at the point “Initiation of access to data inside Statistics Norway shall not be possible from the outside”
The communication is using a dial-back RAS connection (Remote Access Server) over ISDN. The interviewer client communication software talks to a reverse proxy server, which is polled from the inside. In this way, all traffic through the firewall is initiated and controlled from the inside.

The main units in the communication solution are the packages. We have packages of different kinds for the different purposes (For more details, see Thomas Hoel’s paper “ Central and local survey administration through communicating data systems”)

The tools used in the communication part are Internet Explorer 5.0 and Java. For accessing Blaise databases Java calls Manipula scripts.

The consultants did the main part of the development here. It was done in close cooperation with people from the Division for IT, as well as people from the IT-office in the Department for Social Statistics.

Schedule

We started planning the process in the autumn 1998. The project was intended to start as early as possible in 1999. The real kick-off of the project, however, was not until the beginning of March. Almost all the groups had their deadline in the end of November. The plan was to use December for testing, and January 2000 for training of the interviewers. However, we got a delay on the communication functionality. This was not complete until the middle of January, 5 days before start of the courses.

Resources

We received the laptops in December. It was planned that way in order to delay the main expenditure of hardware purchase to 2000. The main burden for software development was in 1999. From an economic point of view it was preferred to have the expenses divided over two different years' budgets. The total budget was 5.5 mill NOK, and additionally 5050 man-hours of work inside Statistics Norway.

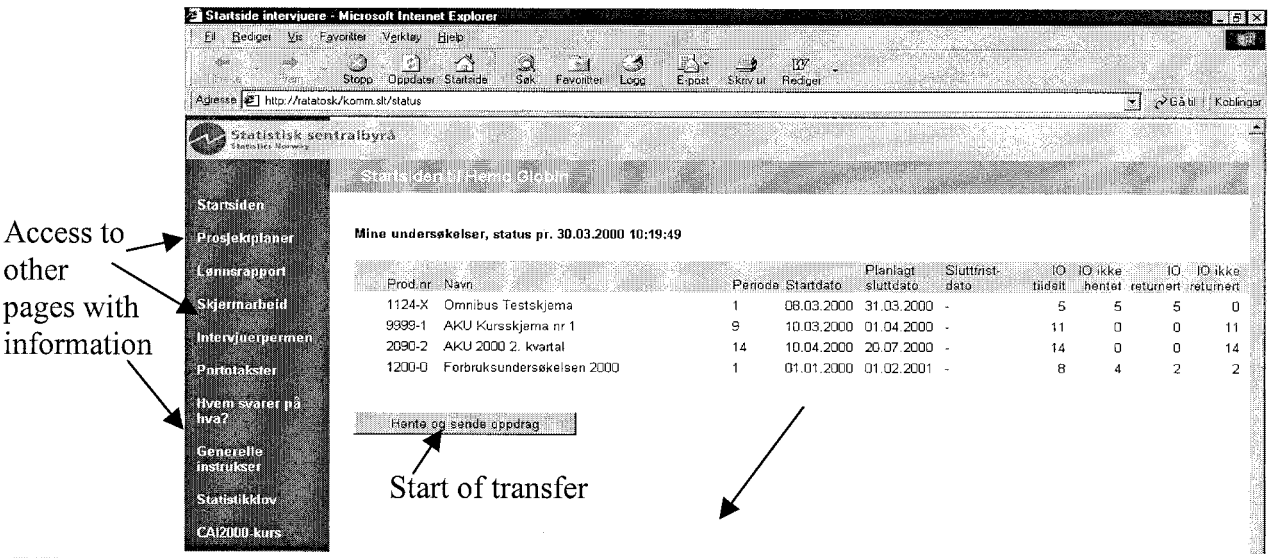
Training of the interviewers

We arranged 5 courses at different locations in Norway. During the courses the interviewers received their laptops, and they learned to use the new software. The training was combined with training for a new big survey starting in February. Only one day was dedicated for learning the new CAI-operation. In addition the interviewers was paid for 10 hours of training and initial preparation at home.

The experience so far

We have had more ”children’s diseases” than we wanted, mostly in the area of communication.
There have been some problems with session handling, resulting in lack of contact with the database. The solution with the routers has also proved to be somewhat unstable.
We started with laptops with encryption of the disk, but this solution led to a lot of hang situations with blue screens. So still we are testing out other sorts of software for this purpose.

All in all I think the new CAI-operation means an improvement for all users.
First of all we have far much better administration tools both in the office and on the laptops.
The whole solution is built up on modern software. The Web technology is a handsome way of delivering and reaching information. The interviewers really appreciate their home page (an example in figure 3) giving them the status of their workload for the moment.



	Period no	Start of the period of data collection.	Deadline	Changes in deadline	Number of respondents dedicated for you	Respondents still not transfered to your laptop	Respondents finished by you and returned	Respondents not returned
Survey A	1	08.03.2000	31.03.2000		5	5	5	0
Survey B	9	10.03.2000	01.04.2000		11	0	0	11
Survey C	14	10.04.2000	20.07.2000		14	0	0	14
Survey D	1	01.01.2000	01.02.2001		8	4	2	2

This page also offers access to a lot of information needed from time to time, as lists of postcodes, rules of working conditions, tips on good working habits etc. They also reach reports of their working hours reported, for each day, and month. There are plans for more reports, e.g. a report making it possible for the interviewers to compare themselves with their colleges in question of non response percent for a survey and so on.
Another feature appreciated by the interviewers is the automatic dialling of phone numbers. Using the analogue telephones together with the internal modems in the laptops makes it possible to dial a phone number from buttons in the Maniplus-screen.

We have also succeeded meeting the restrictions from “The Data Inspectorate and the protector of privacy in Norway”. There have been composed several reports for the purpose of supervision, and even more are planned, meaning that the system offers a good tool for supervision.

So, all in all, I think the process has been a success, even though it has not been without complications.

I will also use the opportunity to thank Vesa and his colleagues for several good ideas during our visit in Helsinki in May. We will also thank Lon and Marien for answering countless questions about Blaise/Manipula when we visited them in September and in several mails. Last, but not least, thanks to Leif, for his kind help with the TAPI functionality.

Five years' experience with CAI and Blaise

Fred Wensing, Eden Brinkley, Australian Bureau of Statistics

Abstract

This paper summarises five years of experience by the Australian Bureau of Statistics (ABS) with Computer Assisted Interviewing (CAI) and the use of Blaise.

The paper will give a brief history of the use of CAI in household surveys at the ABS, commencing with a small scale trial in 1994 and progressing through its use in 5 major surveys. The paper will discuss the issues considered in the business case for CAI and some of the concerns which led to it not being implemented as widely as first planned.

The ABS decided to use Blaise for CAI in household surveys after a detailed evaluation of the software was made in 1994 and in recognition of the plans that were being made to further develop the product. The ABS has used version III of Blaise since the early beta test versions became available in 1995. Our experience with Blaise software has been varied and much has been learned about building instruments and applications. In recent months some of our Blaise facilities have also been converted to make use of Blaise 4 Windows. The paper will give a summary of those experiences and highlight some of the lessons learned.

Five years' experience with CAI and Blaise

Fred Wensing, Eden Brinkley, Australian Bureau of Statistics

Introduction

Computer assisted interviewing (CAI) has been employed as a collection method for a selection of household surveys at the Australian Bureau of Statistics (ABS) since 1994. During that time we have maintained a stock of 230 notebook computers, conducted over 17 pilot tests and 6 major surveys involving more than 250,000 CAPI interviews, 400 interviewers and 150 office staff.

This paper summarises the ABS experience and highlights the major issues associated with the decisions to make use of CAI. Some of the difficulties experienced are also discussed.

When CAI was first employed by the ABS in 1994 version III of Blaise software (for DOS) was just becoming available in a beta test version. Our use of Blaise has progressed through a number of enhancements of the software and we are now commencing to make use of Blaise 4 Windows.

This paper also describes our experiences with the development of the infrastructure associated with CAI, in particular the key role played by the Blaise software suite.

Brief history of CAI in the ABS

The use of CAI in ABS household surveys was examined in 1993 and a case was prepared for its introduction subject to a comprehensive test being conducted to ensure that it was viable. Previous considerations of CAI had concluded that systems were not advanced enough. But the situation had changed, with a number of overseas agencies adopting CAI.

A small scale trial of CAI was conducted in July 1994 using the Household Expenditure Survey (HES). The HES was deliberately chosen as it was a large survey questionnaire involving more than 800 questions. The trial was conducted on a sample of 450 households using 10 interviewers who were each equipped with a 486 notebook computer (monochrome screen). The test also included the transmission of data via E-mail.

On the basis of the success of this first trial of CAI a proposal was developed and approved in 1994 for the introduction of CAI to all household surveys by 1997, including the monthly Labour Force survey.

From the end of 1994 and through 1995 work proceeded on the infrastructure required for CAI, such as field systems, office systems, transmission systems and instrument design. During that time a further four tests were conducted to check various aspects of the infrastructure, office and field procedures, and training material.

In order to ensure that the systems could support the requirements of a monthly survey with a tight schedule, a major trial of CAI was conducted in the first six months of 1996. This trial made use of 80 interviewers and a rotating sample of 4,000 households per month which was conducted in parallel with the existing monthly Labour Force survey (which used a pen and paper collection methodology) to enable direct comparisons to be made. This major test provided valuable experience which contributed further to the development of systems.

At the same time, indications were emerging that the original cost estimates for CAI were likely to be significantly exceeded particularly in the area of hardware. This led to a management decision taken in late 1996 to pull back from full implementation in all household surveys. Given that the stock of notebook computers had reached 230 by then (in preparation for the first production use in an ABS survey), it was agreed that CAI should continue to be used for a number of major stand-alone surveys but that plans to employ CAI for the monthly Labour Force survey should be abandoned for the time being.

The first production application of CAI at the ABS occurred with the second wave of the longitudinal Survey of Employment and Unemployment Patterns, conducted in September 1996 with a sample size of 8,500 and interviewer work force of around 200. The most significant feature of this survey was the use of dependent interviewing in which information from the previous wave of the survey was used within the CAI instrument to guide the conduct of the interview.

CAI went on to be used in the following major surveys conducted by the ABS:

- Survey of Mental Health and Wellbeing (1997) using a client-provided CAI instrument;
- Third wave of the longitudinal Survey of Employment and Unemployment Patterns (1997);
- Survey of Disability, Ageing and Carers (1998);
- Household Expenditure Survey (1998/99);

- Australian Housing Survey (1999).

With the stock of computers coming to the end of its useful life in 1999, it was necessary to develop a new case for continuation of CAI. With careful structuring of the survey program and due consideration of the costs and benefits, a successful case has now been presented to management to enable CAI to be continued for major surveys in the future. The details of this case are discussed later.

Initial justification for CAI at the ABS

The case for CAI at the ABS was based on expectations of improvement in data quality, survey timeliness and cost effectiveness. At the time of preparation of the initial case for CAI, these benefits were described in the writings of a number of authors (Weeks 1992, Manners 1992, Martin, O'Muircheartaigh, Curtice 1993). The attractions of CAI could be summarised as:

Improvements in data quality - Interviewers are directed automatically by the computer to the next relevant question, eliminating any sequencing errors. Editing of responses can be done during the interview, allowing queries to be answered directly and immediately by the respondent. Introducing questioning based on responses given in previous interviews (dependent interviewing), can provide greater consistency and accuracy of data over time.

Improvements in timeliness - Timeliness of survey processing can be improved as data is available in electronic form at the end of the interview. Time spent on handling paper forms and entering data into the office computing system is eliminated. Potentially, the data delivered by the survey instrument could be a clean unit record which would be fed directly into the survey output system. In practice, for a complex survey, some post-field processing may still be required to clean records.

Reduction in survey operating costs - CAI offers savings in a number of areas of survey operations. Printing of paper forms is no longer required. Physical handling of forms (bundling, processing, storage) is also removed. Office editing and coding is greatly reduced. Clerical data entry is eliminated. It is also possible that costs of survey management can be reduced. Any savings in these areas need to be counterbalanced with the additional costs of hardware, software and development time accruing to CAI implementation. As these costs are greatest at the outset, savings are likely to be realised only in the longer term.

It was recognised that the cost reductions mentioned above may not be as great at the ABS as some other agencies because clerical data entry had been replaced with optical mark reading (OMR) of forms for household surveys in 1989. The remaining benefits were accepted by ABS management, subject to confirmation through the testing programme.

The small scale trial, which was conducted in July 1994, concluded that CAI was indeed viable and could deliver quality and timeliness improvements with possibly some cost savings. The trial also showed that it was relatively easy to introduce CAI to an interviewer workforce who have had very little computing experience. Respondents were not at all concerned by the use of computers in the field. It was on that basis that continued use of CAI was approved at the time.

Major issues which received attention

<u>Choice of software</u>

One area to receive early attention was the selection of suitable CAI software. Due to the special nature of CAI it was preferable to use an existing software package rather than to build one of our own. Evaluation of available software was carried out against a set of defined criteria which can be grouped under the following headings:

Facilities provided - the software must provide adequate functionality for the survey business and primarily for the interviewing part. Features should include support for editing, routing, coding, derivation, complex data structures, error recovery, management and analysis.

Metadata - this area of concern related primarily to how the product was to fit into the ABS corporate infrastructure which placed a significant emphasis on metadata. Features would include the ease with which metadata could be used by or supplied to other systems.

Usability of the software - this related to how efficient and easy the product is to use. The software was assessed on such characteristics as the ease of learning, speed of questionnaire development, provision of development tools, documentation and help facilities, usability by questionnaire designers who are not necessarily IT professionals, maintainability and readability, reusability of code between surveys and training required for all types of staff involved.

Usability of the resulting collection instruments in the field - this related to how usable the resulting collection instruments are in areas such as layout and readability, performance and efficiency (including response time for all functions), on-line

help for all functions, robustness and error recovery (including protection against data loss) and overall acceptance by interviewers.

Post-field processing - this addressed how further processing of data is supported, including derivation, weighting, tabulation and ease of linking to alternative post-field processing products.

Other ABS computing environment issues - these requirements were to ensure that the product would fit satisfactorily into the ABS computing environment, and covered such considerations as compatibility with other software, file management, communications and security.

Future directions - this addressed relevance of future directions as perceived by the ABS, in areas such as transition to Windows, links to external systems and adaptablity.

A brief assessment of the alternatives was made and two serious possibilities (one of which was Blaise) were then given closer scrutiny and testing. In the end, Blaise (version III) was selected as the most appropriate software for CAI in the ABS due to its language characteristics (simple syntax and block structure), its metadata-centered approach (shared by all the tools) and the availability of data and metadata conversions to interface with the ABS environment. While there were some limitations in the software at the time (being 1994) it was known that these were being addressed by the software developers. It was further recognised that the developers of Blaise, Statistics Netherlands, had very similar goals and priorities to the ABS and was pursuing developments in accord with those at the ABS.

Selection of hardware

The minimal technical requirements for notebook computers required to operate Blaise III software in 1994 were determined to be:

- Intel 486sx processor (this was later changed to 486dx in anticipation of additional demand by the software)
- DOS 6.2 operating system
- 4 megabytes of RAM (preferably upgradable)
- 80 megabyte hard disk (allowing for future requirements)
- Full size keyboard
- VGA graphics screen (to handle 80 by 25 characters of text)
- Unit to be connectable to modem, external keyboard and/or monitor

Non-technical requirements included:

- Low physical weight (preferably less than 2.2 Kilograms)
- Screen to be easily readable (colour optional)
- Minimum of four hours continuous battery life
- Unit that is easily to carry and use while sitting or standing
- Shock resistant case
- Cost
- Future plans for upgrades and support

Weightings were assigned to the functional requirements of the notebooks with non-technical issues being given a high level of consideration in the selection/evaluation process. The physical and ergonomic features/characteristics of the notebooks were considered very important. Consequently, the following criteria were given high weightings as mandatory requirements:

- low physical weight
- high quality display screen
- long battery life
- reliable battery life indicator

Tenders were received from 14 suppliers which were then shortlisted on the extent to which each tender complied with the mandatory functional requirements specified. The tendered notebooks were then ranked on their value for money, calculated as a ratio of the cost over their score on technical worth. Six shortlisted tenderers were asked to provide the ABS with appropriately configured hardware to allow performance tests to be conducted.

The shortlisted notebooks underwent comparative performance testing using the CAI application. A physical evaluation of these notebooks was also conducted examining ergonomic issues such as keyboard feel and screen clarity. Some interviewers were also invited to assess the equipment.

Following the detailed assessment described above, and further discussions of price and future plans, the decision was made to purchase the IBM Thinkpad 340 (486dx 75Mhz colour with 4Mb RAM).

Purchase and delivery of the notebook computers were made in three lots with a total of 230 being purchased by 1996 when the decision to curtail CAI was made. By the time the third lot of computers (150 in number) was ordered the 486dx processor was no longer available and the IBM Thinkpad 560 (pentium 75Mhz colour with 8Mb RAM) was substituted.

At about the time of the placement of the third order for notebook computers (mid 1996) it was quite noticeable that 4Mb of RAM was inadequate for good performance of version III of Blaise and RAM upgrades were purchased for all the existing stock of 80 computers. This additional outlay was quite expensive.

While the notebook computers were certainly adequate for the operation of CAI applications (all in DOS) when purchased, the speed of change in software was such that by the time they were two years old they were inadequate for operating anything else. In particular, they were not suitable for Windows applications which restricted the possibilities for using Blaise 4 Windows.

The final price of notebook computers in 1996, including an encrypting modem and a three year service arrangement was almost 100% more than the estimate prepared in 1994. The higher than expected costs were a significant factor in the decision to pull back from full implementation of CAI in all household surveys

Occupational health and safety

A consultant was hired to conduct research into feasible and practical ways of minimizing the risks associated with the use of notebook computers in CAI. A primary objective of the consultancy was to determine whether a suitable ergonomic aid could be designed to support the weight of a notebook computer when used in a standing position.

The development of such an aid to interviewing was considered important because most face-to-face interviewing of the Labour Force survey in Australia, our largest and most important household survey, is conducted at the door. Use of the notebook computer in these circumstances, without a physical support of some kind, was considered to be an occupational risk. To encourage interviewers to go indoors risked increasing the enumeration costs.

The consultants designed a prototype collapsible frame which was capable of supporting a notebook computer with safety. Around 80 of the initial design were manufactured and used in the 6 month trial of CAI in 1996. Following feedback from the interviewers the design was revised to make it more collapsible and more readily carried in the canvas bag used to carry the computer. The design has subsequently been patented.

Apart from the ergonomic stand, revised field procedures have also been implemented for the major surveys undertaken using CAI to date. In particular, respondents are requested to make available a suitable table at which the interview can be conducted. Relevant literature and training is also routinely given to all interviewers undertaking CAI surveys about the health and safety aspects of the use of notebook computers.

Security

Security of respondent data is an important issue and a number of measures were employed to ensure that the data was safe both on the notebook and in transmission. The following measures were employed:

No floppy disk access - notebook computers were configured without an internal floppy disk drive to safeguard against unauthorised copying to disk.

Screen saver – screen saver software was included to prevent access to the data if the notebook was unattended for any period of time (such as during transmission).

Encryption and passwords - the notebook hard disk was encrypted (using Blockit software) so that data access was not possible without a password. The encryption was also linked to the configuration of the notebook which made it impossible to access the data on the hard disk if the configuration has changed. Passwords need to be updated by the interviewer on a monthly basis.

Encrypted transmission - transmissions were carried out via an encrypting modem which ensured that the transmitted data cannot be interpreted. While encrypting modems are much more expensive it was justified to protect the data.

Secure logon procedures - logon to the FTP computers in the office (for transmission) was done through a system which requires the entry of a 6-digit pin number obtained from the readout on a smartcard (or key fob) which provides a sequence of 6-digit pin numbers which changes once every minute. The FTP computer in the office matches the generated pin number with the card number and registered owner (interviewer) before further access to the server is granted.

While this kind of system was more complicated to establish and the procedures took a while to master, there was a general acceptance that our duty towards respondent privacy warranted it.

Infrastructure built for CAI

The development of CAI facilities happened at the same time as other significant developments were taking place at the ABS. These were:

> *Development of a corporate data warehouse* which provides a central store of all released and releasable statistical data along with comprehensive metadata and access facilities. By policy all major systems in the ABS are required to link with this facility and eventually deliver data and metadata to it.
>
> *Redevelopment of processing facilities for household surveys* to overcome concerns about the viability of existing systems (which use legacy software). Developments were also aimed at taking advantage of new technologies and linkage to other systems such as the corporate data warehouse.

When CAI was first proposed there were virtually no support facilities in existence in the ABS. The plans for CAI therefore included the development of infrastructure to support it. The main components which were developed were:

- Survey Development Tool to facilitate preparation and specification of the survey concepts, data items, question modules and derivations to feed the CAI instrument preparation
- A field management system called the Interviewer Workload Management System
- An Office Management System
- Transmission facilities

These are described briefly below.

<u>Survey Development Tool</u>

Development of a survey questionnaire or instrument commences with the preparation of detailed data item specifications. Before CAI the specifications had been prepared in the form of documents or spreadsheet tables which described the data items in detail, including relevant respondent populations, definitions and response categories. The specifications provided in this way were then converted to paper questionnaire designs by survey staff using publishing software. The focus of specification in this case was the design of questions with little attention being paid to the edits, derivations and output items at this time.

The advent of CAI brought with it the possibility of applying edits and derivations in the instrument. It also opened up new ways for designing simpler more modular questionnaires, as the number of pages (and hence the need for more convoluted sequencing) was no longer a constraint. A way of specifying the questionnaire for more optimal Blaise coding and questionnaire validation was also required. These factors significantly increased the complexity of the specification process. In addition, because CAI requires the involvement of more people (eg. programmers), there was a need to make the specifications more widely accessible within our network environment. At the same time, the emergence of the corporate data warehouse was also placing pressure on areas to make their metadata available for linking with other collections.

As a result of these pressures it was decided to develop a special tool called the Survey Development Tool (SDT) which could be used to store and manage the specifications (or metadata) for all household surveys and particularly the CAI surveys.

The design objectives of the SDT were to:

- have a single centralised store of survey metadata (or specifications);
- accessible to all who needed to specify, examine, modify or use the information;
- assist with the management of the specification process;
- assist with the instrument development and validation processes;
- have the possibility of generating Blaise code;
- link with the corporate data warehouse; and
- be easy to use.

The SDT was developed as a Lotus Notes database which contained various forms to record all the specification details, and structured views to assist with locating and reviewing the contents. Lotus Notes was chosen because it was, and still is, the standard group-ware used by all staff at the ABS and was therefore considered to be the most user-friendly option.

The basic building unit of a questionnaire specification under this tool is a module of related questions. Such a module may measure a single concept or group of related concepts and will generally be applicable to a defined population in the survey. Earlier prototypes using a question as the building unit gave too many elements and were found to be difficult to manage. For convenience a module can be seen as containing up to 10 questions although provision was made for larger modules. A module has the advantage of having closely related questions kept together and could be small enough to treat as a single unit

that can be stored and reused for other surveys (without the likelihood of breaking apart). The module concept was also similar to the block construct used in Blaise.

The SDT was designed to be linked with the Data Warehouse and a cycle of metadata exchanges were envisaged between them to ensure that data items and concepts were aligned with those of other collections. Control of the development and collection processes were to be linked with other corporate management facilities of the Warehouse. Integration of the SDT with Data Warehouse is described in detail in a separate paper (Colledge et al 1996).

A production prototype SDT was constructed and used for the first few CAI surveys. The initial functionality was limited to the development and storage of specifications, with some export functions to assist with other aspects of survey work, including an early attempt at Blaise code generation. Unfortunately, the decision to pull back from full implementation of CAI in all household surveys in 1996 meant that further work on this tool was also stopped. Nevertheless, the SDT has continued to be used for all CAI surveys and is still in use today.

Further development of the SDT will occur as part of future work on the CAI infrastructure with particular attention being paid to the links with other systems.

Interviewer Workload Management System

Soon after the commencement of work on CAI it was realised that a system was required to manage the interviewer work in the field. Since there was no generic facility available from other agencies using Blaise (particularly not in Blaise III) it was decided that one should be built.

The first prototype system for field management was built in the ABS using Pascal. This facility simply fed a list of addresses in a screen to the interviewer who selected them for interview. This was adequate for the first few tests using CAI.

As soon as Maniplus became available (in beta form in late 1995) serious development started on a comprehensive Interviewer Workload Management System (IWMS). Maniplus, being part of the Blaise suite, had the distinct advantage of being able to extract information from Blaise data files for display and then update those same files with interviewer remarks, address changes, appointment information and status codes, all fed from Maniplus dialog boxes and display screens. The compiled facilities of IWMS had a consistent look and feel to the Blaise instrument and made the transition between field operations and interview quite seamless.

The IWMS as developed in the ABS provides the following major functions:

- receipt and transmission of data and programs from the office
- access to training materials
- listings of parcels of work (known as a workload)
- listing the addresses to be visited
- display the names and details of household members
- recording of appointments
- backup facilities
- control the flow of interview between instruments
- ability to update the status of records

The IWMS was intended to be a generic facility capable of managing all surveys in the same way. However, the differences in requirements for complex surveys were such that the IWMS needed to be adjusted for almost every survey. Differences have occurred in information to be displayed, different flow of interviews with different instruments, different recording of status and different appointment details.

The main characteristic of the work provided to interviewers is that it is organised into parcels called workloads. A workload is a group of addresses (usually in the same local geographical area) which are to be administered the same survey. The number of addresses in a workload varies according to the complexity of the survey but is approximately what can be achieved in a one week or two-week interviewing contract. The workload has its origins in the paper systems but was kept as something that interviewers and office staff were used to dealing with.

Supporting the workload concept described above has made the management of cases under CAI a little more complicated. This was particularly so when one or more cases need to be referred to the office, or to another interviewer, or when transmission of some completed cases occurs. Because all cases in a workload are generally kept together, transmissions would involve all records in the workload no matter whether those cases were completed or not. This can result in the same record being transmitted to the office a number of times as the workload becomes progressively more compete. While this was initially thought to be a problem, it turned out to have a positive aspect in that it provided multiple copies that could form

backup versions if the workload became corrupted or a transmission was lost for some reason. The problem with potentially multiple copies of a workload being available, however, was to know where the latest copy of any case was.

The solution which was devised for tracking of individual cases in the field and the office involved the use of a control file which is maintained as a Blaise data file in the office. The control file has a record of every case and an indicator of which interviewer or system component has the most up-to-date details for the case. The operation of this control file is described in more detail in a paper on the Office Management System (Henden et al 1997).

The main design feature of the IWMS is the use of "buttons" and fields that can be updated on the screen. The use of pull-down menus, although possible, has not been employed in the IWMS because most interviewers were not familiar with computers and track balls, making buttons operated by Alt-key operations (or by tab key movement) easier to use.

Some performance problems were encountered in the refreshing of lists on the screen particularly when a case or household record had been updated, or when the interviewer applied a sort operation to the list of addresses. These problems were overcome through the use of indexing on the underlying data files.

The functionality of the IWMS has served our CAI surveys well and the latest version provides a good model for the one which will be written in Maniplus under Windows for future surveys. It is expected that some refinements will be made to make it more generalised and easier to maintain.

Office Management System

An office management system (OMS) was developed to manage the flow of work to and from the interviewers and to enable the received data to be checked and prepared for processing.

The system was expected to provide the same degree of management and flexibility which existed with non-CAI systems in existence at the time.

The OMS was developed during 1996 and now provides the following functionality:

- assign selected addresses to workloads;
- assign workloads to interviewers;
- prepare respondent records for each workload from data collected previously;
- collate workload data for transmission to each interviewer;
- collate associated instrument software for transmission to each interviewer;
- manage transmission to and retrieval of data from interviewers;
- provide for reallocation of workloads or individual respondents from one interviewer to another;
- enable the examination of received data to clean up 'dirty' records or to resolve queries raised by interviewers;
- provide for the coding of some data fields in the office (eg. occupation, industry);
- provide different levels of functionality for central and regional staff;
- monitor survey progress and extract management information; and
- export a clean data file for further processing.

The OMS facilities were built using a mix of Oracle/SQL, Blaise and DOS. The Oracle components were required to interrogate and manage the links with the sample address lists (based in Oracle tables). The Blaise components were required to load and prepare the instruments with records passed to it from the Oracle facilities, then package them and copy them to the FTP server for interviewers to collect (by transmission).

Once the data is returned from the field (by transmission), Blaise based facilities are used to unload the data and present the records to office staff for checking. At that stage additional coding may also be done. Survey data is then collated from groups of interviewers into regional data files which are then sent to the central office for final checking and export to ASCII files for processing by other systems.

A comprehensive description of the OMS is contained in a paper presented at the Fourth International Blaise Users Conference in Paris (Henden et al, 1997).

As mentioned earlier, a key feature of the OMS is the use of a control file to track the location of respondent records between sample systems, office processing and field work. Each time a respondent record is moved to or from any of the processes which form part of the office and field systems, the control file is first checked to determine whether that process has control of the record. If it does then the process is activated and a record is written or modified in the control file to indicate the change in control.

Transmission

Transmission to and from the interviewers is managed through a series of regional FTP (file transfer protocol) servers connected to the LAN and protected with a "firewall" which certifies the user (both internal and external) and controls access to the facilities on the server. Dial-in access to the server is only possible through encrypting modems which ensure that all communications are authorised and protected. Access is further controlled through a technique known as "strong authentication" which requires the interviewer to carry a smart card (or key fob) that generates a single-use password with a limited validity time (a few minutes) that can be validated by the server.

Experience with Blaise

As mentioned earlier, the ABS decided to use Blaise for CAI in household surveys following an evaluation of the software in 1994 (see earlier section). All the Blaise systems and survey instruments mentioned in this paper were developed using version III of Blaise (various releases).

Some of the issues that have arisen in our use of Blaise are discussed below.

Developing software

A succession of updates in the early days of version III of Blaise did provide us with the challenges of testing the software and then convincing our development and field operations staff that the new release would (generally) be better than the old with risks of problems in the field being minimal.

Introducing new releases of any software to production systems does have an element of risk and it is pleasing to note that generally the experience with Blaise upgrades of version III has been uneventful. The software release practices of Statistics Netherlands have also improved considerably with very good versioning and update history now being made available.

Extent of use in ABS

Although Blaise has been approved for use in the ABS for household surveys it has been restricted to data capture and limited office processing functions as described in this paper. The main reason for this has been that Blaise III is a DOS product and many ABS applications, as well as the general office software, had been operating in a Windows environment for some time. A further reason was that many of our processing systems made use of other software (eg SAS or Oracle/SQL) which was where the expertise was and there was no convincing reason to change. Some of components of the Blaise software suite (eg. Abacus, Bascula and CATI call management) have received little attention at the ABS as a result.

The advent of Blaise 4 Windows does open up opportunities for more extensive use of Blaise software in applications other than household surveys. However its use may be limited by the ability for it to fit into the broader ABS corporate infrastructure, in particular, the Data Warehouse and our office group-ware (Lotus Notes).

Some experiences in integration with Blaise III is contained in a paper presented at the Fifth International Blaise Users Conference in Lillehammer (DeMamiel et al, 1998) which discusses the use of Blaise in the data capture of diary information for the Household Expenditure Survey and the exchange of data and messages with office software.

Experience in programming in Blaise

Given the amount of infrastructure that needed to be built we quickly established a fair amount of expertise in the programming of Blaise applications. Most of the training was on-the-job and made use of the manuals and sample code provided with the software.

At the time of peak demand for Blaise experience in the ABS (probably 1996) there were 3 officers who were well experienced in the programming of Maniplus and another 12 officers who were involved in writing the Blaise code for various instruments. With the recent pull back in CAI, however, those numbers have reduced to around 3.

Who should write Blaise code

There are differing opinions on who should write the code for CAI instruments and a fundamental issue is whether the same or different people are responsible for content development and CAI programming (Kinsey and Jewell, 1999).

At the ABS, the writing of Blaise code for instruments has been carried out by survey branch staff rather than programmers, although advice and training has been provided by them. People writing Blaise code at the ABS have tended to be staff who have some understanding and experience in survey processes and who posses an aptitude for or skills in programming work. The specifications for CAI instruments are supplied by development staff or researchers who have training or experience in the design and testing of questions. In order to standardise the specification process there has been a requirement to make use of the Survey Design Tool (SDT) described earlier.

While there is no objection to the suggestion that development staff could write their own instruments there is a feeling at the ABS that people with training and technical skills in question design and testing are better to focus on questionnaire development work, while others with skills in programming are better to focus on the activity of Blaise programming. Given the relatively high staff turnover in our survey infrastructure areas it would be difficult for someone to become highly proficient in both areas of work, but more importantly the creative tension between the question designers and Blaise programmers has been a healthy one for the surveys where we have pushed the limits of what is possible. There is also an expectation that the further development of CAI facilities will result in more code being "generated" by the system which supports the SDT.

The development of Maniplus facilities such as the IWMS and OMS described above has always been considered the function of programmer staff at the ABS.

Software interaction problems at the ABS

The functionality of version III of Blaise has continued to improve over the years although a few problems in the software and its interactions with ABS technical infrastructure remain. These are:

The sticky key problem - for some unknown reason, the Blaise III software occasionally produced a locking of certain keys on the IBM 340 Thinkpad notebooks. Despite sending the computer to the Netherlands for further investigation and upgrading the system BIOS this problem never disappeared. It was tolerated by interviewers who developed ingenious methods for "unsticking" the keys so they could continue interviewing.

The network interaction problem - use of Blaise III produced an occasional problem on the ABS network (Banyan Vines) which resulted in a "locked file" situation on the ABS logo file (in a read-only directory) and terminated the execution. This problem was never resolved but could be avoided by removing the offending logo file from the software set.

The shared file problem - use of shared network files (for code look up) in an office data entry system (for entry of diary data from the Household Expenditure Survey), involving 6 coding staff sharing the same network drive, produced mysterious "crashes" which were only solved by localising both the lookup files and the software. (This solution also produced better performance).

Resolution of some problems is hampered by an inability to run some of the diagnostic software which is only available to the software developers, and the cost of arranging for someone to come halfway around the world to be on site to investigate matters locally.

It is expected that the Windows version of Blaise will be more compatible with other software written for Windows.

Support from the supplier

Blaise software was developed by Statistics Netherlands and, despite the separation of distance, relations between the ABS and Statistics Netherlands in relation to Blaise have always been good. The problem of whom to contact, which was present in the early days of ABS use of Blaise, have largely disappeared with the creation of the blaise@cbs.nl e-mail address. Nevertheless, communications which are separated by time and distance can sometimes be a cause for frustration if systems are dependent on an urgent solution to a problem, no matter how small. The inability to share one's problems face to face with the Blaise developers is also a disappointment, although new possibilities could be opened up with video links over the internet.

The manuals for Blaise software and the sample programs which accompany the software are very useful sources of information about its operations.

Sharing experiences

Given the extent of use of Blaise around the world, there should be an increasing pool of people to share experiences with. The establishment of the Blaise user group with its newsletter and website, the Blaise Corporate Users Board, and series of international conferences provides excellent avenues for the sharing of experiences to occur.

ABS staff have tried to maintain contacts with key people in the Blaise fraternity but it can be time-consuming because most communications are by e-mail which takes time to compose. Furthermore, most people being consulted are heavily committed in their own work areas and not always able to respond in a timely way.

Split datamodel instrument design

One of the advantages that CAI provides is the ability to store survey data collected information from a complete household within one physical record. While this keeps the members of a household together it has the limitation of providing a more complex instrument (essentially an array of person records) with many more fields, leading to a demand on both memory and storage space. A single household record containing all persons also results in a nominal limit being placed on the number of persons that can be included (currently 10 in the ABS).

When problems were encountered with lack of memory on the 4Mb notebooks, the possibility of separating the individual questionnaires from the household was suggested as a way of reducing the demand on memory and improving performance (Wensing, 1996).

This proposal became known as the split datamodel design in that it splits the physical datamodel into two or more parts. Once the household part has been completed the interviewer drops back into the IWMS which presents a dialog box of the personal interviews that remain to be conducted. Each required personal instrument is initialised with corresponding data from the main household instrument. Edits in the personal instrument which need information from the household instrument can still be carried out using relevant Blaise statements that can extract (lookup) the required data from the corresponding household record.

The disability survey 1997 was the first survey to employ the split datamodel design and, while it complicated the management of questionnaire flow in the IWMS, it was considered to be a success and has been used in most CAI surveys since.

The main disadvantage of the split datamodel is that both parts of the datamodel need to be present for any processes (such as interviewing, editing or transferring data) to be applied successfully. On the other hand, a split datamodel enables each part to be treated as an instrument on its own from the point of view of the data within it being considered clean and available for use.

Other instrument design issues

CAI has brought with it a temptation to collect more information because the constraints of a paper form do not exist. Thus, it is easy to add a field here and there, or to collect text responses where previously there may have been a simple tick box. Also, the limits on collecting the details of instances of something (eg. loan details in the HES) can be pushed out beyond those which may have applied to a paper form. This has resulted in much larger record structures and greater volumes of data to be processed, possibly at the expense of efficiency.

Integration with other processing

Use of CAI enables other processes, such as imputation and derivation of new variables, to be brought forward in the survey cycle, thereby saving output time. Ideally some of these processes should happen in the electronic survey instrument and Blaise provides the functionality for that.

While it was the intention of the CAI development team at the ABS to incorporate additional processes in the instruments that have been developed over the past five years, in practice only those items deemed necessary for the conduct of the interview have tended to be derived. In only one CAI survey at the ABS has this integration of derivations into the instrument been achieved, and even then the processing was executed in the office. In all other cases the data has been extracted from Blaise files and processed in other software (usually SAS).

A major problem encountered in transferring data to other software for processing was the need to translate the Blaise field names into a set of unique 8-character names. The Cameleon software component of Blaise provides a function to “generate” these unique 8-character names but the outcome suffers when an existing Blaise field name ends in a numeric character (and the field is used in an array). This led to the preparation of a naming convention which kept those parts of Blaise names both short and devoid of numeric character endings (Wensing, 1999).

The issues of integration of other processes will be looked at more closely with the next round of developments for CAI at the ABS. An emphasis will be placed on translating the questions to as complete and final a data item as possible in the instrument and keeping the re-processing of data in the office to a minimum.

Business case for renewed CAI

Despite the pull back from CAI in 1996, there has remained a positive opinion among survey staff at the ABS about the prospects of continuing to make use of CAI. With the stock of notebook computers approaching the end of their serviceable life, a business case was prepared in 1999 to recommend the continuation of CAI for larger household surveys.

The business case for the re-development of CAI focussed on three key aspects:

Better utilisation of notebook computers – by structuring the schedule of surveys appropriately so that there are no significant peaks and troughs in the work, it is possible obtain more usage from the stock of notebooks than had been obtained previously. This means that less notebooks are needed, saving on cost.

Determination to actively pursue the re-engineering of all processes – CAI has the ability to deliver data which is more complete in that more of the processing operations (eg. coding, derivation) can be done in the field. These gains are only possible if the development and operational processes involved are changed (re-engineered).

Management of the project - a strong commitment to carefully manage the project, so that all of the benefits that the methodology can provide would be realised at some point in the future.

With this approach, it is expected that CAI will produce improvements in quality and timeliness and some small savings in ongoing costs that will be worth the investment in hardware and software development.

Conclusions

What can be seen from the ABS experience is that CAI requires a fair amount of infrastructure and we have built almost all of it ourselves. Given that other agencies using CAI need similar facilities there would be merit in some joint developments occurring between agencies.

The Blaise suite of software has provided the underlying tool set for most of the facilities we have built. It may be appropriate for more infrastructure elements to be built into Blaise software. One example where this has been done is in CATI call management which operates on special blocks that are required to be added to CATI instruments. Maybe features like this could be added to support case management via a generic case management tool (replacing our IWMS).

The ABS has gone from being an early user of Blaise version III to a late starter in Blaise 4 Windows. When Blaise was chosen for CAI in 1994 other developments at the ABS were well advanced in the use of Windows, and office software was about to move to Windows 95. Use of Blaise III for CAI kept those developments in DOS when other staff were becoming used to a Windows environment. This meant that use of Blaise beyond data capture was unlikely to happen at the ABS. This may change with Blaise 4 Windows.

Enhancement of Blaise and other software over time has increased the demand on hardware such that our CAI notebooks are now suffering in performance. Software developers, such as those developing Blaise, need to be aware that users do not always have the latest most powerful hardware and resist the temptation to make their software bigger and faster without due consideration of the equipment implications for their customers.

The ABS has a diverse technical environment and only a few applications have been built in Blaise. With the move of Blaise to the Windows environment it is hoped that there will be more compatibility between Blaise and other applications. That way there will be greater opportunity to develop integrated solutions that draw on the best features of each software. One particular need that arises out of integrated solutions is the need to be able to convert data and metadata more readily from Blaise to other forms (and vice versa).

Finally, much has been learned about CAI at the ABS over the past five years and we are well positioned to launch into another period of development in preparation for the next series of household surveys to use CAI commencing in 2001.

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Session 6

Design issues in using Blaise

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Configuration Management and Advanced Testing Methods for Large, Complex Blaise Instruments

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Abstract

Blaise instruments that Westat creates for its clients are often large and complex. These instruments can include hundreds of files, including source code files, external data sources, and configuration files. Additionally, instrument development is performed by teams under tight schedules. Efficient development and testing requires frequent builds (at least once a week) of the instruments. Thus, these instruments create severe file management challenges. It is imperative to maintain version control of all files, generate and track problem reports, and efficiently test the instrument after bugs are repaired and new features added.

This paper describes some of the applications and methods that we are using to manage version control, error reporting, and automated testing. We discuss how four kinds of tools have been adapted to help manage these functions during the development of instruments. For version control we discuss Microsoft's *Visual SourceSafe*™ and Mortice Kern System's (MKS) *Source Integrity*.™ For person-based interactive error reporting, we discuss our own error reporting system and its integration with MKS *Track Integrity*.™ For automated testing of instruments and automated testing of Blaise as a system, we discuss *WinRunner*™ by Mercury Interactive. The paper discusses the strengths and weaknesses of each type of tool in the context of Westat's experience.

1. Introduction

Configuration management is the repetitive process of source code revision, testing, integration, and problem management. Poor configuration management often causes serious and frustrating problems for software development. To manage a Blaise project successfully, it is essential to track every change to every module in both large and small systems. Version control, in its simplest definition, means keeping one official copy of each source module within the project. There are many commercially available version control programs that can perform this task. This paper examines two commonly used version control applications: Microsoft's *Visual SourceSafe*™ and Mortice Kern System's (MKS) *Source Integrity.*™

More difficult then managing version control is the arduous process of testing and tracking problems in instruments. Westat has developed an error reporting system that allows testers and other users to automatically record critical information about a bug or problem in an instrument *during data entry*. The error reporting is invoked in the Data Entry Program (DEP) by an extra menu option, *Error Report*, which has a short-cut key assigned to it. The *Error Report* menu option launches a Delphi executable program. The DEP automatically passes parameters to the executable, a feature already supported by Blaise. This is extraordinarily useful, as it 1) automatically records critical information such as the primary key, field name, field value, and meta file name; 2) eliminates the use of paper; and 3) greatly reduces the overall burden of error reporting while increasing its accuracy.

Simply discovering and recording errors is not sufficient. Errors must also be reviewed, assigned, corrected, and tested. Tracking error resolution is complicated, labor intensive, and prone to management problems. With that in mind, Westat has integrated its unique error reporting system with a mature and robust error tracking system, *Track Integrity* by MKS. With this integration, errors are accurately recorded *and* entered into a tracking system with a few keystrokes. This paper explains Westat’s automated error reporting and tracking process.

Finally, this paper addresses automated testing of Blaise instruments and automated testing of Blaise as a system and product itself. Automated testing of instruments can be very problematic, as test scripts can be difficult to maintain during development when the instrument is frequently changing. However, after an instrument has become reasonably stable, there is little doubt that automated testing is an extremely useful tool for regression testing and maintenance. Testing Blaise as a product has also been a focus at Westat. As a stable application, it is a perfect candidate for automated regression testing.

2. Version Control

2.1. Importance

Version control of Blaise source code files is the only way to ensure reliable instrument development. The importance of version control cannot be overstated. The entire task of configuration management revolves around the principle that *only one master copy of each source file exists.* There are examples of instruments that were built and shipped without features and bug fixes that developers *knew* they made. Invariably, their changes were indeed made, but were not included in the build because another developer, working on the same module, copied his module over the changes made by the first developer. These types of errors are completely avoidable when version control systems are used.

There are many other advantages of using version control besides the basic function of keeping one official copy of each module. All version control products provide archiving capabilities that not only backup all revisions of each module in the project, but also allows programmers to compare any of the revisions. This is of great value to programmers, who can easily compare changes to modules made by all members of the development team. In this way, debugging is greatly facilitated by version control.

Version control also solves the serious issue of code divergence. Code divergence occurs when there is an instrument release that must be maintained and at the same time the development team needs to add new features and bug fixes for a future release. Code divergence can also occur when an entirely new or experimental instrument is developed based on a revision from the main development path. Code divergence is solved by two methods: labeling and branching. When a project is labeled, every module in the project is given a logical label such as *Version 2.12.0054*. This enables all modules with a given label to be retrieved whenever necessary (for example, to rebuild an older version of the instrument). Branching is the process of taking one file or project in two different directions at once. By labeling and/or branching projects when instruments are built, version control solves the code divergence problem while providing an easy way to build and maintain old versions of an instrument.

Version control also provides an environment that allows for automating the build process. Batch files can be created that confidently use the most recent version of the files needed for the instrument. Automated builds can be written to not only build the instrument, but also to launch automated testing and distribute the instrument to testers and other users.

Version control forces structure on a project. Version control applications require the instrument modules to be in a special directory structure defined within the version control application. Invariably, this forces the version control administrator, with the assistance of developers, to create a logical group of folders in which to keep all the files necessary to build an instrument. The latter point is also significant—in order to build an instrument from the master version control copy, *all* required modules must be present. This frequently forces developers to assess which files are necessary, and becomes a catalyst for more efficient instrument development.

Finally, though difficult to measure, version control is unquestionably cost effective. Version control applications cost anywhere from $600 to $2000 per license, but the losses incurred by releasing inferior products and discovering bugs late in development are far greater. Studies[1] have shown that the later an error is found, the more it costs to fix, and the cost increases exponentially. In one example, software development costs were approximately $75 per instruction and maintenance costs were approximately $4000 per instruction. Version control helps to catch errors earlier. This has been confirmed by Westat's own experience, where projects that were late in implementing version control experienced more costly and difficult problems.

In summary, version control:

- preserves source code integrity by keeping one master copy of each source file
- facilitates debugging by allowing easy comparison between revisions
- solves the problem of code divergence
- provides an environment for automating builds
- forces structure on the project
- is cost effective

2.2. Two Major Version Control Products

There are many version control products on the market. In this section we briefly discuss two of them: Microsoft's *Visual SourceSafe (VSS)* and *MKS's Source Integrity (SI)*. Both of these products provide robust and reliable version control.

In both version control applications, *master* projects are created on servers. Administrators create the master project, manage security settings, create users, and assign user privileges. Developers then "mirror" the master project on their local drives. When a developer wants to modify a module, the module is "checked out" of the master project, giving the developer exclusive editing rights to the module. This means that the developer has a writeable version of the file to edit on his or her local drive.

VSS calls the local areas where developers work *working directories*. SI calls them *sandboxes*. This conceptually and practically embodies the main differences between the two version control applications. SI manages code divergence by creating different types of sandboxes, called *variant sandboxes*. Thus, in SI, a new release is typically maintained as a variant sandbox, which is, in fact, another physical group of directories on a server or other computer. VSS manages code divergence by *branching*. Like the variant sandbox, branching is the process of taking one file or project in two different directions at once. Up to the point of branching, files share a common history because they were one and the same. After branching, they diverge. Each direction is a different development path. VSS tracks branches by making each development path a different project within the VSS working environment.

Both applications provide excellent history tracking, revision numbering, labeling, and tools for viewing and comparing revision changes. For projects that are time limited and that do not consist of years of upgrades and maintenance, VSS is more than adequate. Ultimately, SI probably provides the most flexibility, but with the added cost of complexity.

Another consideration for implementing either VSS or SI is the time required for learning and configuring the systems and for training personnel. For either system, there must be a skilled administrator, probably a mid- or senior-level analyst or developer, who understands the concepts of version control. If the administrator has previous experience with version control programs, he or she can master the basics of either application in a week or less. Developers who are clients on the systems can be taught the basics in less than an hour.

Both systems integrate with error tracking systems. VSS integrates with *Visual Intercept*, by Elsinore Technologies. SI is integrated with another MKS product, *Track Integrity*, a highly configurable change management system that tracks errors, proposals, and work instructions. For those who are interested in a completely integrated change management system that includes proposal and specification integration, problem tracking, and work instructions, as well as version control, SI is more strongly indicated.

[1] Testing Computer Software, Kaner,Falk,Nguyen, pg 31, Boehm study

2.3. Blaise-specific Considerations

When placing Blaise projects under version control, it is important to consider *all* files in the project, including the data files. Typically, version control systems only retain source code modules, include files, specification files, and other *source* files. Files that are the result of compiles or are otherwise generated, such as Blaise data files or object files by C compilers, are typically *not* included in the version control system. However, Blaise projects frequently include generated files that are essential to the project and that rarely change once they are created. Examples include lookup tables (external Blaise files), Maniplus shells, and Manipula setups that connect to other programs. These are candidates to include under version control, keeping in mind that a goal is to be able to build an instrument completely from the contents of the version control project. Ultimately, including these files under version control can be evaluated on a case by case basis.

2.4. Possible Blaise Enhancements to Help With Version Control

There are problems associated with identifying the version of Blaise instruments. These are most evident when new instrument versions are distributed (with and without new data models) and when problems are reported about an instrument.

Configuration management procedures assign a version number to an instrument, such as *3.12.0008*, where *3* is the major version number, *12* is the minor version number, and *0008* is the build number. (This is similar to the scheme that the Blaise system itself currently uses.) In this scheme, the build number is incremented at each build. The minor version number is incremented for minor instrument changes or milestones, such as when the data structure changes. The major version is usually reserved for major functionality such as adding multimedia to an instrument.

When distributing updated versions of an instrument, electronically or otherwise, managing the update process for hundreds of interviewers is a formidable task. This becomes even more difficult when the update also includes a change in the data structure. In this case, previously collected data cannot be read using the new data model, requiring the data to be restructured. Without clear identification of the instrument version, these tasks become very difficult.

The inability to identify an instrument version number also causes problems when errors are discovered in an instrument. At this time it becomes imperative that the instrument version be recorded along with the problem report. Not all interviewers receive their updates at the same time, therefore, we cannot assume that all interviewers are running the same instrument at the same time.

These scenarios lead us to the follow questions:

1. When a user receives an update or reports a problem, what instrument version is being used and how can it be found?
2. For a Blaise data file, how do we know which instrument version it was created with and which Blaise data model to use to read it?

Resolving these questions is facilitated when instrument versions are easily known. Interviewers can be confident that they are using the latest version, and data model “matching” can be managed.

To help resolve these questions, in some projects we now code the instrument version as a field of the data model. This version field has to be updated manually every time there is a new build. We then display the contents of the version field on the screen of the questionnaire –typically on some easy to remember place, such as the first question in the questionnaire. In this case, if an interviewer reports a problem, then he or she can press the *Home* key while in the DEP and read the instrument version. This is not the preferred way to display the instrument version. It would more robust and convenient if we did not have to hard code it in the data model and if it were accessible from any screen in the questionnaire.

A possible Blaise enhancement to make the instrument version more accessible would be to include it in the MI file of a prepared data model. The MI file already stores the date and time of preparation. If the instrument version were an element of a Blaise project file (bpf), the major and minor parts of the version could be set explicitly and the build number portion could be automatically incremented every time the main data model was parsed successfully. The instrument version could then be written to the MI file. The DEP could then use a menu option, such as *Help* or *About*, to display the instrument version number. In this case, the Structure Browser could also display the version, since it reads the MI file.

Solving the problem of data model matching is more difficult. Hard coding the instrument version in a data field does not solve this problem, because even if the version is part of the data record, we can’t read the data until the instrument version is known. Furthermore, having interviewers send the MI file, which is frequently very large, with every data file is not practical. We currently have a non-elegant solution for this dilemma—we automatically create a text file with the version number of the instrument. The interviewer sends the text file along with the Blaise data file (BD file). We can read the text file and know which data model version to use to read the BD file.

A better solution can be achieved by using the MI file. In the same way that we suggested storing the instrument version in the MI file, it may be possible to copy it from the MI file to a generally accessible part of the BD file. In this case, a Blaise enhancement could provide a way to read the information from the BD file, perhaps by using Manipula. This could be read regardless of which version of a data model the BD file was created with. This would still require a two-step process—first reading the version number from the BD file and then pointing to the right MI file—but it would be more manageable and less error-prone than using text files.

3. Testing and Error Reporting

"Software testing is defined as the execution of a program to find its faults."[2] More time is spent on testing than in any other phase of software development, and there is no question that software that is not tested will not work. Software testing is difficult to design, time consuming, and repetitive. In addition, testing is only the first part of a cycle of error resolution. The typical process consist of seven steps:

1. testing
2. error discovery
3. error recording
4. assignment
5. fixing
6. unit testing
7. integration

There is great complexity and bureaucracy in tracking these steps. At the most basic level, testers can record the problems they discover on problem sheets. The problem sheets can be sorted, distributed, and tracked. However, this is usually not successful. At the very start, problems are not accurately described and critical information required for resolution is not recorded. Problems recorded on paper are difficult to track and archive efficiently. Automating the process is the only way to ensure success.

3.1. Westat's Automated Error Recording System

With this in mind, Westat developed an error reporting system that can easily record errors during data entry *and* automatically enter the errors in a problem tracking system, *Track Integrity (TI)* by Mortice Kerns Systems. This is extraordinarily useful, as it: 1) automatically records critical information such as the primary key, field name, field value, and meta file name; 2) eliminates the use of paper; and 3) greatly reduces the overall burden of error reporting while greatly increasing its accuracy.

The error reporting executable, a Delphi program, is integrated with the instrument. A menu option that runs the executable is placed in the DEP's *Options* menu and a short-cut key is assigned to it. When a problem or proposal is discovered during data entry, pressing the short-cut key invokes the dialog shown in *Figure 1*.

[2] Managing the Software Process, Watts Humphrey

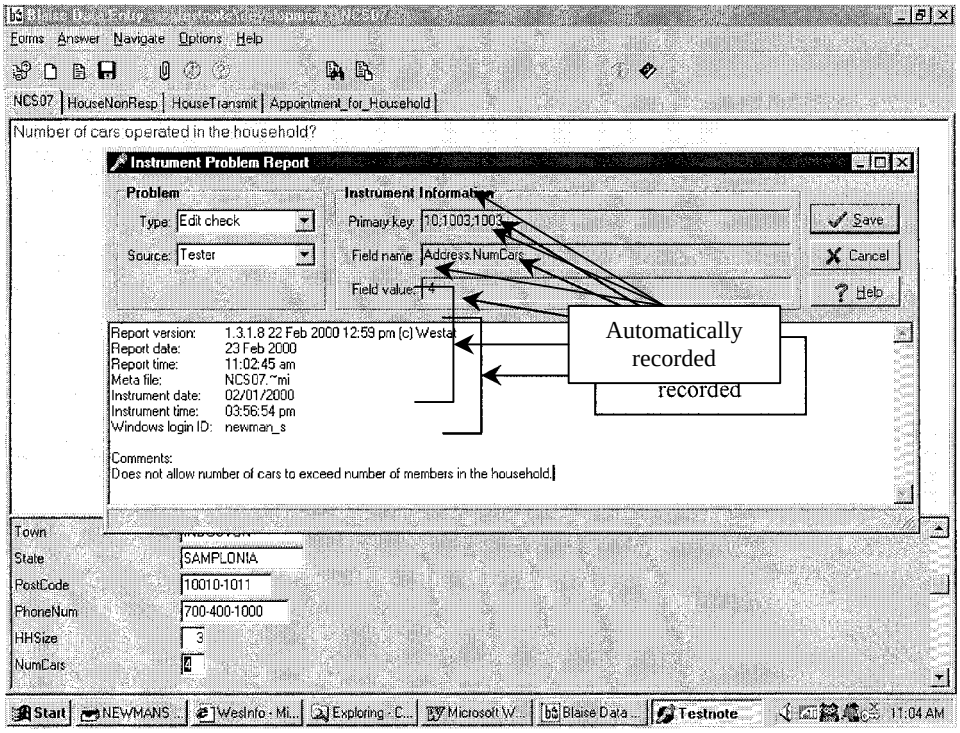

Figure 1: Dialog for Automated Capture of Problem Information

The primary key, field name, field value, report date and time, meta file name, instrument date and time, and the Windows login ID are all captured automatically. The user only selects the *Type*, *Source*, enters a *Comment*, and presses the *Save* button. When the *Save* button is pressed, the problem report is inserted into a TI database. If the TI database is not available, such as when a user is using a laptop, a text file is written which can later be automatically integrated into the database.

The efficiency of this process for recording errors cannot be overstated. Of particular interest is the great amount of information that is recorded automatically. Furthermore, the selections in the *Type* and *Source* list boxes are configurable, so that the list of choices that appear in the *Type* and *Source* list boxes can be easily determined by the administrator. Errors are accurately and easily recorded, which greatly reduces the burden of testers and other users. Because errors are entered into a tracking system, they can be traced throughout their resolution. Once errors are in the database, they can be reviewed, assigned, corrected, and tested.

Frequently, a text description of a problem is not sufficient and a screen capture is required for completeness. Though not currently implemented, it would be very simple to acquire a screen capture on demand. Significantly, the TI database supports attaching a file to a problem report, so the infrastructure already exists to associate files (screen captures or other file types) with a problem.

In the next section we will show an example of how *Track Integrity* records and displays problems and how Westat has integrated its automated error reporting capability shown in *Figure 1* with *Track Integrity*.

3.2. Track Integrity Database Example

Track Integrity is a highly configurable change management application. It controls the software configuration management process by tracking the relationship between three classes of inputs: problems, proposals, and work instructions.

To illustrate how a problem is recorded, we will show an example of the TI database. *Figure 2* shows the problem overview display from TI. *Problem ID 103* (the highlighted entry) is the most recent entry, and is the problem report example recorded in *Figure 1*.

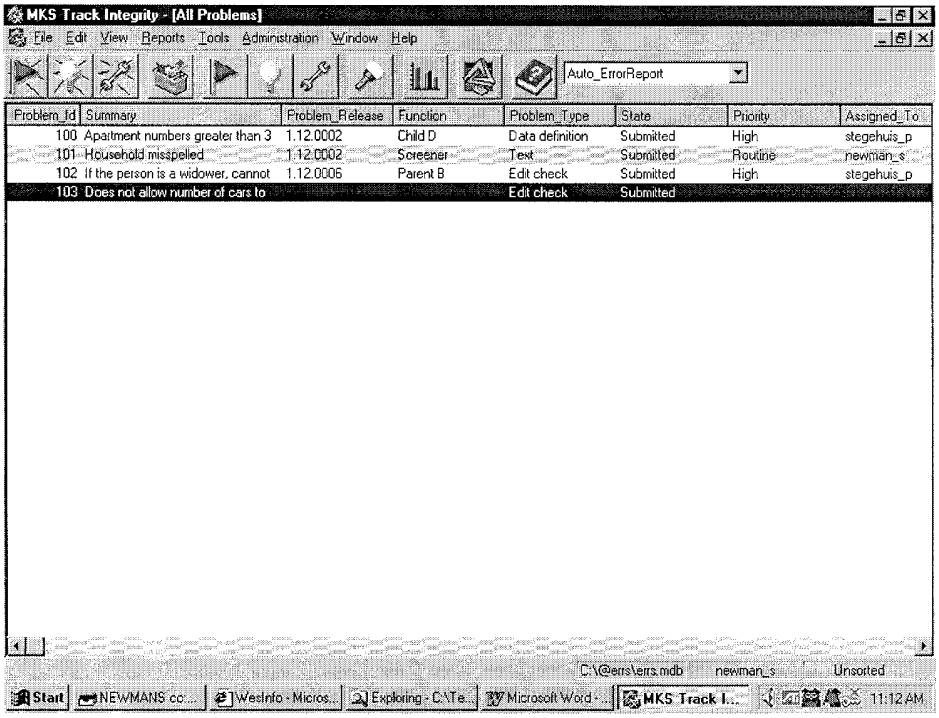

Figure 2: TI Problem Overview Display

Figure 3 shows a detail of *Problem 103*, and contains some of the information passed by Westat's error reporting system, specifically the *Type*, *Summary*, and *Description*.

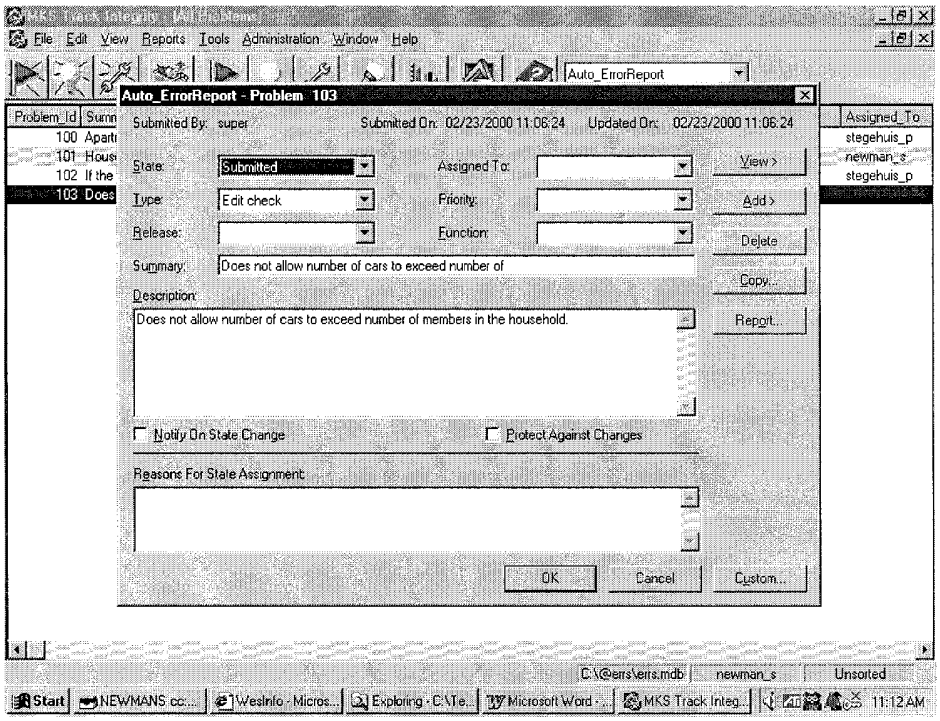

Figure 3: Detail of TI Problem Report

Pressing the *Custom* button in the lower right-hand corner displays the rest of the information transferred by the error reporting system. This is shown in *Figure 4*.

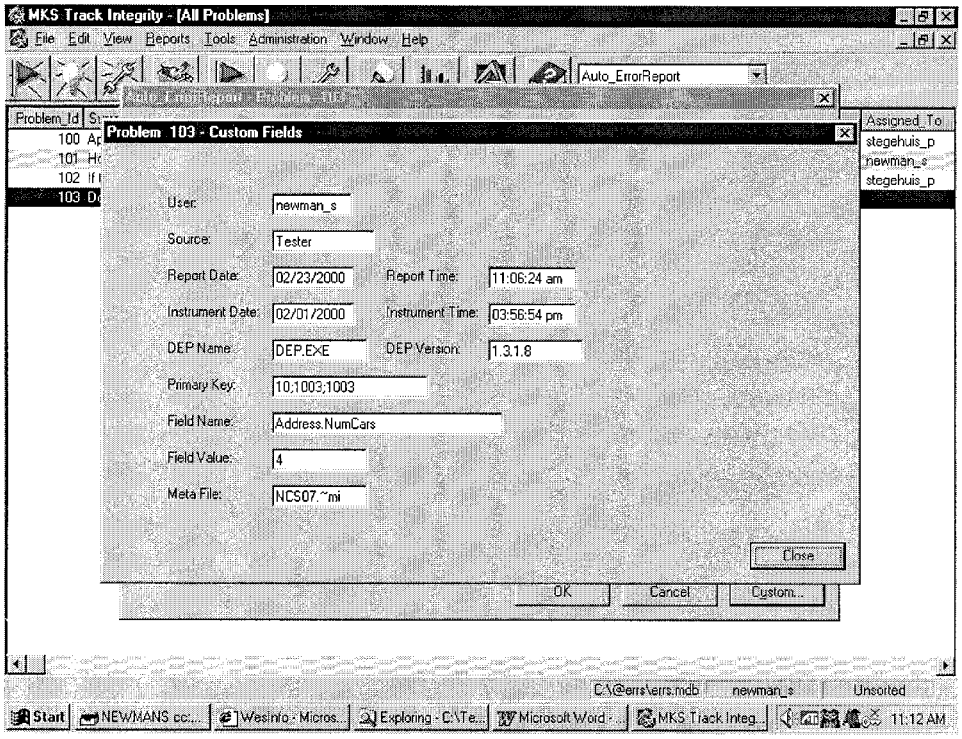

Figure 4: Customized Portion of TI Problem Report

3.3. Conclusion

Automating the error recording process and integrating it with a tracking system can profoundly reduce software development costs while simultaneously producing more error free instruments. By reducing the burden of reporting, testers have more time to execute test plans. Problems tracked in a robust tracking system can be resolved with confidence.

4. Automated Testing

4.1. Benefits of Automated Testing

Software managers and developers are being asked to turn around their products within tighter schedules and with fewer resources. More than 90% of developers have missed ship dates. Missing deadlines is a routine occurrence for 67% of developers. In addition, 91% have been forced to remove key functionality late in the development cycle to meet deadlines.[3] Automated testing can help alleviate these pressures. There are three significant benefits to combining automated testing with manual testing: 1) production of a more reliable instrument, 2) improvement of the quality of the test effort, and 3) reduction of the test effort and minimization of the schedule.[4]

Ultimately, because of the repetitive nature of testing, particularly regression testing, the process must be automated. Although all test phases—unit, integration, and system—can profit from automated testing, it is important to distinguish the types of tests that benefit the most from automation:

1. Performance testing—confirming that response times of the instrument are within acceptable limits
2. Stress testing—ensuring the instrument runs under maximum loads and high volume scenarios
3. Regression testing—performing identical tests on an instrument before and after a bug has been fixed or a new feature added. A regression test allows the tester to compare expected results of a test with the actual results.

[3] Automated Software Testing, Dustin, Rashka, Paul, pg 3
[4] Ibid, pg 37

4.2. An Overview of Automated Testing

Automated testing tools such as *WinRunner*™, by Mercury Interactive, provide a way to record and play back mouse movements and keystrokes. These recordings are called scripts. Scripts are written in special scripting languages, similar to Visual Basic or C, and can be corrected and customized. Scripts that only play back keystrokes and mouse movements would only test an instrument's graphical user interface (GUI). That is, they would only confirm that a new build of an instrument accepts recorded inputs. They could not detect if the *position* of the input fields on the page have changed or if features not affecting the input sequence have changed or been added.

For robust testing, scripts must do more than simply play back mouse movements and keystrokes. They must also do *object testing*. Object testing records the properties of objects in an instrument, including non-visible properties that cannot be tested manually. For example, an *object* or *control* would be any input, display, or interface device within an application, such as edit boxes, list boxes, form pane, buttons, and so on. A *property* would be an attribute of the object such its location on the page, height and width . *Figure 5* is a page from a typical instrument. Using *WinRunner*™, we can capture the properties of the field labeled *Employer*, for which *Westat* has been entered. *Figure 6* shows the dialog displaying the properties of *TInputLine*, which is the name of the control containing the entry *Westat* in *Figure 5*. The list of attributes for *TInputLine* appear as a list in the name column. It includes the height, width, and X,Y pixel positions of the control. If there were a new build and, for some reason the position of the control changed, *WinRunner*™ would report an error.

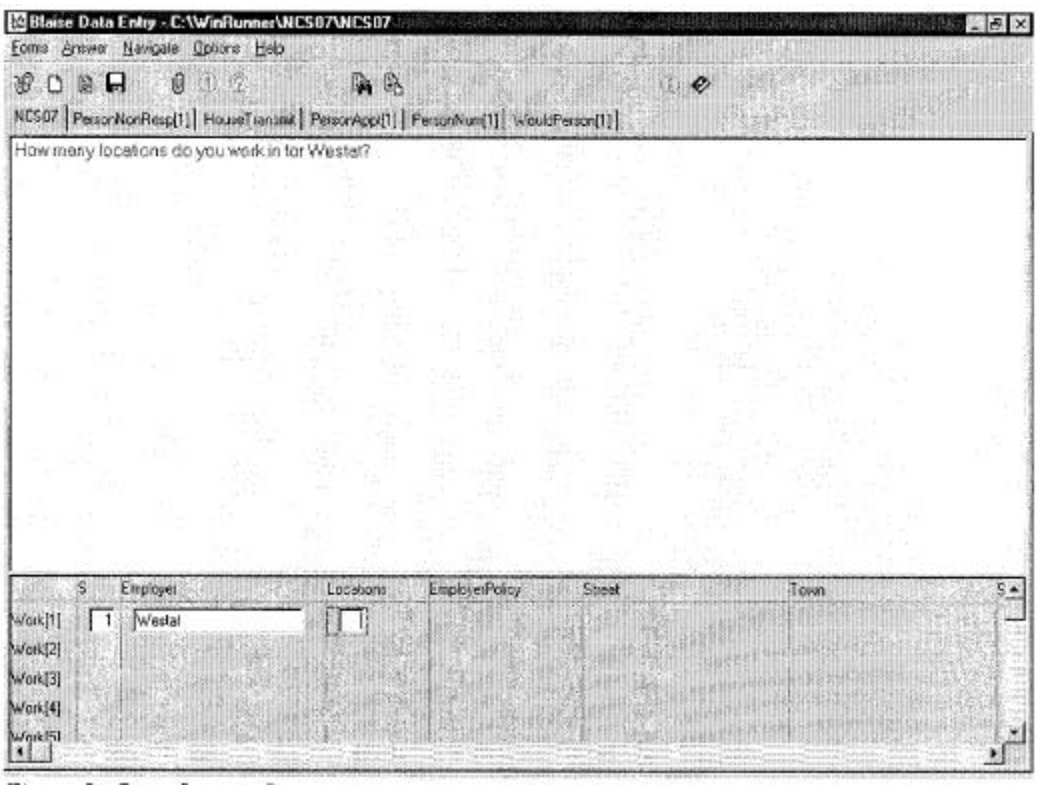

Figure 5: Page from an Instrument

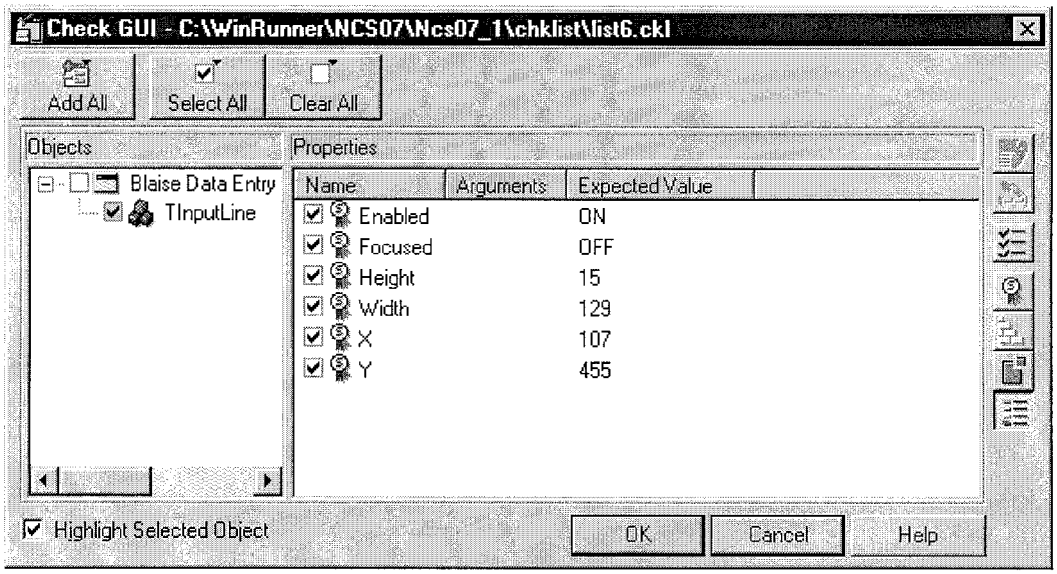

Figure 6: Properties of Object TInputline

Testing tools can also provide image comparisons, where a baseline screen image is obtained and compared to an image acquired during testing of a new build. *Object Properties*, *Region Image*, *Object Data*, and other comparisons are referred to as *test cases*, or *checkpoints*. A test case acts as a validation point for the application under test. Test cases are created to capture and record information about the current state of an object in the application under test. The test case then stores the information as a baseline of expected behavior. As subsequent builds of the application become available, the recorded test procedures are played back against the new builds to compare them with the established baseline. When a test procedure is played back, the testing tool repeats the recorded actions. Each test case recaptures the information and compares it to the baseline. If the information is the same, the test case passes. If not, the test case fails.

4.3. Testing the Blaise System and Blaise Instruments

It is important to distinguish between testing Blaise as a system/product and testing an instrument that was developed using Blaise. In the former case, testing is performed on a stable, mature application. There are typically few GUI changes from one Blaise version to the next and scripts written for one build should easily work on another. Testing instruments that were developed with Blaise is more problematic. Since there are frequent and intentional changes to the instrument during the development phase, previously recorded scripts quickly become out of date and unusable. However, as instruments become mature and stable, automated testing becomes more useful. As an aid for updating scripts, testing tools provide a feature that allows a script to be updated with new or changed information during play back. This makes minor updates more manageable.

The capability to recognize Delphi object properties requires that Statistics Netherlands compile files supplied by the testing tool manufacturer when preparing the Blaise system. This extends the automated testing ability from only comparing screen images to checking Delphi specific object properties. The extent to which a testing tool can recognize Delphi objects and properties is determined by the robustness and completeness of the files the testing tool manufacturer supplies to Statistics Netherlands. To support Delphi, the manufacturers must create up-to-date files when Delphi versions change. This commitment to Delphi support is imperative when evaluating a tool for Blaise testing.

Automated testing of Blaise as a system has been a focus at Westat. In this case, we have a stable system that, upon new releases, can be tested using various data models. This is a classic example of regression testing. Blaise tools such as Manipula and Hospital can also be tested. *Figure 7* shows a flow chart for the process of testing the Blaise DEP, where each **n** represents a different data model selected to optimize testing for different aspects or targets for each test. Example aspects include *normal interview*, *extreme navigation*, *parallel blocks*, *lookups*, etc. Note that there are two paths of testing: a baseline branch and a testing branch. The baseline branch stores the information as a baseline of expected behavior. The test branch plays back recorded procedures with new builds to compare their results against the established baseline.

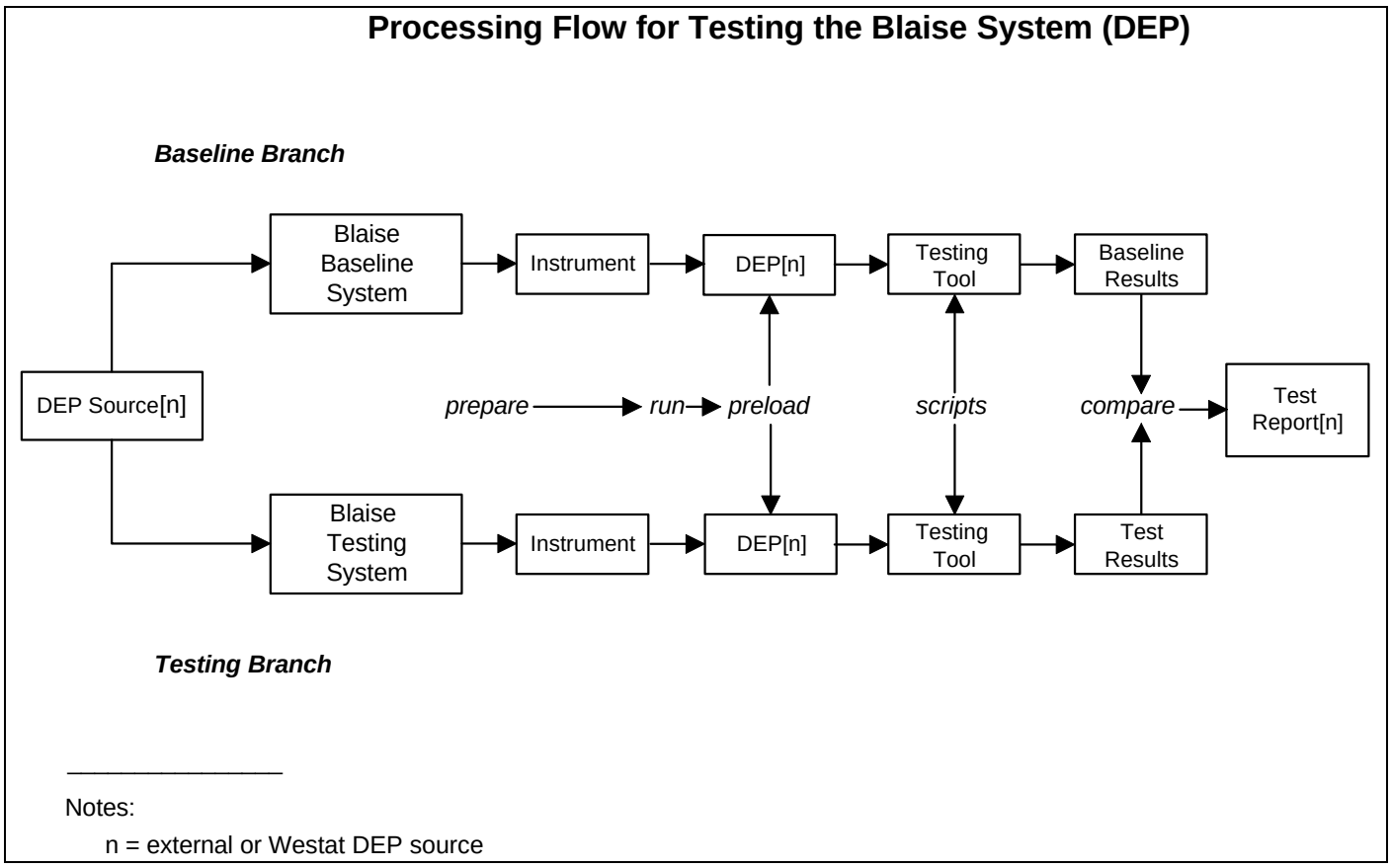

Figure 7: Processing flowchart for testing the Blaise DEP

Figure 8 is a Requirements Tracing Matrix for testing the Data Entry Program (DEP). Westat has created similar matrices for testing the Blaise Control Centre, Hospital, Cameleon, Manipula, CATI, and other Blaise system components. Each row represents an aspect of the DEP being tested. A column exists for each data model being used for testing. Within each cell is the name of the script that meets the required aspect test for each data model. To avoid unnecessary and redundant testing, there are empty cells indicating scripts that are not required.

Instrument Names	**Diary**	**Eu9707s1**	**DACFINFA**	**HLFS**
Aspects				
Normal interview	DIAR0001	EU970001	DACF0001	HLFS0001
Interview with edit failures and other navigation	DIAR0002	EU970001		HLFS0001
Extreme navigation	DIAR0003			
Edit invoking, edit navigation	DIAR0001	EU970001		HLFS0001
Parallel blocks, parallel tabs	DIAR0001			
Language switching	DIAR0004	EU970002		
Functions keys	DIAR0001			
Lookups		EU970003		HLFS0002
Browse records and other data file access		EU970001		
Coding – hierarchical		EU970001	DACF0001	HLFS0001
Coding – trigram	DIAR0005	EU970004		HLFS0001
Coding – alphabetical				HLFS0001
WinHelp		EU970002		
Multimedia		EU970001		
Audit trails	DIAR0006		DACF0001A	
Stress		EU970004		
Display features	DIAR0001			
Data storage		EU970001		

Figure 8: Requirements Tracing Matrix: DEP

The complexity of testing such a large system becomes immediately apparent. There are hundreds of scripts to run in various combinations to get complete regression testing coverage. Testing tool programming languages provide a way to run these script combinations. This means that we can play back a row, column, or any combination of scripts as one test, rather then executing each script individually. This provides great flexibility in focusing the testing on suspected weak areas. Scripts can run overnight, with obvious savings in cost and time. The testing tool automatically records test results.

4.4. Final Comments on Automated Testing

There is a substantial learning curve and commitment associated with learning and implementing automated testing tool software. In particular, while recording scripts can be relatively simple, to implement a robust automated testing system, the scripting language must be learned. As with any high level language, this takes some time and experience. When testing the Blaise system, for example, the Requirements Tracing Matrices indicate the numerous scripts and scenarios that have to be addressed. A “front end” programming task, written in testing tool script language, could provide the user with an interface to select which scripts to run. Tasks such as pre-loading data and launching instruments need to be programmed. Furthermore, testing tool systems come with management software that must be implemented to successfully plan, track, and report the testing process. Finally, as distributed and Web-based systems become the rule, automated testing tools can simulate hundreds of users for load testing—a topic we can address in the future. Given the growing complexity of surveying instruments and scarcity of resources for testing, time spent learning and implementing automated testing is time well spent.

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Whatever Happened To Our Data Model?
Documenting Change in Continuous Surveys.

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Many, if not most, of the large social surveys are either conducted continuously or are repeated at fixed intervals. The survey processing systems can usually be recycled with some alterations for the next wave. The effort spent on these amendments depends on how much the data model has changed. The amount of work can, however, be reduced by good documentation of the data model changes.

Of course, there are already methods to document data collection instruments - survey organisations have a strong business need for such documentation. Moreover, the TADEQ project will develop a standard system for documenting computer assisted interviewing instruments once it is completed. Meanwhile, most organisations have developed their own systems for documentation. Others have to make do with what the Blaise system can offer: the Blaise data model specification, the Structure Viewer and Cameleon. However, while some of these documentation systems may be extremely elaborate they fail to address the issue of alterations to data models, they still only give the static picture of a data model.

1. The Survey

Our need to develop a system for documenting changes between successive data models arose from the Family Resources Survey. This survey has a very complex instrument, as it is designed to collect information on all kinds of household income in great detail. The survey is conducted in co-operation between the National Centre for Social Research and the Office for National Statistics (ONS). The data collection and editing are shared between the two organisations, while the National Centre maintains the data model and the ONS processes the data for delivery. The data collection is conducted continuously and the data model is revised once a year.

The Department of Social Security (DSS) - the client - has specified the delivery data as a set of tables together with detailed meta data documentation. The production of the delivery tables requires a very complex data processing system. Even small changes to the data collection instrument will have consequences for the processing of the data. For example, an added answer category to catch a new benefit payment requires a new output table entry with a unique key value. The data output system is too elaborate to re-design each year. To make the necessary amendments, the specialists at the ONS and the DSS need the best possible documentation of what exactly has changed since the previous wave.

2. Program Requirements

There are four key requirements for the documentation of changes between successive data models:

- It must be generated from the Blaise files, either the data model specification or the prepared data model, as manually maintained documents may not reflect the true contents of the data models;
- The documentation must record all the relevant changes without over-reporting irrelevant differences;
- It should be automated as far as possible; and
- Finally, the system should be applicable to all surveys.

2.1 Comparing What?

Which is the best basis for the comparison: the data model specification or the prepared data model?

The data model specification is the complete definition of the data model, often referred to as the source code. It is possible to compare two data model specifications and report on the differences using a standard file compare utility, e.g. FC or DIFF. However, this method would generate a vast output file. Every differing byte in the two input files is reported. It requires a parser to analyse the output file and eliminate the irrelevant differences. At this level of program development, it would be more

efficient to build a parser that produces a standardised description of each data model specification and then to compare the two descriptions.

The alternative to the data model specification is the prepared data model. This is not directly readable. It can only be accessed via the Data Entry Program, the Structure Viewer or Cameleon. Cameleon has a well-defined language that allows you to specify how to record information about a data model in an output file. All the information from the FIELDS sections is available for the output specification. However, Cameleon has no knowledge of the RULES sections.

2.2 No Rules?

From the point of view of the current users, reporting differences in the RULES sections between successive data models may not be a necessary feature as long as the document signals changes to the number of block and field iterations. For example, in a household survey instrument, the number of possible respondents has been reduced from twelve to ten. This is an important change that must be reported, but it doesn't require any direct knowledge of the RULES, because the change will also be reflected in the array sizes of person level blocks and fields.

Another RULES related change that may be of interest is in the sequencing of the fields. Although the order of the fields in the FIELDS section doesn't have to be the same as the order in the RULES section, it is good programming practice to synchronise them; and Cameleon can be instructed to assign a sequence number to each field.

3. The Design

In designing the system to document changes, the basic idea is to let Cameleon record a standardised set of properties for each field, then sort them by field name and compare the lists. Any reported difference is categorised into one of three types;

- A deletion - a field or answer category that has been removed from the new data model;
- An insertion - a new field or answer category; or
- A change - a field that is re-specified in some way.

3.1 The Level of Cameleon Output

The implementation of this simple idea of comparing standardised and sorted lists of fields is not as easy as it may seem. There are a number of factors to consider:

- **First, how to handle the answer categories for enumerated and set field types?** The documentation system has to be able to detect and record any changes to single answer categories, even if the field level properties remain unchanged. The answer categories are on a relational level below the field to which they belong. Each field can have a number of answer categories, but each answer category can only belong to one field. The easiest solution is to let each answer category form a separate record in the output file so that they share the field level properties but differ in the answer level properties. The resulting file will then have the answer category, rather than the field, as its basic level.

- **Second, whether to record all the instances of a field or just one instance?** This issue arises out of the fact that fields, and blocks of fields, can be repeated in arrays. Recording all the instances of a field would give a much larger output file and, unless suppressed, changes will be reported over and over again for every instance of such a field. Selecting just one instance of a field is more efficient, as long as a change to the array size can be detected.

- **Third, how to deal with different fields that share the same field name?** Blaise allows fields to have the same name as long as they are declared in different blocks. As the Cameleon output is sorted by field name, these fields will be stored in adjacent records. There is a risk that the wrong fields will be compared, which would result in changes being reported where no change has occurred. The solution is to sort the records by sequence number as well as by field name.

3.2 The Field Properties

Each field and answer category should be sufficiently well described to allow for a detailed comparison. The properties we have selected include:

1) Field Name
2) Field Sequence Number
3) Field Path
4) Field Text
5) Field Type
6) Field Attributes
7) String Length (for String type fields)
8) Lower Bound (for Numeric type fields)
9) Upper Bound (for Numeric type fields)
10) Number of Codes (for Enumerated and Set type fields)
11) Number of Choices (for Set type fields)
12) Answer Index (for Enumerated and Set type fields)
13) Answer Code (for Enumerated and Set type fields)
14) Answer Text (for Enumerated and Set type fields)

Some of the above properties may need further explanation. The *answer index* can differ from the actual answer code. The Blaise programmer may have defined the answer code, but the answer index is always incremented by one. The *field path* gives the full field name, including the names of enclosing block fields, separated by dots. The *field type* is defined as Enumerated, Set, Integer, Real, String, Date, Time, Open or Class.

Not all the properties apply to all the fields. For example, fields of the types Date, Time and Open can only have meaningful values for the properties one to six. Field properties that don't apply are generally set to zero or one or a null string.

There are some other field properties that are worth considering. It may be useful to include the field description text (or field label) for data models that consistently use it. The field description gives the best indication of the meaning of the field.

4. Notes on Implementation

The Cameleon script allows the user to specify the level of the output. As mentioned above, one issue relating to the level of output is whether to record all the fields or just one instance of each field. The default setting is to select one instance, but the user can override this by telling the script not to suppress the repetition of arrays. If the array repetition is suppressed, the user can still select whether to output the first or the last element of the array. Selecting the last element means that the program will be able to detect changes to array sizes. This is possible because the field path property then records the highest index number of all the array elements.

It may cause a serious problem for the comparison of the Cameleon output if several fields share the same name. Sorting the records by sequence number as well as by field name only works if the two data models have exactly the same number of these fields. Some data models may have special identifier fields in repeated blocks that stores the situation, person, instance, etc, that the block relates to. If each of the blocks has a unique name (instead of being declared as an array) and the number of these blocks differs between the data models, the comparison won't work. Therefore, an additional parameter to Cameleon allows the user to specify any field name that should be excluded from the output files.

Comparing the two Cameleon output files is a routine data processing task. Pairs of records are compared. If a record is missing in one of the files, it is either because of a deletion or an insertion. If the pair has exactly the same contents, it is ignored. If they differ, the program has to establish in what way. The current program applies a priority order of field properties, to avoid over-reporting of fields that have changed in more ways than one. This could be amended so that the user can select whether to report only the most important change for a field or all changes for a field.

Most of the field properties are compared literally. It is only the text properties that require some special handling. We have designed the current program to take a very simple approach. Only letters, digits and brackets are included in the comparison and all the letters are converted to upper case. This means, for example, that adding or deleting a comma will not be reported as a text change whereas renaming a text substitution variable will be reported.

5 The Report Output

There are eleven possible report files, five of which are for printing and six of which are prepared for further processing. The reason for the latter is that the principal end user wants to load the files into Excel spreadsheets.

The non-printed files contain the Cameleon record from the old data model and, if applicable, the Cameleon record from the new data model. As all the field properties are comma separated, the records can easily be imported into Excel. These six files contain deleted fields, inserted fields, deleted answer categories, inserted answer categories, changed fields in field name and changed fields in sequence order.

The printed files only document the changed fields. Two files record all the changes, one in field name order and one in field sequence order. The contents of the former is then further split into a file recording text changes, a file recording field type changes and a file recording changes to the block or array structure. The latter distinction is possible because the field path is included as one of the field properties.

6. Different Versions

The system for documenting change between successive data models was originally developed in a DOS environment. The user starts by running the Cameleon script on both data models, copies the output files to a common directory and runs a DOS batch file. The batch file takes two parameters: the name of the old data model and the name of the new data model. At the core of the batch run is a QuickBasic program that compares the two files and generates the output files.

The system has subsequently been updated to run in Windows using only Blaise 4 Windows tools. A Maniplus shell, that collects information from the user and runs the appropriate Cameleon and Manipula routines, controls the processing. A Manipula setup converts the Cameleon output into Blaise data files. Additional Manipula setups compare the two data files and generate the report files. All the records that differ between the two data models are stored in a single Blaise data file. In the Windows version the user can select either or both of the report file formats.

The Windows design is clearly preferable to the DOS version. The user is able to select the data models, set the parameters and specify the report format in one single environment. There is, however, one small difficulty: the inability to store and process long strings in Blaise. It is not possible to store the field text in a single data structure, as a field, an auxfield or a local. The only way around this is to store the field text as an array of strings.

7. Conclusion

The documentation of change between successive data models is already being used with great success for the Family Resources Survey. It has also proved useful in other surveys. It could provide even more benefits if a future Cameleon has access to more information from the RULES sections. For example, knowledge about the number of edits in each block would make it possible to quickly find out why two consecutive data models are incompatible.

What users want from a tool for analysing and documenting electronic questionnaires: the user requirements for the TADEQ project

Maureen Kelly

Abstract

The TADEQ project is funded under the European Commission's Esprit programme to develop a tool for documenting and analysing electronic questionnaires. It is led by Statistics Netherlands and the other partners are the Office for National Statistics, UK; Statistics Finland; Instituto Nacional de Estatística, Portugal; Max Planck Institute, Saarbrucken, Germany.

National Statistical Institutes (NSIs), research institutes, and commercial marketing research organisations are making an increased use of computer-assisted interviewing (CAI) systems for collecting survey data. The growing possibilities of computer hardware and software have made it possible to develop very large and complex electronic questionnaires. As a consequence, it has become more and more difficult for developers, interviewers, supervisors, and managers to keep control of the content and structure of CAI instruments. The TADEQ project proposes to develop a flexible tool for documenting and analysing electronic questionnaires. As a documentation tool, it must be able to produce a human-readable presentation of the electronic questionnaire.

The paper will describe the first stage of the project: the user consultation and translation of the results into a user requirement to serve as a basis for the remainder of the project.

Keywords: TADEQ; user requirements; documentation; flexibility; electronic questionnaires

Introduction

Questionnaire documentation is a core tool within the survey process. Throughout the life of a survey there are many different users of the documentation who use it to perform a number of different tasks. Computer assisted interviewing (CAI) systems are increasingly replacing paper questionnaires to collect survey data. The documentation of the CAI instruments used to collect data, electronic questionnaires[1], has been problematic and time-consuming. The increasing capabilities of computer hardware and software have made it possible to develop very large and complex questionnaires. It has become increasingly difficult to comprehend these complex questionnaires in their entirety. The TADEQ project was set up to develop a tool for the automatic documentation and analysis of electronic questionnaires.

1. Background

Computer Assisted Interviewing

National Statistics Institutes (NSIs), research institutes and commercial market research organisations are increasingly using CAI instruments used instead of paper questionnaires to collect survey data. CAI has made many quality improvements to survey data that have been well-documented (see for example W L Nicholls II et al. or M Couper and W L Nicholls II).

However, one area where CAI instruments have not brought improvements is questionnaire documentation. The paper questionnaire, as well as being the interviewing tool, also served as its own documentation; it contained the information required by documentation users – the questions and the routing instructions. The edit checks were carried out separately in the office and these were usually available in a separate document.

With the introduction of CAI, questionnaires became more complex. At the same time, it became more difficult to provide documentation to understand them. The documentation of CAI instruments became a separate task, one that was not necessary when paper questionnaires were used. At first, this task was not recognised. In the early days of CAI, when electronic questionnaires were developed for computers of limited size and speed the computer programs were seen by the pioneers as 'self-documenting': the programs contained all the information about the questions asked and the routing. However, to a non-programmer, using the actual program could be confusing. Users were nevertheless forced to accept it, as it was the only documentation available. This situation was always unsatisfactory and soon became wholly untenable: as CAI instruments grew

[1] Throughout the paper CAI instruments and electronic questionnaires are used to refer to computer programs which are used for data collection. CAI programs refer to the source code used to produce the electronic questionnaires.

more complex users were unwilling and unable to use the CAI programs. Therefore users required other forms of documentation of the electronic questionnaires.

Current solutions to the documentation problem

At present there are a variety of ways in which users have attempted to solve their documentation problems: producing separate questionnaire specifications independent of the CAI program; manual editing of the program; and semi-automated documentation of the electronic questionnaire.

Some surveys produce a questionnaire specification that is wholly independent of the CAI program. This type of documentation can be useful for testing the instrument. However, these documents are produced manually, which can be time consuming and error-prone. As the questionnaire is produced independently, there is no guarantee either that it matches the specification exactly or that the specification accurately documents it at the end of the process.

On other surveys, there is an attempt to document the CAI instrument once it has been written, in part or in full. Manual editing of the CAI program has formed the basis of much recent documentation of this kind. However it is a large and laborious clerical task to get the documentation into a presentable format. Again, as it involves manual editing it can be error-prone. Moreover, it is difficult in practice to ensure that any amendments to the CAI program are carried over into the documentation, particularly if these amendments are made under extreme time pressures.

Consistent and accurate documentation can only be obtained if it is generated automatically from the electronic questionnaire itself. In 1996 the Social Survey Division of the Office for National Statistics (ONS) developed a tool, in co-operation with Statistics Netherlands, which could automatically produce documentation from programs in Blaise. This documentation tool met many of the user needs for ONS's documentation: it has produced the documentation for such large and complex surveys carried out by ONS as the Family Expenditure Survey, the General Household Survey, and the Family Resources Survey. It has greatly improved the speed with which the documentation is produced: for example, it is fast enough to be used by the ONS Omnibus Survey, which has rapid turnaround from module request to fieldwork and results. However, the output still requires some manual editing so it can still be subject to errors and the updating issues that other documents have - albeit to a much reduced extent.

Many continuous surveys have a different kind of problem when updating their documentation, in which the majority of the questions asked are the same as in the previous version. It is sometimes quicker to manually update the previous version of the document with the recent changes, rather than to start the documentation from scratch again, and repeat all the editing done on the previous version. Over time, there is a risk that documentation and CAI instrument may diverge significantly, as in the more general case mentioned above where documentation and instrument are developed separately.

The TADEQ project

There is a need to produce documentation for CAI instruments that is comprehensive and accurate. It needs to be produced quickly and requires no or little manual editing. This can only be obtained if it is generated automatically from the CAI program, as that contains virtually all the information required for the documentation. What is needed is a software tool capable of automatically translating the CAI program into a human readable form.

The TADEQ project is funded under the European Commission’s Esprit programme to develop a tool for documenting and analysing electronic questionnaires to meet this need. It is led by Statistics Netherlands and the other partners are the Office for National Statistics, UK; Statistics Finland; Instituto Nacional de Estatística, Portugal; Max Planck Institute, Saarbrucken, Germany.

The objectives of the project are to produce a neutral tool, which can be used by different CAI systems. The existing ONS tool it is limited to documenting questionnaires developed in Blaise, and it does not attempt to meet all the user needs which have been identified by the user consultation and which TADEQ will incorporate.

The TADEQ tool will be able produce both paper and electronic documentation. The tool should be able to analyse the structure of the questionnaire and report statistics and possible problems with the structure.

There are several stages to the project:

- A survey among the current users of documentation from electronic questionnaires and development of a user requirement for the TADEQ project which will form the basis for the remainder of the project.
- The development of a neutral file format for storing questionnaire contents and questionnaire logic in an efficient machine-readable form.
- Development of an interface to CAI systems. The interface must allow CAI systems to deposit metadata in a way that can be read by the neutral file format.

- Development of a software module that is able to read the neutral file format, produce paper and electronic documentation, and carry out an analysis of the structure of the questionnaire.
- Testing of the developed tools by users of CAI systems.

This paper discusses the first of these stages: the user requirements for documentation of electronic questionnaires.

2. The users of documentation from electronic questionnaires

There are many different users of the documentation from electronic questionnaires, spanning the whole of the survey process. In the first quarter of 1999, the project team consulted a purposive sample of more than one hundred users in twenty-four organisations throughout Europe. The respondents completed a paper questionnaire or its Web equivalent. The survey's aim was to provide ideas about the different types of user and their different documentation requirements. As well as the survey, a number of discussions took place to get a more in-depth view of what users required.

Conducting a survey involves a large number of people, who perform different tasks and they use their questionnaire documentation in a variety of ways to help carry out these tasks. Different users therefore have different requirements for their documentation. TADEQ has to produce documentation from CAI instruments that has the flexibility to meet the needs of all these users.

The responses received from users in the user consultations covered the whole spectrum of survey work: from commissioning the work at the beginning to archiving the data at the end. Fifteen main roles were identified within the survey.

Users:

- commissioned survey research;
- were survey customers;
- were survey managers;
- designed surveys and survey questions;
- were subject matter specialists;
- developed electronic questionnaires;
- developed and use other CAI applications;
- developed CAI software;
- interviewed respondents;
- trained and managed interviewers;
- processed or edited the data;
- analysed data from their own survey;
- analysed and used data from other surveys;
- were survey methodologists; or
- archived and disseminated survey data and results.

Most users carried out more than one role within a survey. For example, many survey customers also commissioned surveys and acted as managers for part of the survey process. Sometimes customers were also subject matter specialists or data analysts. The division of responsibilities for carrying out these tasks can vary from organisation to organisation, survey to survey. For example, on one survey the people from the organisation responsible for the data collection may also analyse the results in the first instance. On another survey, the people commissioning the survey may do the analysis themselves, or a third party, not involved in the any other part of the survey, may be commissioned to do the analysis.

Users perform a number of tasks and can use the documentation in a variety of ways. They therefore have different requirements for their documentation. Users also have different levels of knowledge about the survey and its contents. Some users involved in the day-to-day running of the survey have an intricate working knowledge of the questionnaire contents and need documentation to check on minute detail. Others, such as managers and customers, may not have the information they require first hand. They may rely on the documentation rather than their own knowledge to provide this information. Policy makers and academics analysing the data once it has been made public are not involved in the main survey process, but still require information, albeit at different levels. The questionnaire documentation is their only source of information about the survey.

Below are listed some of the main tasks for which questionnaire documentation can be used, and the types of users that perform the different tasks.

Designing surveys and survey questions

Survey designers often wish to use questions from previous surveys, to build on good practice or to facilitate the comparison of results.

Approval of questionnaire design

The people who are responsible for the design of the CAI instrument and the data collection are not usually the people who commission or design the survey. The commissioner may wish to approve the CAI instrument to ensure that the instrument is collecting the information they require. A paper questionnaire used to provide a ready form of documentation. However, with CAI this approach is no longer feasible – commissioners can rarely understand the CAI program and, even if they can, it does not usually provide the information structured in a way that they can use quickly and accurately. Tailored documentation is therefore an essential tool in gaining approval for the content of a survey.

In some organisations the developers of the CAI instruments are specialist computer programmers. Specialist survey researchers design the questions and also need to approve the design of the electronic questionnaire. Like survey commissioners, the survey researchers need to approve the design of the CAI instruments developed by the programmers, so they have the same needs for documentation.

Providing information on the content of the questionnaire

Different users require different levels of detail from questionnaire documentation. Some users, particularly data analysts, methodologists and survey designers, require the exact wording, routing and answer categories for each question. Other users such as policy makers and survey managers may require more of an overview of the questionnaire and less detailed information about individual questions.

Interviewers also like some sort of documentation of the electronic questionnaires, even though they have access to the questionnaires. Although CAI instruments have dynamic routing (that is, the next question that appears is dependent on previous answers and is automatically controlled by the program), it is sometimes difficult to get a sense of the overall structure and flow of the questionnaire as a whole. Alternative documentation can provide this. Interviewers find it useful as they can use it to gauge the length of an interview and which questions may appear in certain circumstances.

Public documentation

Many survey organisations and customers, particularly those in the public sector, have an obligation to make their survey data publicly available. Documentation has to be produced which can be archived or published (in survey reports). People who have had no connection with the process of producing the survey data will be the main users of this documentation. It is essential that the documentation is self-explanatory and comprehensive enough to meet their needs. These people may use the documentation for a variety of purposes: for example, to analyse the data from the survey, to help design another survey or to carry out a methodological study.

Users' requirements

Users require (and therefore TADEQ will need to produce) documentation to be:

- accurate – the information displayed in TADEQ should exactly reflect the CAI instrument;
- automatic – the documentation should require no or little manual editing and therefore be quick to produce;
- comprehensive – all the information that the user may require from the electronic questionnaire should be available (even if it is not all displayed at the same time);
- flexible – users need to be able to easily change the information shown by the tool to meet their individual requirements;
- available electronically and, subject to the constraints of the medium, on paper; and
- easy to use for a non-technical user who has no knowledge of CAI programs.

3. Paper and electronic documentation

One of the objectives of TADEQ is to produce both electronic and paper documentation. Almost all the users consulted use paper documentation. Some users had electronic documentation although none stated they used it exclusively. However, people

report that their use of electronic documentation is limited by a need to mimic the paper documentation they currently use (for example, a Word document). Improvements in the quality of electronic documentation available would mean users would be able to utilise the many benefits of using electronic documentation such as: quick navigation using hyper-text links; computerised search and help facilities; and being able to copy information into other computer packages. Electronic documentation could be used interactively and the user could alter the documentation to suit their own needs.

However, even with these advantages, there will still be a need to produce paper documentation. Almost all the users that were consulted stated they would still require a paper version. The reasons users gave were:

- it was what they were used to;
- they could still use it when they did not have access to a computer;
- to show clients, policy makers and to take to meetings;
- they could easily annotate the document;
- they could use it as a reference when using other computer packages (for example, some data analysts prefer a paper document containing the information on variables rather than switching between screens on a computer; and
- they would need it for publication in a paper report.

TADEQ needs to produce both types of documentation.

Good usability of the documentation produced is vital in both modes. A document can contain all the necessary information but if it is not well presented users will not be able to find the information they require. The documentation will have failed in its prime purpose.

There are different considerations for documentation in the two types of media. The paper document is static, whereas the electronic version can be interactive. The best layout of a paper document is likely to be different from a document viewed on a screen. In a paper document all the information needed has to shown on the page, whereas on a screen, items can be displayed or hidden as necessary.

Although some surveys produce different paper documents for different users, most produce one document that attempts to meet the requirements of the majority of their users. Electronic documentation can be tailored to suit individual requirements. The navigation and searching for information is different in the different media: in an electronic environment, users can use hyper-text links, clicking on icons; paper documents require other sign-posts such as page numbers, contents page, section headings, and an index so that users can find the information they require.

4. Information required from the electronic questionnaire

Users require a wide range of information from the questionnaire. The key to TADEQ will be the flexibility to show information as and when required, and allowing the user to have control, as far as possible, over what the documentation looks like.

The key information that users need is: what questions were asked; what the possible answers were; to whom they were asked; and in what order.

Although most users want the question text, answer categories and a description of the routing, there are various ways this information can be presented. Users may not wish to see all the possible information on all the variables at one time. It may actually be counter-productive to show too much at the same time; essential information could be lost in a forest of detail. Users need to be able to select which variables they require information for and what information they require for these variables.

As well as information for specific variables there is other information that a user will need to know:

- A title to identify the document. Users may also want a version number, the filename, the time and date of production and who (person or organisation) produced the documentation.
- The questionnaires that TADEQ will be used to document may be long, with a huge number of questions. For example, Manners and Deacon report an instrument with some 30,000 questions. Many of the questions were in loops for all household members, but some 3,500 were unique. In addition there were 2,500 consistency checks. In order for users to navigate their way around the documentation it needs to be split into meaningful sections, with signposts and labels. This is particularly important for paper documentation. Some CAI systems allow questionnaires to be built from blocks of questions. If these exist they can be used to split the questionnaire into sections or sub-questionnaires.
- Indexes and variable lists are also essential, in order for users to find the variables they are looking for. Indexing should be possible by description or by keywords as well as by variable name so those users without detailed knowledge of the survey can find the relevant variables.

- Some CAI systems offer the facility to use external data files to read data in or code data contained within the questionnaire. Users may wish to have references to these files, and a description of their function. They may wish to have a list of all the files used within the questionnaire and also state at a particular question which file was used. The CAI instrument may also use external programs that are not part of the CAI system. Again, these programs need to be documented with a description, if available, of what the function of each program is.
- Some users may wish to add external information to the electronic version of TADEQ, that is information not produced from the CAI instrument itself. This further information may be about specific variables, such as frequencies; or a history of changes to the questionnaire; copies of external coding frames or more general information about the survey, such as dates of field work, sample sizes etc. There may be a need to add information to meet data documentation and archiving standards set by customers, National Statistical Institutes or international agreements.

5. Information required for each variable

As previously mentioned the information about the variables contained within the questionnaire is the fundamental part of any documentation. A wide range of information is required for each variable. There are different ways of presenting each piece of information as well as issues surrounding how all the information fits together.

Which variables are shown

It may be the case that a user does not want to display all the variables within an electronic questionnaire. Users need to be able to select the variables they require individually. However, for large and complex questionnaires this could be a time-consuming task. Users need to select different groups of variables according to different criteria:

- Many CAI systems allow instruments to be built from blocks of questions. If these exist, then the user could select/deselect all the questions within a block.
- Not all variables in a questionnaire are questions that are asked to respondents. As well as variables that are *asked*, some variables are computed and *shown* for information and others are computed and *kept* in the questionnaire without being seen. Also some variables can be asked in some circumstances and computed in others. Users may want to see all the variables, only those that were asked or shown or kept, or any combination of these.
- Some CAI instruments use variables that are temporary and do not appear on the final database. These are sometimes used in computations, routing and other functions within the questionnaire, which are not required afterwards. Some users may wish to see all the variables used in the program others may only want to see those that are permanent variables.

Not showing all the variables can cause problems if any of the variables that are not shown are referenced elsewhere in the documentation, such as in the routing specification. To users unfamiliar with the CAI program these references will be meaningless. TADEQ needs to find a way of dealing with such variables. One solution would be to provide a list of variables that are not shown but are mentioned elsewhere in the documentation.

Variable identifiers

These are essential, however different users need to identify the variables in different ways. In Blaise, variables are identified using names that include the blocks they belong to, using dot notation. For example, QTHComp.QHComp.NumAdult. Some users, particularly developers of CAI instruments, require these full names so that they can find the question within the program itself. These may also be needed to identify a variable with the same name in several blocks. Other users may prefer to have a short variable name (for example, NumAdult), as this is how the variable is likely to appear in the final database. However, using these short names could result in more than one variable having the same name. Many users also thought that the variables should be numbered as it would give an easy reference point. Other users felt that a description of the variable was important, particularly if the user was unfamiliar with the data and documentation.

Question text

Documentation of the question text is essential. However, many CAI instruments use text substitution where the text of a question can be altered depending on individual circumstances of the respondent. Although it usually improves the flow of the interview, it makes documentation of the question text difficult. TADEQ substitution can use either the values of another variable directly to a temporary string variable into which the appropriate text is computed depending on the answers to previous questions. In extreme cases, a question may be no more than a sequence of text substitutions.

The documentation tool needs to identify the parts of the text where substitution is used. In many instances the user will not know what the variables refer to (and the names may not be intuitive) and therefore some indication what the text substitution is necessary to understand the question. There are several possibilities: a label for the text substitution for the variable; a link, reference, or box showing where all the text alternatives (and the conditions under which they apply); or a conventional simplification, such as a pronoun is always shown as 'you', 'yours' etc. The main requirement from users is for a description or a conventional simplification. However, in many cases where the text varies substantially, all the alternatives will be required.

Answer types

The type of answer required from the questions is essential information for the majority of users. There are different types of answers to questions: numeric (integer and real) values; strings, where a text (usually of specified length) is entered; enumerated types, where there are specified response categories; multiple response enumerated types, where more than one answer can be recorded; and other special types, for example for recording times, dates or verbatim answers.

Enumerated types have similar presentational problems as variable identifiers, since the answer categories can be referenced in a number of different ways (by number, a short name that is used in the CAI program, the full answer, or a descriptive label). Some CAI systems allow text substitution to be used in the response categories and therefore the answer categories can have the same problems with text substitution as occur in the question text.

Some questions can be left blank, or special keys can be used to enter 'don't know' or a 'refusal' at a specific question. Many users need to know when these keys can or cannot be used or when the questions can be left empty.

Routing

Documentation of the routing was essential for the majority of users. However the routing for many of the surveys for which TADEQ will be designed is complex and difficult to show in a comprehensible format. One problem with routing (as has already been mentioned and can make routing incomprehensible to users) is that the routing can contain variables that are not displayed anywhere in the documentation. Also, the references to the answer categories from an enumerated type need to be consistent with what is shown in the main documentation. For example, if the short names as used in the CAI program are used in the routing but are not listed in the documentation then the routing can become meaningless.

As the routing within large CAI instruments can get very complex, many users require an explanation in natural language for what the routing is doing. This is particularly useful for customers, policy maker or other users who are unfamiliar with programming languages. Although some users would find this sufficient, many users still require the more 'technical' and exact routing. Some users would like the option to display both. These descriptions of the routing would need to be incorporated within the CAI instrument so that they can be used by TADEQ.

There are two different concepts that CAI programs can use to control the routing of the questionnaires: 'conditional' routing, which specifies under which conditions the questions will be asked, and 'goto' routing which states which questions will be appear next once certain answers are given. Electronic questionnaires use only one type of routing, users want both types of routing displayed. The majority of users require the conditional routing and although many users also wanted the goto routing, none stated they could use this type of routing on its own.

Both types of routing have problems associated with clearly displaying the information. Some of the issues and problems in showing the routing information required by users are described below. The paper by Jelke Bethlehem elsewhere in this publication discusses the detail of displaying routing structures of electronic questionnaires.

Go-to routing

For complex questionnaires 'go-to' routing is difficult to display in an easy-to-read format, as the 'go-to' instructions themselves may be dependent not only on the answers to the current question but also answers to previous questions. For example:

```
Marstat
Are you:
(1) single, that is, never married                -> if (DMSIZE > 1) goto LiveWith
                                                      else goto HHldr
(2) married and living with your husband/wife     -> goto HHldr
(3) married and separated from your husband/wife  -> if (DMSIZE > 1) goto LiveWith
                                                      else goto HHldr
(4) divorced                                      -> if (DMSIZE > 1) goto LiveWith
                                                      else goto HHldr
(5) or widowed ?                                  -> if (DMSIZE > 1) goto LiveWith
                                                      else goto HHldr
```

This is a simple example. Many of the conditions used in CAI programs are much more complicated. In complex instruments, go-to routing which creates the conditions for a variable from routes from several different parts of the instrument makes it very difficult for an analyst to reconstruct the conditions accurately. Many of the users stated that they would like to have documentation which shows 'goto' routing for their questionnaire (irrespective of the CAI software used to collect the information). However, many users were worried about the complexity of their surveys and that this would make the documentation unusable.

One option is to display goto routing as a graphical representation as a 'flow diagram'. Many users thought a diagram would be useful to get an overview of the questionnaire as a whole or to look in detail at the flow of questions in particular sections. However, they felt that a diagram showing the detailed routing for the entire questionnaire would be too complicated to use.

Users stated that they needed some sort of overview of content and structure of the questionnaire. Although many users stated that this would be extremely useful very few had documentation that provided one. In the electronic version of TADEQ this diagram could be used interactively, as the basis of navigation throughout the questionnaire; to move up and down hierarchies and between blocks to see the flow of questions at a particular section. However the user must be able to know where they are within the questionnaire as a whole, as it would be easy for a user to get lost within a large and complex questionnaires.

Users would also like the option to alter the information shown in the diagram, such as showing just the variable names, or names plus the description and the answer categories. To keep the diagram simple many users may wish to display the variable names and would therefore need links and references to the other information they require.

Conditional routing

The conditional routing of questions in complex questionnaires is usually built up from a number of nested statements. For example:

```
IF (LDMINDINTERVIEW[LDM1] = now) THEN
   Natural
   IF  Natural = Yes THEN
       NatNum
       IF (Filling = yes) THEN
         NumFill
      ENDIF
   ENDIF
ENDIF
```

Some users need to see the full conditions under which each variable applies. This is particularly useful for data analysts or other users looking at individual questions in isolation. However in complex questionnaires the number of nested conditions can get very large, resulting in a number of complicated conditions being repeated for each variable. This can make the documentation hard to read and many users do not find all this information useful; the most useful information is lost in the forest of detail.

Many users will only be interested in the last few nested conditions, as these are the most likely to change in a related sequence of questions. Users need to be able to control the levels of routing that are displayed. This could be done either by hiding the routing which is common to a selected set of questions or they may wish to hide all the nested conditions. Whenever any routing is hidden there would need to be some indicator to the user that they were not seeing the full conditions of the routing for the variables.

In many electronic questionnaires questions are repeated, such as asking the same questions for each adult in the household. These questions can be nested within each other. This repetition, although it makes the instruments more efficient, can cause problems when trying to make the routing transparent for users. In general, the questions that are repeated should be shown only once (otherwise the documentation would be extremely lengthy). Users need to know under what conditions and the number of times the questions are repeated. In many instances repeated questions require the use of temporary variables as counters that may not appear in the documentation. Sometimes the number of times the question is repeated is not fixed and depends on the answer to another question within the questionnaire. The ability to add natural language descriptions to describe the routing and to hide some of the nested conditions would make the routing for repeated questions more comprehensible.

How the question appeared on screen

Some users, particularly methodologists, stated that they would like to know how the questions looked on screen. This was something that was not available on their current documentation. However, the information required to produce this is not usually part of the individual questionnaire, but is controlled by the CAI software itself. With the increasing complexity of

computer software the interviewers can change the settings on their computer. That could affect how the questions look, such as changing the background colour, or the colour, size and font of the question text. Also, with the use of text substitution the questions themselves can change in different circumstances and this can affect how the questions appear on the screen.

Edit checks and computations

One of the major advantages of using CAI is the ability to conduct consistency checks on the data during the interview. Some users want to see what the checks were, others do not. Again, TADEQ will need to be flexible enough to provide the information in the format that is required. The users may wish only to display the checks for certain variables. They may wish to display the checks as part of the information for each variable or they may want all the edit checks to be displayed together. They may wish just to see the conditions under which the questions are checked or they may also wish to see the message that appears to the interviewer.

Likewise, some users want to see the computations that are carried out within the CAI instrument, others do not. There are many uses for computed variables: to calculate variables that are subsequently used in routing or checks; or for text substitution; or be used in the analysis of the data, instead of calculating them at a later stage. Some users may wish to know that the variables were computed without knowing the specific derivation, others wish to see the exact conditions under which all the possible values are computed. Some wish to see the computations with the main documentation for the variables, others want them to be listed separately.

Many of the issues and problems of documenting conditional routing also apply to the documentation of edit checks and computations. For example, there may be a repetition of nested conditions if a number of different variables are computed or checked under the same conditions, which could greatly add to the length of the documentation.

6. Analysis tools

The aim of TADEQ is to produce a tool that can analyse the structure of a CAI instrument as well as document its content. The first prototype will concentrate on the documentation tools and the analysis tools will be added later. However during the user consultation some users did state some user requirements:

- Questions which can never be asked due to impossible conditions within the routing;
- Basic information on the questionnaire, such as the number of questions, the maximum, minimum and average number of questions asked etc.
- Which questions apply given certain conditions, for example, people aged over 16 and not working;
- A theoretical simulation of the number of questions and therefore the length of the interview when fieldwork is carried out. This could be done by estimating of the average number of questions asked calculated from the average number of questions for separate subgroups of the sample and weighting them according to external information (such as population figures).
- Comparison and documentation of the changes between two versions of the same survey.

7. Display templates

As the user will be able to control what information is displayed, they should be able create templates on how the information will look on the screen or page (such as fonts, sizes, colours for different information). It should be possible for the user to save these options so that the documentation will appear in the same way the next time it is opened. Users could then use the same options to look at the documentation from another questionnaire. This would enable users to produce a ‘house-style’. They may also want a different template for producing documentation for internal use and one for general dissemination. Users may also want to create a special template for producing a paper document that could include the creation of page numbers, contents page and an index etc.

8. Conclusion

Large and complex questionnaires require a large amount of information to be documented. The TADEQ tool needs to be flexible to allow the user to display as little or as much information as they require. The means of achieving this aim will be different for electronic and paper modes of documentation. This paper has discussed a number of the different requirements and problems that the TADEQ project has to solve in order to produce documentation that can be used by a wide range of users to help perform a wide range of tasks.

The TADEQ project will produce a tool that will automatically document electronic questionnaires. It will provide an accurate and comprehensive representation of an electronic questionnaire. The project will make full use of the facilities available when documentation is itself electronic, including those such as hypertext links which are not available for paper versions of the documentation. However, it will be guided by the user requirement for paper documents for the foreseeable future. The project will ensure that a wide range of options to print out the documentation is available.

The paper has concentrated on what the TADEQ tool may do for users - on its outputs. As with any tool, the inputs (in this case, from survey designers and their customers) will be crucial to its success. The quality of any automatic documentation from electronic questionnaires can only ever be as good as the quality of electronic questionnaires themselves, irrespective of the quality of the documentation tool. If the questionnaire is badly structured so will be the subsequent documentation. Many of the features requested by users, and which will be available in TADEQ, will require the addition of information to the electronic questionnaires, such as natural language descriptions of routing. There will be ways to add this information at the later stages of a survey, but, to realise the full potential of the TADEQ tool most cost-effectively, users will need to plan and input documentation at the design stage of the survey work. In this, we see another example of the way that CAI integrates the formerly sequential processes of survey work.

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Converting a Blaise2.5 Questionnaire to a Blaise4W Instrument

By

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1. Introduction

The Quarterly National Household Survey (QNHS) commenced in September 1997 replacing the annual Labour Force survey which had until then been accepted as the definitive source of data on employment and unemployment in Ireland. This had been conducted each April/May on a biannual basis from 1975 and annually since 1983.

The QNHS was the first major survey to use Computer Assisted Personal Interviewing (CAPI) in the CSO. CAPI was introduced to ensure an optimum turnaround time from the start of data collection to publication of results. Blaise2.5 was used to write the questionnaire with a front end written in Microsoft Visual Basic and data productivity and quality checks written in Access2.

The QNHS field staff consists of ten regional Co-ordinators and one hundred and thirty Interviewers. Each Co-ordinator is responsible for thirteen Interviewers. Approximately, three thousand households are interviewed each week or thirty-nine thousand over the course of the quarter.

The sample design for the QNHS comprises 2,600 smaller areas or blocks. This set of blocks remains fixed for five years. Each block contains, on average, 75 households, of which 15 are sampled in a quarter. Households participate in the survey for five consecutive quarters and are then replaced. This means that, in each quarter, 20% of the households are rotated out of the survey and replaced by new households in the same block.

Initially, the hardware in the field consisted of 200 identical Interviewer's laptops and 10 Co-ordinator's P.C.s. However, since then due to wear and tear two other types of laptops have been introduced.

At the end of 1998 it was decided to migrate from Blaise2.5 to Blaise4W because of doubts as to the formers Y2K compliance. This paper outlines the work involved in the move and the reaction of the developers to Blaise4W.

2. Moving to Blaise4W

2.1 Starting the Project

We first set up a project team specifically to look at the move to Blaise4W . The reasons for using project management techniques were threefold:

- it was a new project, we had not done a similar type of project before and we therefore lacked the requisite experience
- it was relatively complex
- there was no margin for error, we had to get it right first time.

The project team included people from the IT area, business area and field staff. Although there was a large number of people involved, their roles and responsibilities meant that their input was not required on a full time basis for the duration of the project. The first priority of the project team was to define the scope and objectives of the project. We felt it was important to set out the goals from the start as it provided focus and clear objectives for everybody concerned.

The scope and objectives were to:

- rewrite the system maintaining the structure and functionality of the original system
- successfully convert our existing data collection and productivity and quality checking applications used by the Co-ordinators and in-house CSO team.

Having agreed the scope and objectives we proceeded to draw up a project plan and work schedule.

2.2 Blaise4W Training

The first requirement was to train the development team in Blaise4W. Both of us went on a week long training course in December 1998. The course consisted of four days Blaise4W training and an introductory day on Maniplus. We were also given time to work with the product in order to become comfortable and confident with the software.

We then began to look at ways of addressing issues such as questionnaire design, data conversion etc. Once we started to form a plan of what we needed to do and how to do it we brought in a Blaise4W consultant from Statistics Netherlands.

There were three reasons for this:

- to confirm our approach was correct
- to provide technical help in achieving our objectives
- to ensure best practice and efficiency.

2.3 Questionnaire

The new Blaise4W version of the questionnaire was due to go live in Quarter 4 1999. A pilot was scheduled for Quarter 3 1999. This was to be conducted in conjunction with the usual Blaise2.5 questionnaire. The aim of the conversion was to produce a Blaise4W version of the questionnaire maintaining the structure and functionality of the original Blaise2.5 questionnaire.

The Blaise2.5 questionnaire had been in use since Quarter 4 1997 and had evolved to its current complex structure since then. For example, the Quarter 3 1999 questionnaire consisted of 4,447 lines of code split over sixteen files and blocks. The questionnaire was required to accommodate up to twenty people per household which necessitated the use of a block of array type one to twenty within a table. This type of structure was also used to handle separate questions on emigrants which was required to accommodate up to six people.

The new datamodel was to have a similar structure to the Blaise2.5 questionnaire (see Appendix). Every block in the new datamodel was based on a block in the Blaise2.5 version. The opportunity was taken to rename the blocks with more meaningful names and each block was established as an *INCLUDE* file due to their size. The new datamodel consisted of thirteen blocks, a procedure and a library. The procedure was a new addition and is used to perform checks on the numeric key fields. Using a procedure allowed us to discard several lines of repetitive code. A library of answer types was also created which can be reused every quarter.

When rewriting the questionnaire as a Blaise4W instrument the main objectives were:

- Preserving the layout to keep a familiar look and feel for the business area and field staff.
- Reducing ongoing maintenance. Every three months we release what is essentially a new system with additions and amendments to the questionnaire. We identified and wrote the code in modules which would rarely need to be changed.
- Providing a similar level of functionality for the Interviewers from the available menu options within Blaise4W.

2.4 Handling External Files

The questionnaire accesses five different external files sources.

1. ***Lookup1***
   Block1 : STRING[4]
   WkNo1 : 01..13
   Rot1 : 1..5

2. ***Lookup2***
   Rotn2 : 1..5
   Year2 : 1997..2020
   Quar2 : 1..4
   Rota2 : STRING[1]
   Wave2 : 1..5

3. ***Lookup3***
   Year3 : 1997..2020
   Quar3 : 1..4
   WkNo3 : 01..13
   Day3 : 01..31
   Mth3 : 01..12

4. ***Refquart***
   SDS4 : STRING[3]
   Quar4 : 1..4
   Year4 : 1998..2000

5. ***Previous Quarter's Questionnaire***

The information on the lookup files (1 to 4) combine to give all possible reference data for each block over the entire QNHS sample. This information relates to reference week nos., reference week dates and quarter information. The lookup files are the same on all the QNHS laptops which allows the laptops to be moved between Interviewers and from Co-ordinator area to Co-ordinator area if necessary.

The fifth external file is the previous quarter's questionnaire which is accessed on all repeat calls to participating households. The current quarter's questionnaire is required to access the previous quarter's questionnaire and bring forward any data necessary for routing purposes.

2.4.1 Lookup Files

With Blaise2.5 it was possible to run an *External File* option which converted the external lookup files into a format that Blaise2.5 could access. This option generated two new file types with the extensions *.dat* and *.idx*. To access the external files in Blaise4W the files first had to be converted into Blaise4W databases. Blaise4W datamodels were prepared based on the files' record description. We then used the Manipula application to convert these Ascii files into four separate Blaise4W databases.

With Blaise2.5 the record layout of all the external files had to be included in the Blaise2.5 questionnaire code. We were using the *READFILE* command to access the external files which is a complex command involving the use of five parameters i.e.

READFILE (IndexFileName, Key, DataFileName, InputVariable, Result).

The fifth parameter is based on the search for the key i.e. *0* if the record was found and *1* if the record could not be found.

In Blasie4W the external files are listed in the *USES* section of the datamodel and in the *EXTERNALS* section where the read is to take place. Blaise4W includes the *SEARCH* and *READ* statements which allows more readable code to be developed. The *SEARCH* is used with an *IF* condition and if the *SEARCH* is successful the *READ* is done i.e.

IF BlaiseDatabaseName.SEARCH(key) THEN BlaiseDatabaseName.READ.

The overall effect was to reduce the amount of code required and the end result was more transparent, readable code.

2.4.2 Previous Quarter's Data

The Blaise4W instrument was due to go live in Quarter 4 1999. It was required to access Quarter 3 1999 data collected using Blaise2.5 if a repeat visit to household took place. The first step in converting the Blaise2.5 data into a format that Blaise4W could read was to produce a full file description of the questionnaire fields we wanted to access. Once we had established the file description we used Blaise2.5 manipulas to convert the Blaise2.5 data into Ascii format. The next stage was to convert the Ascii data file into a Blaise4W database. This was achieved by first creating a datamodel based on the Ascii file layout and then using a manipula setup to convert the Ascii data into Blaise4W format.

Reading the previous quarter's data in Blaise2.5 had been a complex procedure. A full file description of all the fields in the previous quarter's questionnaire had to be included in the *EXTERNAL* section. An external file description of the previous quarter's questionnaire was generated using the *UTILITIES* option from the Blaise2.5 menu. The file description was then incorporated into the new questionnaire.

To access the previous quarter's data the question cluster numbers had to be identified. Question clusters are created in questionnaires where one or more blocks are declared as subfiles. Blaise2.5 creates one cluster for every question referred to as a subfile block. Clusters are identified by sequence numbers corresponding to the order in which subfile questions are referred to in the route paragraph at the highest level. The cluster numbers for each person within each block were identified and then used in the *READBLAISE* statement i.e.

READBLAISE (External Key, External File Name, Block Name, Cluster No., Result).

Blaise4W does not require a full file description of the previous quarter's questionnaire. We included the questionnaire in the list of external files in the *USES* section of the datamodel and in the *EXTERNALS* section where the read is to take place. We could then access the data using the *READ* and *SEARCH* commands as described already. To access particular fields from the previous quarter's data we could use dot notation to identify the exact location, for example,

PrevQnhs.PersonGrid.Person[Line No].Individual.Name.

The procedure to convert the Blaise2.5 data into Blaise4W format was eventually combined as an option on the Interviewers' Visual Basic front end menu. This enabled the Interviewers to convert the Blaise2.5 interviews from the previous quarter into Blaise4W format in order to proceed with Blaise4W interviewing in the current quarter. They could then complete any unfinished or late interviews as normal in the previous quarter and when complete convert the data again using the same procedure. This option was only required for Quarter 4 1999 as from that quarter on all the data was in Blaise4W format.

The main considerations accessing the Blaise2.5 data were:

- To convert and/or drop data not required to be carried forward into Blaise4W. This was done by identifying what could be dropped and then writing a Blaise2.5 manipula to convert the data into an ASCII file.
- Creating a Blaise4W instrument to reflect this ASCII file and then converting the ASCII file into a Blaise4W database.
- Rearranging the data in a different layout to reflect the structure of the new datamodel.
- Ease of use for the Interviewer. We set up the conversion procedure to run when "clicked on" by the Interviewer. This option converted any Blaise2.5 data on the laptop from the previous quarter into Blaise4W format.

The biggest problem we encountered with the data conversion concerned the Blaise2.5 manipula. This manipula is a DOS based program and would not run on the Interviewer's laptops due to an insufficient memory problem. This problem occurred because of the amount of memory allocated to DOS based programs by Windows 95. Our solution was to reduce the size of the manipula, however, the effect of this was to limit the amount of data it was possible to carry forward into the Blaise4W questionnaire.

2.5 Other IT Applications

Our old applications used a combination of Blaise2.5, Visual Basic, Dos and Access2. With the move to Blaise4W it was necessary to review the use of all the other software tools.

We decided to update the front ends, written in Visual Basic, to compliment the new look of the Blaise4W screen. This was quite a radical change as it involved moving from command buttons to drop down menus and toolbars. We were able to remove all the DOS programs and use Visual Basic instead to connect with the Blaise4W Dep and Manipula applications. We built in additional message boxes to provide the field staff with more information on the outcome of the procedures they were running.

The Co-ordinator and Office Applications used Access2 for productivity and quality checks on work done by the Interviewers. After the review it was decided to upgrade the software to Access97 mainly because Access2 was not Y2K compliant. The upgrade incorporated a redesign of the screens compatible with the new look of the Blaise4W and Visual Basic screens. The redesign also had to handle the new AsciiRelational files created by the Manipula applications which we used for transferring data.

2.6 Data Transfer

With the old applications the data was transferred from the Interviewer to the Co-ordinator and then to the CSO. This was done by converting the data to AsciiRelational files on the Interviewers' laptops, sending the data to the Co-ordinator who loaded the data to a Blaise2.5 database on their PC. The Co-ordinator then checked for productivity and quality and if satisfied sent the data to the CSO also in AsciiRelational format. This was done on a weekly basis and only "*new*" and "*changed*" forms were sent. There was also an option to send cumulative data by both the Interviewer and the Co-ordinator. This option would be used primarly as a security procedure.

We needed to replicate this scenario in Blaise4W using the manipula application. This required careful consideration, as there are subtle differences between the old convert features of Blaise2.5. and the new Blaise4W manipula application.

We used the *HISTORY* method to select the interviews. The result of the method is *"new"*, *"changed"* or *"unchanged"*. Using this method we could select only the interviews that were new or had been amended. We then used the *RESETHISTORY* method to mark all the interviews as *"unchanged"*. For example,

```
IF (InputFile1.HISTORY = NEW) OR (InputFile1.HISTORY = CHANGED) THEN
    OutputFile1.WRITE
    InputFile1.RESETHISTORY
    InputFile1.WRITE
ENDIF.
```

We also included an option to send cumulative data by both the Interviewer and the Co-ordinator. Again this option would be used primarily as a security procedure.

3. Preparing for Live Release

3.1 Testing

From a testing point of view we regarded the applications as completely new and as such we would need to test them in the same way as we would test any other new application. To do this we drew up test plans. These test plans were designed to provide a structured systematic approach to testing.

Using the test plans we developed test data. Testing was first done in the IT area where each program was tested individually. We then carried out suite tests and finally the whole system was tested**.** At this stage, the systems were passed to the business area for further testing (this included both in-house and field staff). This paid off as no major bugs were found after live release.

3.2 Pilot

A pilot was scheduled for Quarter 3 1999 which was to be conducted in conjunction with the usual Blaise2.5 questionnaire.

The objectives of the pilot were to:

- assess the Interviewers' reaction to the new applications
- identify areas of difficulty for field staff e.g. problems with layout, clarity of messages, procedures etc.
- identify any software problems from source Interviewer laptop to CSO e.g. problems with routing, data transfer etc.
- assess training requirements for the field staff.

3.3 Training Field Staff

All field staff were trained centrally in the CSO. The training course was developed based on the existing knowledge base of the Interviewers and the experiences of the Interviewers involved in the pilot.

Groups of approximately thirty Interviewers were brought together for a two day training session. They were first given an opportunity to see the new application and then they were brought through a number of sample interviews. They also had an opportunity to run each procedure available on the menus.

The training sessions provided an opportunity for team building and standardisation of work practices throughout the 10 different Co-ordinator areas. Sample applications were loaded to the Interviewers' laptops which gave them time to practice and get familiar with the new system at their own pace.

3.4 Live Release

The live release was scheduled for September 1999. Final training sessions took place in the10 Co-ordinator offices and the final versions of the applications were loaded on the Interviewer's laptops. These training sessions built on the earlier training and provided an opportunity to deal with any further questions by the field staff.

Some new laptops also being introduced at this stage resulted in an unexpected problem. The Blaise2.5 manipula would not run on the new laptops due to an insufficient memory problem. This was due to the amount of memory being allocated to DOS based applications on a Windows 95 machine except in this case because the machines were new they had a later version of Windows 95 which had further reduced the amount of memory available. The data conversion from Blaise2.5 to Blaise4W had to be done on the old laptops and then the converted data was copied onto the new laptops. Unfortunately this put the trainers under pressure having to deal with the extra workload.

4. Review of Move

4.1 Conclusions

The project began in early December 1998 with the initial training in Blaise4W. The pilot was successfully conducted from June - August 1999 and the new system was released live in September 1999. A considerable effort was required to support the field staff from the time of the live release until March 2000.

By adopting a project management approach to the development we were able to provide a less stressful environment to work in and also provide a focus for everybody involved. It was an invaluable tool in providing an early warning system if deadlines began to lag or problems were encountered.

A project like this needs to be well thought out and planned before the start or there is a huge potential for failure. Active involvement by the business area and the use of “RAD“ techniques were essential in providing a system which the business area were happy and comfortable with.

The pilot was important for a number of reasons. It provided an opportunity to assess the field staff reaction to the new application. It helped identify training requirements and it allowed us to monitor the new applications in the live environment.

A good training programme was important to ensure that the Interviewers were both comfortable with and had a good understanding of how the new system works resulting in relatively smooth transition from the old to the new applications. Bringing everybody together for the training reinforced good work practices and standardised work practices countrywide.

We were also fortunate to have good support from Statistics Netherlands.

Overall the project went well in spite of some “minor hiccups” towards the end. The transition went according to plan and was relatively smooth.

4.2 Some points worth noting from our experiences

- "Feel good" factor of pilot Interviewers from their involvement in the project.
- Attachment of Interviewers to certain features in the old system that were missing from the new system.
- Information messages not as clear as we thought, different interpretations possible.
- We originally used the standard Blaise4W screen, however, the Interviewers found the screens difficult to look at e.g. background colour, font size, etc. We changed the background colour and font in the subsequent quarter.
- Data transfer using the Manipula application had to be carefully thought out as there are differences between the Blaise4W and the Blaise2.5 manipula and convert applications.
- Regular occurrence of the "Hospital" error message. Blaise4W seems to be susceptible to data corruption if there is either a hardware or software(Win95) problem on a machine. At this stage, due to the frequency of the occurrence of the "Hospital" error we are moving to a later release of Blaise4W for Quarter 3 2000.
- Mysterious appearance of *.~lc* and *.~la* files. We could not find any reference to these files in the manuals.
- Different hardware. Applications working on one platform and not on another e.g. different models of laptops.
- Different versions of Windows 95. The amount of memory available to run DOS based applications varies depending on the version of Windows 95 on the machine.
- Developing Visual Basic applications in a WindowsNT environment for roll out to a Windows95 environment.
- Duplicate forms appearing on the Browse Option. This is still under investigation by the CBS.

4.3 Additional Benefits

- New laptops unable to run large DOS based applications which resulted in Blaise2.5 falling over. This is not an issue with Blaise4W.
- Reinforce good practice during training (backups procedures etc.).

Appendix

1. Original Blaise2.5 Questionnaire Structure

```
Questionnaire Qnhs
    Block Main1
      Table Main2
            Block OverAll : Array [1..20]
                    Block Din2
                    Block Res1
                    Block Hist
                    Block Age1
                    Block Rel
                    Block Header
                    Block Weekend
                    Block Q2B
                    Block Q2Ba
                    Block Q3B
                    Block EduMod
      End Table
    Block Hmod
    Block Smod
    Block Emig
      Table Emig
            Block Emig : Array [1..6]
      End Table
    Block Appointment
End Questionnaire
```

2. New Blaise4W Datamodel Structure

```
DataModel Qnhs
    BlockMainDetails
    Table PersonGrid
            Block Person : Array [1..20]
                    Block Individual
                    Block History
                    Block Relation
                    Block Employ
                    Block Employment
                    Block IndOcc
                    Block HrsWorked
                    Block JobSearch
                    Block Education
    End Table
    Block Housing
    Table EmigGrid
            Block Emigrants: Array [1..6]
    End Table
    Block MakeAppoint
End Model
```

NASS Conversion to Blaise 4 Windows with a Visual Basic Interface

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2000 International Blaise Users' Conference – Kinsale, Ireland

Introduction

In the Fall of 1999, NASS began the extensive conversion of all its Blaise Applications from Blaise III to Blaise 4 Windows. This major conversion had two primary areas of focus: Blaise 4 Windows ManiPlus interfaces and a Visual Baisic interface.

The Blaise 4 Windows ManiPlus interfaces were developed to provide a more interactive, user-friendly system. They also allowed the NASS CASIC System to have more control over the forms being processed. The whole survey management process was redesigned as it moved into a Windows environment The capabilities of ManiPlus aided in the development of a more efficient system.

The Visual Basic interface replaced all the DOS batch files that were used with Blaise III to run the survey processes. The Visual Basic interface also replaced a Sabre Menuing system. Using one Windows software to drive survey processes was the most desirable alternative to other options, like using WinBatch. Visual Basic gave us the flexibility of DOS batch files to move files, copy files, and perform all the functions on files and folders. In additions, Visual Basic provided a built-in menuing system, with button objects and sub-forms. As processes were developed, Visual Basic was used to view and run Manipula generated reports, ManiPlus interfaces, and provide users with other information previously not available with DOS batch files. Because of the ease of learning Visual Basic and the availability of training, it was the Windows software of choice over other more powerful, but more difficult, software. In NASS, job rotation can be frequent, so a software that is reliable and easy to learn was a top priority.

System Changes

The ability to control access to the dataset with ManiPlus, while allowing both CATI and interactive editing to run simultaneously on the same dataset, opened up possibilities for NASS to redesign the system flow of data. Since NASS is changing platforms from DOS to Windows, and from Blaise III to Blaise 4 Windows, it was a good time to examine the current system and improve it. NASS previously collected CATI data in the "CATI" dataset, and physically moved the completed forms to an "EDIT" dataset for the interactive editing process. NASS suspects that the frequent deleting of forms from the "CATI" dataset occasionally led to corruption of the "CATI" dataset. Usually, rebuilding that dataset recovered the forms.

In the new NASS CASIC system design, all the forms remain in one dataset. All records are initialized into the dataset, and the Blaise call scheduler is used to deliver the forms. If a form is to be removed from the call scheduler, a Non-CATI transaction can be created. A ManiPlus setup will read this ASCII file of transactions, set a switch within the dataset, and remove the identified forms from the call scheduler.

If an interviewer needs to retrieve a specific form, a ManiPlus setup is run which prompts the interviewer for the key fields. It gets the form and checks a field in the dataset that identifies the process for which the form is available. If the form is available for CATI, the Data Entry Program (DEP) is executed and the form is delivered. If the form has already progressed into the edit process, a message box is displayed to the interviewer, and the form will not be delivered.

One of the interruptions to the CATI and editing processes is the reading in of paper data. This data has been keyed using a heads-down data entry software. Manipula is used to read this file of code data and write the data to the Blaise dataset. With proper planning, this data may be read in during interviewer break times or during a shift change.

The interactive edit is another ManiPlus interface that again controls the delivery of forms, but this time to the statisticians doing the editing. Forms are typically edited in batches. When a paper batch is read into the dataset, a batch number is assigned. For forms collected in CATI, the Julian date when the forms were collected becomes the batch number for those forms. The statistician may then retrieve forms by batch or by date collected. A special option on the dialog box allows the statistician to choose a date, which is then converted to a Julian date, and then used to display that group of forms in a table. The dialog box also allows the retrieval of a specific form with the same type of process checking done for the retrieval of a CATI form. Other options on the dialog box include all completed forms and adding a form.

This one dataset concept allows the CATI completed forms to become available for interactive editing immediately. The interruption to the CATI interviewers while moving the forms from one dataset to another no longer exists.

System Changes Effecting Interviewers

In Blaise 4 Windows, most of the changes were cosmetic. The Windows look was different, but most of the functionality was retained. Most interviewers adapted easily to Blaise 4 Windows.

One notable exception was the procedures for making appointments. Many interviewers who weren't skilled in computers, experienced difficulty using the mouse and clicking to set appointment parameters. The parameters with drop-down boxes and up/down scroll buttons were especially difficult for some interviewers. Extra time was required for interviewers to practice their mouse skills.

Visual Basic was used to provide a simple way for interviewers to begin data collection. Buttons were added to conduct and get live and practice interviews.

In NASS, the interviewers' supervisors are usually given the responsibility to create the day batches and make sure practice interviews can be done. Supervisors also sometimes run Manipula reports to check on the status or progress of data collection. To facilitate this, a *Supervisors Only* button was provided that allows supervisors to run special processes.

The *Supervisors Only* button allows the supervisors to run CATI Management, create day batches, run CATI Specs, run Manipula reports, Browse History, and refresh practice datasets. Since these functions are only the responsibility of supervisors and not the interviewers, these options were password protected.

System Changes Effecting Survey Management Processes

The most significant changes to NASS's Blaise 4 Windows Applications were with the survey processes. In NASS, the data is analyzed in Blaise before it is processed further for more detailed analysis and summary. Statisticians analyze this data immediately after data collection so inconsistencies can be quickly corrected. Most of this analysis is done by Interactive Editing by the statisticians.

A Visual Basic interface was also built to provide editors with all survey processes in a simple, user-friendly format. First, the specific survey is selected using a List View in Visual Basic, which is the control used by Windows Explorer.

After the survey is selected, the window with the CASIC interface is loaded. This interface gives editors the ability to Initialize, or set up, a survey. It provides information about the name and period of the survey. Processes available to the supervisors are available. Additional processes like interactive editing, deleting a form, and integral check are also available.

Having these processes available in a simple interface where they can be accessed at the touch of a button is a great improvement over the previous menus, where some processes were 5 levels deep. As more respondent databases become integrated, the Visual Basic interface should be able to provide editors with access to historic and detailed information from other NASS databases.

Technical Challenges

In order to convert from Blaise III to Blaise 4 Windows, several major technical challenges had to be conquered.

In Blaise 4 Windows, the primary challenge was the use one dataset for both data collection and the interactive edit. In Blaise III, there were two separate datasets because of the database conflicts between editors and interviewers. Having separate databases made the two processes faster, but forms had to be moved from the data collection dataset to the editing dataset, which sometimes caused dataset corruption when the move process failed. With a one dataset system, forms are no longer moved from one dataset to another, but this system would have to track the process status of a form. New ManiPlus interfaces were developed to maintain the control needed by the new system.

The primary challenge in Visual Basic was first to learn Visual Basic and then duplicate and improve the Sabre menus and DOS batch files it was replacing. Since Visual Basic training was readily available and the language itself was intuitive, learning Visual Basic wasn't a very big challenge.

Technical Challenges: Visual Basic

One of the biggest challenges using Visual Basic was determining how to present the interface. Previously NASS was limited to a menuing system, but with Visual Basic, menus, buttons, toolbars, list views and other controls were now available. These had to be presented in a simple way so interviewers and editors would know what to do by intuition alone. Since many of the

processes were one-step, buttons were the most common control. The interface was presented in a way that best follows the processing flow of each survey.

By designing the interface this way, all surveys would be able to “plug into” the standard interface. Some minor survey specific changes were made, but almost all the processes were standardized throughout all surveys. That is no small accomplishment, considering Blaise 4 Windows will be used on over 100 surveys in NASS for the year 2000. All users are automatically familiar with a new survey. All the buttons, processes, and reports function very similarly for all surveys. This was accomplished by command line parameters that launch the Visual Basic executables.

The commands that were used in DOS batch files had to be duplicated in Visual Basic. Commands or functions were necessary to check if a file exists, a folder exists, copy, delete, rename, write lines to a text file, execute an executable and wait for it to finish, and determine the drive and path of files, and viewing files. While over time NASS developers were able to find acceptable Visual Basic code to perform these tasks, it took some initial time to learn them. However, now that developers have learned Visual Basic, tasks much more advanced than DOS batch commands can be performed.

Surprisingly, probably the most difficult part of implementing the Visual Basic interface was distribution and setup on other workstations. NASS has over 45 servers located in individual states with about 30 workstations on each server. All applications had to be distributed and setups run on each workstation.

While the Visual Basic Package and Deployment Wizard was used to create a setup to distribute the application, some additions had to be made for the setup to work correctly. Several DLL’s had to be distributed and registered on individual workstations, and two Microsoft executables had to be run to update components. The procedures of correcting the setup were not easy to understand. The setup would indicate it failed when the application was run, but an error message appeared. Several separate errors had to be corrected in the setup. The errors were corrected by contacting Microsoft Technical Support and user groups. Now these errors will be solved easier because the Visual Basic knowledge base in NASS is growing. Although corrected problems were difficult, once the setup was corrected, it ran consistently and correctly on all workstations in NASS.

Technical Challenges: Blaise 4 Windows

Maintaining a high level of performance in both CATI and interactive editing is the most challenging part of the CASIC system. Some of the ManiPlus setups seem like they are having an impact on the CATI interviewers’ performance while running against the same dataset. Further testing will be necessary before we will be completely comfortable with the entire process. There are a couple of backup procedures that we may use, but they will require loosening some control of the system. We hope to solve the performance issues between CATI and the ManiPlus setups before going into full production, so that the system may have the control that it was designed to have.

Another technical challenge continues to be the video resolution on the screen that affects how the form pane and info pane are viewed. Some show fields were not visible on a lower resolution screen when the instrument was prepared with a modelib that was acceptable with a higher resolution. Work is in progress to find the best solution to this problem.

Conclusion

The conversion to Blaise 4 Windows with the Visual Basic interfaces has been very exciting. The enhancements to Blaise 4 Windows have been an asset to the design of the new NASS CASIC system. The Visual Basic software has given the system a much more powerful and user-friendly interface.

Session 7

Authoring and metadata in Blaise

Helping non-programmers to specify a Blaise Questionnaire
Mark Pierzchala, Graham Farrant, National Centre for Social Research & Westat

Development and evaluation of screen design standards for Blaise for Windows
Mick Cooper – Paper Not Available

From DOS to Windows
Diane Bushnell, ONS

The TADEQ Project, state of affairs
Jelke Bethlehem, CBS

Helping non-Blaise Programmers to Specify a Blaise Instrument

Mark Pierzchala, Westat, US
Graham Farrant, National Centre for Social Research, London, UK

I. Overview

Some computer-literate researchers now specify their questionnaires directly in the Blaise language, while others who rely on programmers to create Blaise instruments have become familiar with many of the conventions and special features of the system. However, there are many researchers, survey sponsors, and subject matter experts who know very little of how Blaise works, but who still need to specify their questionnaire for a Blaise programmer.

There is the potential for a great deal of misunderstanding and wasted effort if specifications of questionnaire requirements given to a programmer do not reflect the way that Blaise works. Conversely, there can be great gain if specification writers are aware of some of the more powerful features and development methodologies available for Computer-assisted interviewing (CAI) questionnaires in Blaise. These aspects are covered in Section II, *What the Interviewer Sees*, and Section III, *Source Code*. This paper then presents two complementary kinds of specification. **Formal specification** is concerned with codifying the research in terms of concept, question definition, routing, checks, computations, valid values and so on. Formal specification is treated at length in Section IV, *Drafting the Blaise Questionnaire*. **Interface specification** focuses on presentation and usability and aims to help the interviewer to understand the questionnaire. In particular, it tries to help to understand how to handle unanticipated events such as ad-hoc navigation. This is treated in Section V, *Specifying the Blaise Interface*. We consider testing to be an integral part of specification, thus a brief treatment is given in Section VI, *Testing the Questionnaire Program*. Section VII, *Special Topics*, gives an overview of some special topics. Section VIII, *Alternative Approaches*, notes other ways to go about producing questionnaires. Selected references appear in Section IX. Appendix A provides detailed information on navigation and ways to make it more powerful. Appendix B shows a detailed sample specification. Appendix C covers some important details about block specification. Appendix D gives information about data readout possibilities.

This paper constitutes a simple guide to Blaise conventions for non-programmers, to enable them to specify a questionnaire that is rooted in Blaise efficiently, and which a programmer can turn into source code quickly. The Guide is based on documents in use at the National Centre for Social Research in the UK and at Westat in the US. It aims to convey the key conventions and features of Blaise rapidly, without requiring users to specify precise syntax.

1. The Intended Audience for this Guide

This Guide is intended for readers who possess little or no familiarity with Blaise or computer programming. Those who are familiar with Blaise may still find it useful. The reader is likely to be a researcher or academic who needs to draft a Blaise questionnaire, or a survey sponsor who needs to understand and comment on a draft. It may also help survey users to interpret Blaise source code for an existing questionnaire.

The goal of this Guide is not to turn the reader into a Blaise programmer. Rather, the aim is :

- To present some of what is possible with Blaise,
- To introduce simple Blaise conventions, and
- To explain how to achieve *transparency*, so that the specification is clear to everyone involved - researchers, programmers, and sponsors.

This last aim is important. Blaise is a programming language, and a great deal of programming time and effort can be wasted in trying to translate a poorly specified draft questionnaire.

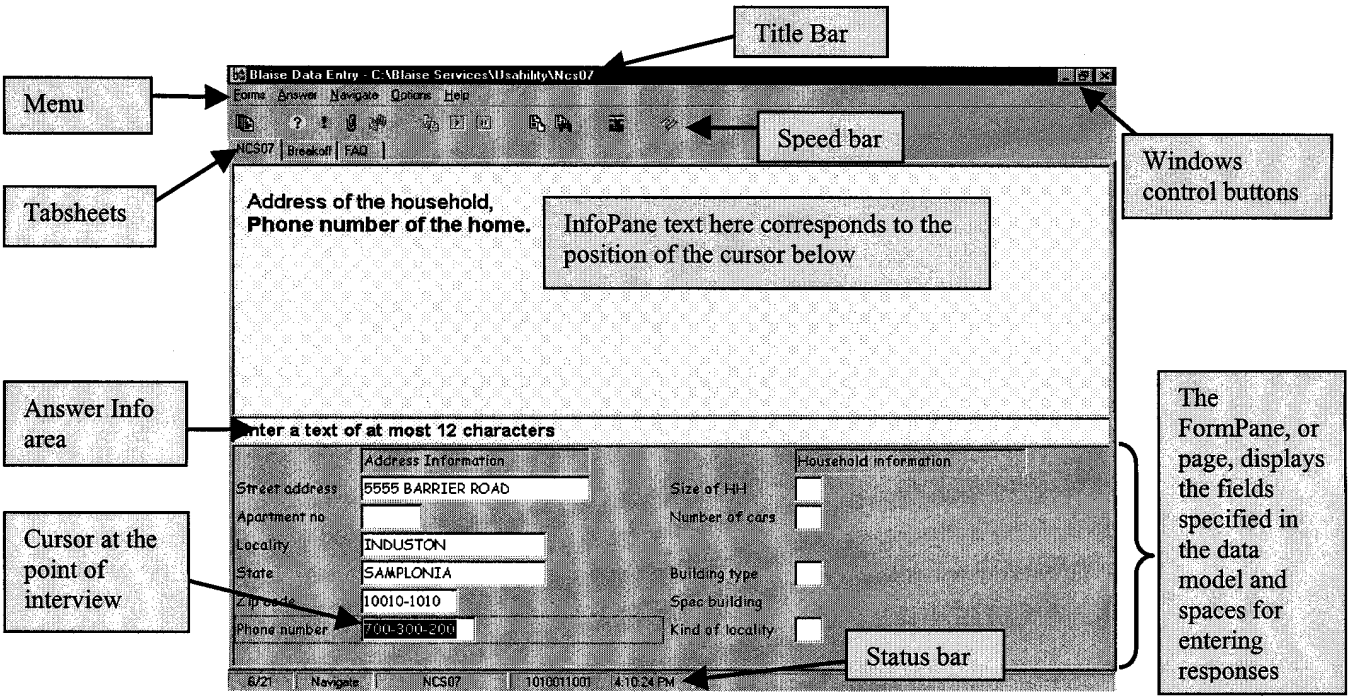
II. What the Interviewer Sees

Before specifying in Blaise, it is helpful to know how the interviewing interface and other aspects of Blaise work, and how they differ from paper or other systems.

1. Split-Screen Interviewing Paradigm and Enhancements

The interviewer collects data with the Data Entry Program (DEP). The Blaise **Data Entry Program** features a distinctive split-screen display shown in Figure 1. The **screen** in Blaise refers to the entire area of the Blaise window, from the title bar on the top and extending to the status bar on the bottom. Thus the concept of a screen in Blaise, a many-question presentation, is much broader than in some other systems. There are also several analogies between a Blaise screen and a page in a paper questionnaire. This aspect is most powerful if explicitly recognized and specified.

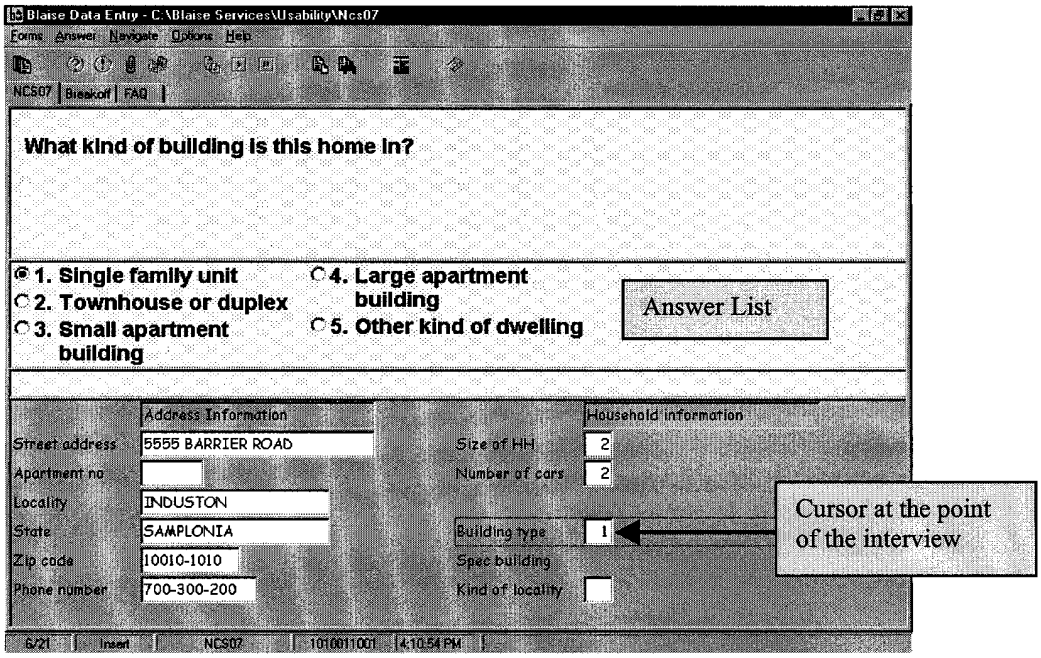
Figure 1: Blaise Screen



The upper part of the screen is called the **InfoPane**. It contains question text and other information meant for the interviewer. The lower part of the screen is the **page** or **FormPane**. It contains data entry cells and the cursor moves from one data entry cell to another. Question text displayed in the InfoPane corresponds to the position of the cursor in the page. The term **page** is used in this paper for the bottom part of the screen because a page on the Blaise screen corresponds to a page in a paper questionnaire. The term is intuitive to the interviewer, and the Page Up and Page Down keys move backwards and forwards, one Blaise page at a time.

Figure 1 shows the Blaise screen with the point of the interview at the *Phone number* field. In Figure 2 the interview has proceeded to the *Building type* field and the question text has changed accordingly. Note that Building type is an **enumerated field**. Figure 2 below displays the answer list. The answer list is associated only with **enumerated** (pre-code) and set (code-all-that-apply) questions. The answer list displays radio buttons for enumerated questions and check boxes for set questions.

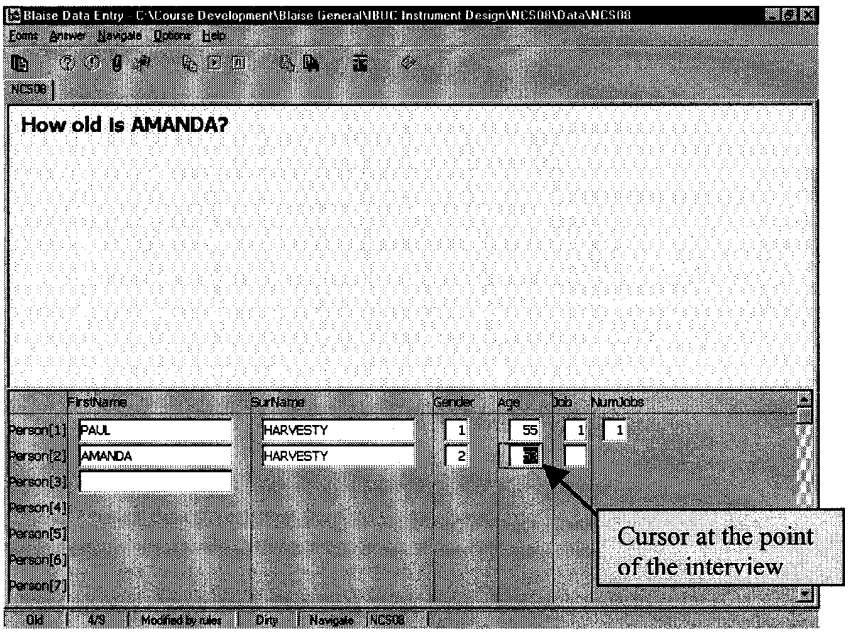
Figure 2: Showing the Answer List Area for an Enumerated (Pre-Code) Question.



The interview proceeds down the first column then the second column, taking into account skips programmed in the rules.

You can use data entry tables in the Data Entry Program as illustrated in figure 3. The table in Blaise can be very flexible in its operation. For example, movement can be strictly controlled (the cursor forced to the right to complete a row), or movement within a table can be free using arrow keys or pointing device. A table can be bigger than the physical screen, horizontally and/or vertically. In the example below, if enough rows are filled in, the table will scroll down.

Figure 3. A Table in Blaise



2. Generated Screens

Blaise screens are generated during preparation (compilation) of the instrument, based on program instructions in the application source code and on general presentation information stored in configuration files. The Blaise split-screen presentation has been accurately described as a many-question-at-a-time system, a page-based system, and as a cursor-based system. The split screen uses limited space efficiently and displays values of several or many fields at one time. This provides interviewers with an overview and allows them to learn the routing based on respondents' answers. They quickly become familiar with the instrument and how questions relate to one another. This makes it easy to navigate and to correct answers.

3. How the Interviewer Works

When asking questions, the interviewer reads the question from the InfoPane, enters the answer in the page, and presses the Enter key. The cursor moves to the next data entry cell in the page and the question text in the InfoPane changes accordingly. Since the values of many questions are presented in the page at one time, the interviewer can verify that the correct response has been typed. The normal forward movement of the interview, including skips, is controlled by the formal *flow* or *routing* specification programmed in the instrument (see Section III for a more detailed discussion of this topic).

Navigation

An often forgotten aspect of specification is navigation. This is important because interviews do not always proceed in the way that we plan. A respondent may wish to change a previous answer and the interviewer will need to back up to make the change. In Blaise, it is very easy to navigate in an ad-hoc manner and to correct answers, even when it is necessary to navigate over many pages. Thirteen (or more) methods of navigation are covered in Appendix A. It is useful to think of navigation in terms of short-range, mid-range, instrument-wide movement, and non-linear motions. There are many ways to enhance the understandability and usability of the Blaise instrument with these kinds of movements in mind. These enhancements are described in detail in appendix A. The basic point to remember is that the basic Blaise paradigm solves many problems of overview and navigation, and that you have options that can enhance the paradigm.

If the result of moving backwards and changing a response is to change the flow of the questionnaire, the new route is immediately implemented. By pressing the End key, the interviewer will be taken to the new route if necessary to fill in the missing details.

III. Source Code

The previous section depicted the Blaise questionnaire as it appears to the interviewer. Underlying every Blaise questionnaire is a set of instructions called **source code**, written in a programming language. The source code for a survey is, in effect, the new Computer Assisted Interviewing (CAI) equivalent of the old paper questionnaire. Source code is **compiled (prepared***)* by the Blaise system into a **data model**. The data model (or **instrument**) is used by the Blaise **Data Entry Program** to run the questionnaire on the interviewers' computers.

The key document in creating a Blaise questionnaire is the **source code**. When we are drafting Blaise questionnaires, we are really drafting source code using the Blaise language. This can be done in any word processor or text editor. A lot of source code in Blaise is not difficult to write or to understand. The questions and answers are described in the source code in much the same way that they will appear on the screen. But source code has other special features and conventions that make writing it quite different from writing a paper questionnaire. This section is merely an introduction to what source code looks like so that you better understand how your specifications relate to the eventual source code. See Section IV for detailed guidelines.

1. Fields and Rules

Blaise **fields** define the instrument's data definition, while **rules** determine the flow of the questionnaire, edit checks for a field or between fields, and computations (math or text manipulations). The following example shows a simple Blaise data model.

```
DATAMODEL FieldsAndRules "Fields and Rules"

FIELDS
  Name "What is your name?" : STRING[20]
  Age "How old are you?" : 0..120, RF, DK
  Job "Are you employed?" : (YES, NO)

RULES
  Name
  Age
  IF Age >= 16 THEN
    Job
    SIGNAL
    IF Job = Yes THEN
      Age <= 85
      "It is unusual for people to work above the age of 85,
        have I mistyped something?"
    ENDIF
  ENDIF
ENDMODEL
```

When the programmer prepares the source code above, the electronic instrument is created. (To prepare a data model, simply press the F9 key in the Blaise Control Centre.) For this simple example, one screen is generated on which all three questions appear. The appearance of the Blaise page and question text is determined by configuration settings that have already been determined, either by default, or by defining your own appearance beforehand. The Blaise database is also generated. This data model contains places for three data items. The Rules section illustrates conditional routing (*Job* is asked only if *Age* is greater than or equal to 16). A soft check is invoked if the person has a job and is over 85 years old.

2. BLOCK and Structure Point of View

Blocks hold related groups of fields and their rules. A block can represent a section or sub-section of a questionnaire. Following is a simple illustration.

```
DATAMODEL BlockDemo

LOCALS
  I : INTEGER

FIELDS
  Job "Are you employed?" : (YES, NO)
  NumJobs "How many jobs do you have?" : 1..10

BLOCK BJobDetail
  FIELDS
    Employer "What is the name of the employer?" : STRING[30]
    KindJob "What kind of job do you have?"
    : (worker, supervisor, manager, director, other)
    JobOS "Please specify the kind of job you have." : OPEN
  RULES
    Employer
    KindJob
    IF KindJob = Other THEN
      JobOS
    ENDIF
ENDBLOCK

FIELDS
  JobDetail : ARRAY [1..10] OF BJobDetail
RULES
  Job
  NumJobs
  IF Job = Yes THEN
    FOR I := 1 TO NumJobs DO
      JobDetail[I]
    ENDDO
  ENDIF
ENDMODEL
```

Blocks can be defined once and reused several or many times, as demonstrated above. Here, the arrayed block *JobDetail* is called once for every job. For example, if a respondent has two jobs, the block is called twice. The reusability of blocks is an extremely powerful feature. If they are used appropriately, blocks can greatly reduce the programming and maintenance burden of questionnaires and reduce their internal complexity. This is because many questionnaires ask the same or similar group of questions about different topics. Appendix C illustrates two ways of customizing details within the same block structure to different subjects. That is, giving them different question text, edit limits, and so on, without having to reprogram the whole thing two or more times. It also illustrates how to separate within-block concepts from extra-block concepts, which is very cost effective for some surveys.

3. Types, Procedures, and Other Blaise Generalizations

In addition to reusable block definitions as described above, **type sections** (or libraries) and **procedures** offer a way to encode frequently used constructions in the Blaise source code. A **type** is a response definition. For example. many questions allow *Yes* and *No* as valid responses. In this situation, you can define a type definition, *TYesNo*, and use it in multiple places. Or, your questionnaire might use an agreement scale many times (*agree strongly, agree, neither agree or disagree, disagree, disagree strongly*) and you can define a type called *TAgreeScale5*. It is possible and advantageous to define each of these responses once and use the definition throughout the questionnaire. Use of pre-defined types reduces programming time and eases maintenance. For example, if your questionnaire all of a sudden had to be put in a second language, the use of types allows you to specify the alternate response text in one place, instead of in many places.

A **procedure** provides a way to define complex computations in a reusable segment of code. This is equivalent to defining a user function. For example, while Blaise has a RANDOM function, it does not offer a way to choose m unique elements out of n possible elements. The programming for this is quite complex, but once done in a procedure, this code can be reused in an instrument or between instruments.

4. Languages, Spoken and Unspoken

Blaise has long had a language capability that allows interviewers to switch between spoken languages. The LANGUAGES declaration has also become a place for declaring unspoken languages with other uses, as shown in the following example.

```
LANGUAGES =
  ENG "English",          {spoken}
  FRA "French",           {spoken}
  HLP "Help"              {unspoken}
  MML "Multimedia",       {unspoken}
  MDL "Metadatalanguage"  {unspoken}
```

In this example, two spoken and three unspoken languages are declared. Each has a 3-character identifier and a description between quotes. The identifiers such as ENG or HLP have no meaning to Blaise, except that these identifiers may be used later in the source code. In the developer's environment, it is possible to state which languages are spoken and which are not. Spoken languages are available to interviewers, while they never know about the unspoken ones. A function key can be used to toggle between spoken languages during the interview.

The unspoken languages are used for other reasons, including multimedia questions (sound, images, video), Microsoft® WinHelp links for question-by-question help, or as a repository for additional field- or block-level metadata. See section 5 below for details.

Blaise knows which language is in use. You can state IF conditions based on a language. For example, a text fill might be computed one way for English and another way for French.

5. The Many Uses of a Field Definition

The **field** is the basic unit of data definition in Blaise. There are six elements of field definition, as shown in the following example.

```
FIELDS
  FieldName  (FieldTag)
            "FieldText" / "FieldDescription"
            : FieldValue, FieldAttributes
```

Section IV, below, details how to explain field specifications to the Blaise programmer. Here we describe what can be done with the six elements of fields with respect to screen display and downstream metadata description, taking into consideration the various needs of users and data export and analysis. The point of this discourse is to allow you to specify what you want without confusing the programming or specification.

Following are descriptions of Blaise field elements:

- The *FieldName* is used in the rules of a Blaise program to describe routing, edit checks, and computations. It can be displayed on the **page** of the Data Entry Program (DEP), and in the edit jump dialog. It can be used as a downstream metadata identifier for the question through a Cameleon setup. Cameleon setups provided with the Blaise system use the *FieldName* as the default downstream identifier. *FieldName* is unilingual. It is required.
- The *FieldTag* may be displayed in the **page** of the DEP (and in the edit jump dialog) if the *FieldName* is also displayed. In the DEP, it can be used to jump to a field through the jump dialog. It can be used as a downstream metadata identifier for the question through a Cameleon setup. It is not used in the Rules section. *FieldTag* is unilingual. It is optional.
- The *FieldText* is almost always displayed in the InfoPane and is used as the question text. Short field text can be displayed in the Blaise Page though this is a specialty use. Cameleon can access the value of the *FieldText*. It is not used in the Rules section. *FieldText* is multi-lingual and can take fills. It is optional.
- The *FieldDescription* may be displayed in the Blaise page as an alternative to the *FieldName*. It can also be displayed in the edit jump dialog. This is a new feature in Blaise for Windows which started in 1999. Cameleon can access the value of the *FieldDescription*. It is not used in the Rules section. *FieldDescription* is multi-lingual but cannot take fills. It is optional.
- The *FieldValue* defines valid values and is represented in the Blaise page by a data entry cell. *FieldValue* can be accessed by Cameleon. *FieldValue* is displayed in the edit jump dialog. It is required.
- The *FieldAttributes* include whether *Don't Know* (DK), *Refusal* (RF), or *EMPTY* are allowed. *FieldAttributes* can be accessed by Cameleon. They are required though if you do not state anything the defaults are NODK, NORF, and NOEMPTY.

Possible Uses of Field Elements and A Suggestion for a Field Name Convention

There can be several ways a field is known to various users of the system. For the interviewer, a readable identifier of 1, 2, or 3 words helps immensely in understanding the instrument and in navigation. The specifier, project staff, and data review personnel may be more comfortable with a question number. Data analysts probably prefer something between a question number and a description, but they would like to have the description too. In fact, their downstream package, for example SPSS, may require variable names of eight characters or less but allow a label of up to forty characters. In a two-language setting, where interviewers are not bilingual, it may be required that the interface be either totally in one language or totally in another language, including all screen display elements. There are yet other required identifiers that may not be obvious, including a link to WinHelp for some or all questions, and perhaps some entity identifier for a downstream relational database system. And as discussed in Appendix C, it is desirable to not attach block-level information to a field-level name.

Given these considerations, we present a field naming convention that allows you to reconcile all these requirements including taking advantage of new features such as descriptions in the page and use of WinHelp for question-by-question help.

An example for elementary fields (not block fields) is shown below:

```
FIELDS
  FieldName  (FieldTag)
             ENG "English Field Text"
             FRA "French Field Text"
             HLP "WinHelp link"
           / ENG "English Field Description"
             FRA "French Field Description"
           : FieldValue, FieldAttributes
```

Where:

- *FieldName* is used in the Rules (you cannot get away from this) and it is the default downstream metadata identifier. It is *not* used in the Blaise page or in the edit jump box. The interviewer never sees it in the screen configuration advocated in this paper.
- *FieldTag* is used for question numbers if they are specified. It is also used for selected section jump points. For example, a household enumeration table may be given a tag of **hh**. Then the interviewer can jump to **hh** to return to that section. For example: **A** to jump to section A, **B** to jump to section B, etc.
- *FieldText* is used as the question text in the InfoPane for spoken languages such as English or French.
- *FieldText* for the HLP language is used as the WinHelp link. If there is no WinHelp for a field, then this entry is left blank.
- *FieldDescription* is used as the interviewer identifier and additionally as a label in a downstream system for all spoken languages. When the interviewer switches languages, everything on the screen, including the visible field identifiers, switch to the next language too. If there is an edit, then the fields are identified by the readable *FieldDescription* in the appropriate spoken language.

The following example shows block fields:

```
FIELDS
  FieldName
    ENG "English banner" {at the top of every field in the block.}
    FRA "French banner"
    MDL "Entity"         {if used in your survey}
    : BlockDefinition
```

The question text defined in a block field definition can be used as a banner, appearing at the top of every InfoPane for every field in the block. The MDL language was mentioned above as a possible repository of additional metadata. It is possible, for example, to use an MDL *FieldText* or *FieldDescription* as an alternative downstream metadata identifier. This is an advanced topic and requires someone that knows how to program Cameleon (or for someone to share a Cameleon script).

6. In Blaise, a GoTo is a No-No

Many paper questionnaires, and many other interviewing systems, use the GoTo statement to direct interview flow. Blaise does not. It implements skips solely through IF conditions. In other words, you state the condition under which a field is on the route. This is known as using **gates** and is also known as stating the **universe** of the field. It is felt by many that by eliminating the use of GoTo (in any system) the source code is better structured, easier to read, and more easily maintained.

If your routing specification is in GoTo format, someone will have to translate it into the converse convention of IF conditions. This can be surprisingly difficult, enormously time consuming, and prone to error. It should not be left to the programmer to do this. The specifier, or someone else, should be the one to state flow in terms of IF conditions. This should be recognized as a separate task. You can produce flow charts to aid the translation, and you can provide block-level scenarios to test the routing.

7. Edits are Stated in a Positive Sense (Usually)

For historic reasons, edits in Blaise are usually programmed in a 'positive' sense. That is, the edit should be stated in terms of what should be correct, not what is incorrect, as shown in the following example:

```
IF Job = Yes THEN
  Age >= 14 "Respondent is too young to have a job."
ENDIF
```

The following example is also valid, but many long-term Blaise programmers may not know this.

```
IF (Job = Yes) AND (Age < 14) THEN
  ERROR "Respondent is too young to have a job."
ENDIF
```

The point is to make sure the specifier and the programmer have this straight between them.

8. Data Export, Data Structures, and Metadata Description

Blaise supports three kinds of data export. ASCII export produces one flat rectangular file as output. ASCIIRELATIONAL export produces one data file per unembedded block, thus resulting in several or many output files. The third kind of data export is a custom export where a Manipula program exports data according to (potentially many complex) instructions. This custom Manipula program can either be hand programmed or Cameleon can generate it based on Blaise metadata contained in the field declarations. There are a few issues to keep in mind in any of these options. Appendix D discusses these three options at length. Suffice to say for now that data export is something one should keep in mind at the time of specification.

9. New Possibilities in the Windows Version of Blaise

The first Windows versions of Blaise were designed to be upwardly compatible with Blaise III, the last DOS version. It is possible to invoke a Blaise III instrument in Windows, and execute a perfectly acceptable Windows instrument. However, Blaise offers more features as time goes on. An incomplete list includes font size and font style possibilities; native multi-media features such as audio, graphics, and video; tab sheets and better labeling for parallel blocks; a much more configurable interface and a tool (mode library editor) with which to do that configuration; a configurable user menu; WinHelp for question-by-question help; an audit trail; enhanced CATI management features; use of field descriptions in the page (instead of field names); ability to tie function keys to parallel blocks, DLLs, or executable programs; enhanced use of DLLs in the rules; identifiable checks and signals; ASCII external files and external files in memory, and edit masks for formatted data entry (e.g., dashes in a phone number). An important new capability, that of Open Blaise Architecture, will be released after the writing of this paper in Blaise version 4.5. This release will allow tighter integration with other Windows systems and open up many new possibilities that are beyond the scope of this paper.

10. Adapting an Instrument

It is easy to change a Blaise data model. Probably more than in any other system, you can easily add or delete questions or whole blocks, change the flow of interview, establish new edit limits, and so on. There is a drawback, however. Even minor changes to the data model can result in a change in the Blaise data file definition. This can be unexpected. For example, if you add an edit, or a response to a pre-coded question, then the new data file can be incompatible with the old data file.

It is not difficult to write a Manipula setup that can translate the data from one version of a data model to another. However, there is an operational problem. You might have different versions of Blaise data sets lying around, and this can be difficult to manage. For example, if one interviewer does not receive an update to a data model, then when she sends her data in, you may try to process it with the wrong Blaise data model and the process can end abnormally.

From the standpoint of specification, let it suffice to say that it is always desirable to send a completely correct instrument to the field. This is helped by clear specification and by knowledge of the process that produces a specification. In those situations where a data model must be changed in the field (with resulting data definition changes) the organization executing the field work must have procedures in place that can handle this transition in data. Such a data definition change need not be traumatic if it is properly anticipated.

11. Capacity and Performance

It has been proven in a few Westat data models that exceedingly large data models, with hundreds of thousands of defined fields, edits, and computations, can execute quickly even on relatively low-end computers (see for example, Frey, 2000). It may take an expert to design such a data model, but it can be done. In both Westat data models, time of instrument administration is not large. That is because they are well-specified in a research sense. There are a large number of potential questions, but in any given interview, only a small proportion are actually asked.

Just because you can specify such large data models does not mean that you should. You have to consider respondent burden as measured by the numbers of questions that are asked. It is possible to specify a large data model, have it run well, and yet be a burden to the respondent. This is not a Blaise issue as much as it is a research methodology issue.

IV. Drafting a Blaise Questionnaire

This section covers the formal specification of the research. An example specification in Appendix B illustrates the guidelines offered here.

1. The Early Draft

Drafting a Blaise questionnaire usually has two stages:

- An early draft that follows only the most basic Blaise principles but doesn't include any frills or detail;
- A later, more developed, draft for the programmers that is more tightly specified, and which can quickly be turned into useable source code.

At the earliest stage of questionnaire development, while the draft is going back and forth between researcher and sponsor, there are good reasons for *not* writing very much that is Blaise-specific. It is inefficient to get into Blaise-related detail while the questions themselves are still subject to amendment or deletion. And sponsors and others who may be completely unfamiliar with Blaise conventions will find it difficult to read.

2. Designing the Questionnaire Structure

The considerations for a CAI questionnaire are very similar to those for a paper one. A questionnaire will usually divide naturally into modules according to the question theme or topic. Within topics, the questions may break into smaller sets according to narrower topics or sub-themes. These modules can often be programmed and tested independently in Blaise, as **mini-data models**. This is an efficient use of time, since each module can be specified, worked on and tested separately.

The general Blaise term for any such group of questions - broad or narrow - is a **block**. So you can have broad blocks and smaller blocks within them, For example, a block of questions on work, and a block inside on travel to work. When specifying blocks, don't re-invent the wheel. Programmers in survey organizations will have blocks of standard or near-standard Blaise code that can be re-used on new projects. This is particularly so for:

- Respondent classification section
- Admin block and outcome codes
- Household grids for adults and children

Talk to the programmers before starting to write a specification. They may have some off-the-shelf source code that can be tailored to your needs. It is also useful before getting started to review the questionnaire draft for the following:

- Common structures in the questionnaires that may form the basis for re-usable blocks.
- Common answer categories that may become Blaise types.
- Determine, even if in general terms, what kind of data readout will be necessary.

High-Level Descriptive Specification

When laying out the questionnaire, it is useful, and at times crucial, to describe how blocks relate to one another. For simple questionnaires, this might be as easy as stating that Section A comes before Section B and so on. For more complex data models, such as a hierarchical questionnaire with several respondents, you should explicitly state how the interview is to flow.

For example, should all one person's questions be asked before another, or should they be asked concurrently? Should you be allowed to leave one person before they are finished and proceed to a second? How should job questions be linked to a row in a household membership table? What happens if a member of the household is deleted but there are blocks of questions that relate to that member, how should they be treated? An example of such descriptive text is given in Section 2 of Appendix B, In the Enumeration Table, Across Member Rows.

3. Basic Specification Conventions and Getting Started

Section III above described basic Blaise terms such as fields and rules, and how they combine to make up a data model. In Blaise source code, fields and rules are separated. For most people this is not a natural way to draft a questionnaire. For all but the simplest of data models, drafting is more straightforward when the questions and their routing conditions are stated side by side. We suggest a compromise, using the 'natural' method but without making too much additional work when the draft is turned into source code.

The specifier and the programmer should agree on basic conventions for the specification. An example of how this is done is given in the first part of Appendix B.

4. Questions (FIELDS) Within a Block

The metadata and display aspects of fields were discussed in section III, above. It is important to make explicit choices about how the field definition elements will work for your survey, including screen display and metadata requirements. Here we discuss their actual specification.

Question Texts

Question text (Blaise FieldText) is placed inside double quotes, and followed by a colon:

```
"When did you take out that pension?" :
```

Every question must be assigned a unique name (Blaise Fieldname), alpha or alpha-numeric:

```
Pen6q
"When did you take out that pension?":
```

Specify show cards and interviewer instructions inside the quotes (and in capitals):

```
Pen6q
"SHOW CARD A  When did you take out that pension?
INTERVIEWER: IF IN DOUBT, REFER TO CALENDAR" :
```

Question Names

There are no hard and fast rules for naming questions. Some people have systems, such as, ‘*all questions in section A start with the letter A*’ (See Appendix C for a discussion that discourages putting block-level meta-data as part of the elementary field definition when a block might be reused for a different, but related, topic).

A ‘fast index’ method can be used to create names with a dual reference: First, an alphabetic reference to a *module* of questions, and then to an *index number* within the module. So questions in a module about Education could be named

```
    Edu1, Edu2, Edu3 {and so on}
```

This is a lot easier and faster than inventing, for each individual question, a distinct name that attempts to summarize the subject matter.

One drawback with fast indexing is seen when questions are deleted or moved later on, thus breaking the number sequence; or when extra questions are added, in which case you’ll need to insert an additional sequence letter (e.g. Edu5**a**, Edu5**b**). Another drawback is that the name is not descriptive of the individual question, making it less useful for the interviewer and the data analyst. If there is time to write meaningful names, this is the best option.

Many ‘downstream’ systems - SPSS being one example - allow a maximum of only eight characters for variable names, so it is easiest to restrict the name to this length. However, there are other ways to add descriptive information. One is via the *field description*, which is specified following the question text:

```
Pen6q
"When did you take out that pension?" / "self pension" :
```

The programmer can arrange for the field description to be displayed on screen instead of the *name*, which makes navigation clearer for interviewers. It can also be used as a descriptive *label* for downstream systems such as SPSS, rather than the default option of using the first forty characters of the question text as a label, which may not express the core intent of the question.

Another option for keeping track of questions is to use the *field tag*, which is specified following the question *name*:

```
Selfpen (q6)
"When did you take out that pension?" :
```

Here a *tag* is used to show the sequence number of the question within the module. Since the tag is not referred to in the routing, it is easier to keep up to date as drafts are amended. Tags can also be used to jump to a field or a section.

You should at least *give a meaningful name to key questions* that are referenced frequently in the questionnaire. Because the question *name* is referenced in the rules, the source code itself will be more readable if key question names are simple and self-explanatory (*Age*, *Sex*, *Tenure*, *EmpStat*, *MarStat*). A routing instruction like `IF Age > 50` is clearer than `IF HGrid4` > 50.

Blaise is case-insensitive, so *MarStat*, *MARSTAT* and *marstat* are all read as the same question. The preference is for logical mixed case (*MarStat*, *EmpStat*).

If you use the automatic Blaise facility to set up an SPSS data set, whatever Field Names you assign your questions in Blaise will be carried over as the SPSS variable names (including your case conventions).

5. Precoded Answers

Put each pre-code in double quotes, separated by an external comma, and put the full list of answer codes in parentheses (brackets). For example:

```
Pen14
"Who contributes to this pension: you, or your employer, or both of
you?" :
("respondent only",
"employer only",
"both")
```

In the final source code, each answer category also must be given a name with a maximum of eight characters). For example:

```
(resp   "respondent only",
 emplyr "employer only" ,
 both   "both")
```

The answer name is essential to the final Blaise specification of the *rules*, where names are referred to directly (*e.g.*, *If Pen14 = resp*). However, in drafting the rules you can get by with just referring to the answer *text* (*If Pen14 = ‘respondent only’*). On balance it is probably more efficient to begin with answer names, rather than to add them later.

The interviewer’s screen will display the answer code text, unless no text was specified, in which case the name is shown. Where there is a single spoken language, it is unnecessary to write both name and text if the name itself is entirely self-explanatory. For example:

```
Nwarea2

"Is there a Neighbourhood Watch Scheme in this area?" :
(yes, no)
```

It would have been unnecessary to write:

```
"Is there a Neighbourhood Watch Scheme in this area?" :
(yes  "yes",
 no   "no")
```

since the screen appearance is identical in both cases. This changes for a bilingual instrument. In that case, you would have the following:

```
(yes  "yes", "oui",
 no   "no",  "non")
```

It also pays to pay attention to your text conventions. If the responses *yes* and *no* are **not** to be read to the respondent, then use the following:

```
(yes  "YES", "OUI",
 no   "NO",  "NON"
```

or, in a single language setting:

```
(YES, NO)
```

For the same field you can provide labels for some codes, but not others:

```
MarStat  "What is your marital status?"  :
(single     "single, never married",
 married,
 divorced,
 widowed)
```

6. Re-using the Same Answer Codes

In Blaise, a list of answer categories that is repeated frequently for different questions need only be specified once. They are declared as a TYPE and given a name. When the list is next required, only the TYPE name is specified; this will have the effect of calling up the full list. For example, the list below might be used at many different questions:

```
(agstr    "agree strongly",
 agree    "agree"
 neither  "neither agree nor disagree",
 disagree "disagree"
 disagstr "disagree strongly"), DONTKNOW
```

This can be specified just once as a TYPE, for instance

```
{TYPE: 'AGREEDIS':  answer codes "AGREE-DISAGREE"
(agstr    "agree strongly",
 agree    "agree"
 neither  "neither agree nor disagree",
 disagree "disagree"
 disagstr "disagree strongly"), DONTKNOW }
```

and then called up for different questions as required:

```
PolPow  "Do you agree or disagree that the police have too much
power these days?" :  {TYPE: AGREEDIS}

UniPow "And how about the trade unions - do you agree or disagree
that they have too much power nowadays?" : {TYPE: AGREEDIS}
```

Discuss this option with your programmer, who might have an off the shelf TYPE you can use.

7. Multi-Codes

Questions that allow more than one answer to be chosen are specified as SET questions, as shown in the following example:

```
"SHOW CARD B
What were your reasons for taking out this pension?   Please look

SET [2] OF
(morinc "To have more income in retirement",

state   "The state pension may not exist by the time I retire",
oth     "Some other reason")
```

Here, **SET [2] OF** means a maximum of two of the answers can be selected. Alternatively, omit the number (**SET OF**) to allow all codes to be selected.

8. Numeric Answers

For a numeric answer, specify the range of possible entries, separated by 2 dots (..). For example:

```
Age "What was your age last birthday?" :  16..120

PenNum "How many pensions do you have altogether?" : 1..5

PStart "Which year did you take out that pension?" : 1930..1995

Pamt "How much money did you contribute last time?" : 0.00..9997.00
```

Interviewers will not be able to key numbers outside the range you specify. Note that in fourth example above two decimal places are defined.

9. Text Answers

For some questions the interviewer can key the respondent's answer verbatim. Blaise features two ways to record text, OPEN and STRING.

Where the answers are to be assigned codes in a separate operation, it is advantageous to specify the question as OPEN in Blaise. All the answers to a particular OPEN question can be exported and viewed together, and coded in one operation, the resulting codes later being merged back in to the data set. The Blaise Data Entry Program also has an explicit review dialog of all OPEN fields. There is no limit to the number of characters that can be keyed in response to an OPEN question.

If you want the responses to a text question to be stored and exported as part of the data record, you should specify the question as STRING instead of OPEN. On screen, the STRING answer is entered by the interviewer in a very similar manner to an OPEN answer. You also need to specify the maximum number of characters that can be entered, *e.g.*,. STRING [80]. Use of string is indicated for short answer fields such as *Name*, *JobTitle*, *StreetAddress*, and so on.

A question often has an *other answer* category. If you want the interviewer to record that other answer, a separate question is needed, for example:

```
Pen27q
"SHOW CARD B  What were your reasons for taking out this pension?
Please look at this card and choose all the answers that apply." :
("To have more income in retirement",
 "Because it gives me life insurance cover",
 "The state pension may not exist by the time I retire",
 "Because most people at work are in the scheme",
 "People at work told me it was a good scheme",
 "some other reason (WRITE IN)" )

OthReas
"INTERVIEWER: ENTER OTHER REASON" : OPEN
```

10. Date and Time Answers

If you want the interviewer to enter a calendar date – For example, *21 9 2000*, specify the question as DATETYPE:

```
Pen6q
"SHOW CARD A
When did you take out that pension?
INTERVIEWER: IF IN DOUBT, REFER TO CALENDAR" : DATETYPE
```

If you want the interviewer to type in a time – For example, *7:00 am*, specify the question as TIMETYPE:

```
Pen7q
"What time do you get up in the morning?" : TIMETYPE
```

See the discussion below on Windows Configuration for details on how the interviewer can enter the date and time.

11. Wording Substitutions (Text Fills)

Sometimes you want to vary the question text according to circumstances. The reason might be to save the interviewer the effort of choosing among wording options (*e.g., he/she; did you/do you; first/next; this/that)* , or to make sure they read a special insert (e.g., *Thinking of just your main job, how much did you earn? How old is your daughter Sally?)*

One of the strengths of Blaise is that it can set up complex substitutions (called *text fills*), that interviewers find helpful. *However, they are time-consuming to set up and test.* The effort saved for the interviewers is time added to the tasks of researchers and programmers. It is easy to get carried away by text fills, but often the time-efficient practice simply is to state the options in the wording - e.g., *"When did (he/she) leave that job?"; "How long have you lived in this (house/flat)?"* - and let the interviewer choose, as they would do with a paper questionnaire.

Where you plan to use a fill, in the early draft, it is quickest just to put the optional wording in parentheses; adding the 'hat' symbol (^), which Blaise uses to denote a fill:

```
"(^Thinking just of your main job) How many hours a week do you
usually work?" : 1..120

"What was the purpose of the (^first/second) visit?" : STRING [80]

"Why did your child (^NAME) visit the dentist?" :
```

12. Routing (RULES)

Questionnaires are divided into *blocks* of questions, usually according to topic. You need to think of every individual question as being located somewhere within a block. It is common to have broad blocks (such as whole sections of the questionnaire) and smaller blocks (short sub-sets of questions) within these large blocks.

There are rules (routing instructions) for blocks. Within blocks, there are rules for individual questions. In the final source code, the rules are stated separately from the description of fields (questions and blocks). However, a more natural way to draft a questionnaire is to specify, in one place, the field *and* the condition under which it comes on the route.

Our recommendation is to write the draft in this natural way, stating the rules next to the fields. However the rules specification should be stated within curled brackets { }. In Blaise, any text placed inside curled brackets is a *comment* and is ignored by the program. Later, the draft rules can be extracted (or copied) to form the separate *rules paragraph* required by Blaise.

Remember that Blaise does not use GoTo. The specifier should translate from any GoTo specification to a gate or universe specification solely in terms of IF conditions.

Routing to a Block

In the draft, use a plain-English description of the rules, but also refer to the specific fields that determine the rules. For example:

```
{now, a short block of pensions questions:  if under retirement age
(men, Age<65, women, Age<60)}
```

Routing from a Precoded Answer

It can help if the rules are in bold text. First, specify the routing condition in plain English. Then, if possible, add the precise condition, referring to questions and answer codes by name. For example:

```
 {IF respondent has a personal pension: Pen5 = haspp }
 Pen6q
 "When did you take out that pension? " :  DATETYPE
```

Note that either condition stated separately would be less than optimal. *If respondent has a personal pension* is not precise enough; *Pen5 = haspp* is not clear enough.

Routing through a Sequence

Don't repeat routing unnecessarily. If the routing to the field has already been stated, for example, there is no need to re-state it above each following question until the condition changes.

Routing from a Numeric Answer

If one particular numeric answer to a question determines the routing condition, state that number (e.g., *If Visits = 0*). If the condition applies for a range of numeric answers, use the Blaise term IN:

```
Hea20
"How many times did you visit your doctor last month? " (0..5)

{IF HEA20 IN 1..5}
Hea21
"Did you receive a prescription on (this visit/any of these
visits)? "
```

In this example, the question Hea21 will enter the route only if the answer to Hea20 is a positive number in the range 1 to 5. The intention is to skip Hea21 if the answer to Hea20 is *none*.

13. Rules for Repeated Questions

With Blaise it is only necessary to describe a set of questions once. You then use the rules to tell Blaise either to re-use a block of questions; or to place questions in a table.

Reusable Blocks

Specifying a block of questions as re-useable is typically done when the information will be collected in different situations – for example a series of questions that is asked several times in reference to different people (e.g., job description questions, asked first about the respondent, then about their spouse). You should specify this type of repeated sequence as a block, and state the conditions under which the block should be repeated, as shown in the following example.

```
{new block: job details.  Ask for the respondent, then repeat for
their spouse / partner, if married or living as married (MarStat =
married or livemar}
```

Rules for Tables

A sequence of questions that would appear as a grid in a paper questionnaire would usually be defined as a **table**. For example, every adult in the household may be asked, in turn, their age, sex, marital status, and when they left education. In a paper questionnaire this appears as shown in Table 1:

Table 1

	Age	Sex	Marital status	Age left school
Adult 1				
Adult 2				
Etc..to *N*				

In Blaise this row is called the first loop

This row is the second loop

In Blaise the row cases (e.g., adults) are said to "loop" through the question sequence, *N* number of times.

The exact specification a CAI table can be complex, and is best left to the specialist programmer. When you have a set of questions that will form a table, use the terms TABLE and FOR to define what you want, followed by a single specification (one loop) of those questions and their routing.

```
{TABLE:  FOR each adult aged 16+, ask Age, Sex, MarStat, TEA }
```

The maximum number of rows in the table is determined by the answer to a preceding question. For example, the following code followed by *one* specification of the content and routing of those 3 questions.
,

```
PenNum
"How many pensions do you have altogether?" : 1..5

{TABLE: FOR each pension at PenNum, ask Pen6q, Pen7q, Pen8q:}
```

….

Here, the TABLE (of Pen6q, Pen7q and Pen8q) automatically opens a maximum of five times - or fewer, depending on the actual answer given at PenNum.

See Appendix B for an example of how to specify a table.

14. DON'T KNOWS, REFUSALS, and EMPTY

Blaise sets aside special keystrokes for the interviewer to record a *Don't Know (DK)* or *Refusal (RF)* for a particular question. (The default options are Ctrl+K and Ctrl+R, but these can be remapped to other keys or function keys.) Using these keys means that DK (don't know) or RF (refusal) will be recorded as a legitimate answer. This means you have to consider these possible answers when defining the rules.

Whether to Allow DK or RF

When you begin, you have a choice of two baseline settings. You can set your questionnaire to always allow DK (don't know) and/or RF (refusal) at any question; or you can set it to *always disallow* (i.e., forbid) them. From either baseline, you can then exempt particular questions. The *always allowed* setting is probably more common. The setting you choose depends on the nature of your questions. That is, you must consider. whether a DK and/or refusal is going to be, more often than not, a likely or legitimate response.

Under the *always allowed* setting, you use the Blaise terms , NODK and/or NORF to forbid these responses for a question. This mean that the questionnaire will not accept the keystrokes for *don't know* and *refuse* for that question. That is, these answers are declared out of range. You might want to do this at questions which are critically important for routing, and which are not thought to be sensitive or difficult (e.g., housing tenure).

This example forbids a *don't know* at the question *JobStat:*

```
EmpStat "Are you an employee or self-employed?" :
(emp   "employee",
 self "self-employed"), NODK
```

The following example forbids a refusal:

```
EmpStat "Are you an employee or self-employed?" :
(emp   "employee",
 self "self-employed"), NORF
```

This example forbids both:

```
EmpStat "Are you an employee or self-employed?" :
(emp   "employee",
 self "self-employed"), NODK, NORF
```

EMPTY

An EMPTY attribute allows the interviewer to move past a field without entering data. While not very common, they do have uses. For example, an apartment number field may be left empty if it does not apply to a household.

Routing Conditions from *Don't Know* and *Refusal*

If DK and Refuse are permitted answers, you need to consider carefully what the appropriate forward routing will be when those answers are given. It is easy, but dangerous, to overlook this. For example:

```
Hea20
"How many times did you visit the doctor last week?" (0..5)

{IF HEA20 IN 1..5}
Hea21
"Did you receive a prescription on (this visit/any of these
visits)?"
```

A *don't know* or *refusal* in an IF condition is evaluated as a 0. Thus, they will not be led to Hea21. To ensure they are included, the correct rules specification is:

```
{IF Hea20 > 0 or DK or RF}
```

If you want, for example, a follow-up question asked only for the *don't know* responses (but not *refusals*), use the term IN:

```
{IF Hea20 IN 1..5
note: including DK, not Ref}
Hea21
"Did you receive a prescription on (this visit/any of these
visits)?"
```

It is a common mistake to route don't know or refusal responses to an inappropriate follow up question:

```
{ask all}
Hunt8
"Do you agree or disagree with the statement: 'foxhunting is
cruel'?":
(agree     "agree",
 neither   "neither agree nor disagree",
 disagree  "disagree")
```

If you wanted to ask a follow-up question of those respondents who agreed or disagreed, you might think you could specify the routing as follows:

```
{IF Hunt8 < > neither}
Hunt9
"How strongly do you feel about that?" :
```

(< > means *is not equal to*). However, if you did that, people answering DK and refusal at Hunt8 would be asked the follow-up question. This is probably not what you intended. So be sure that the specification is absolutely clear:

```
{IF Hunt8 = agree or disagree ONLY; Skip if DK/Refusal}
Hunt9
"How strongly do you feel about that?" :
```

When you are testing your questionnaire, it is useful to enter DK, then Refusal, at every question, to check that people are not being sent on to inappropriate questions from these answers.

With some questions it may be preferable to include DK and refusal options in the list of answer codes directly available to the interviewer, as shown in the following example:

```
Vote
"Which party did you vote for in 1987?" :
(NoVote     "Didn't vote",
Cons         "Conservative",
Lab         "Labour",
Lib         "Liberal",
Other       "Other party")
DKnow       "Don't know",
Ref         "Refused to say"), NODK, NORF
```

If so, disallow the use of <Ctrl+K> and <Ctrl+R> for this question (e.g., by inserting NODK and NORF). Otherwise you may end up with two don't know codes and/or two refusal codes.

15. CHECKS

Sometimes you want the interviewer to be alerted to an answer that is factually inconsistent with a previous answer, or that appears very unlikely, or is simply not possible.

Checks are triggered by a response or combination of responses. A small window appears on the screen, relaying your message to the interviewer.

Probably the main function of checks is to catch interviewer mistakes in the-keying of answer codes, and in particular, of numeric answers (it is easy to hold down a key too long). Aside from this, checks can allow us to query an answer directly with the respondent, bringing some (or all) of the editing of questionnaires forward into the interview. This saves time later on for editors and researchers. It should improve data quality, as we are checking answers with the respondents themselves.

Do not add a check just because you can. In any questionnaire you could include literally hundreds of checks. Avoid the temptation to put in a check just because it is possible to do so, for the following reasons:

- A triggered check brings the interview to a temporary halt, while the interviewer reads your message and acts on it. Checks will inevitably slow down the interview.
- Checks can be very time-consuming to program and test.
- A check, even if not triggered, adds complexity to the program.

Where and How to Specify a Check

In the final source code, checks are included in the rules paragraph, separately from the fields. However, we are recommending that in drafting a questionnaire, the rules should be stated alongside the fields (questions). Therefore, write the check immediately after the question where you want it to be triggered. Later, it must be copied or moved into the rules paragraph.

Checks are like questions in that they appear only if certain conditions are satisfied. So, in plain English and with specific references, write an IF… condition under which the check will be triggered, followed by the wording of the check. Enclose all this in curly brackets. (See Section III for a note on the sense of an edit.)

Writing Check Messages

If an interviewer has simply made a keying error, the check will alert him to the error, which he can amend and move on without needing to consult the respondent. If they have the response given by the respondent, they need to let the respondent know there is a problem with the information.

There are three possible strategies for your message:

- Write the entire message to be read aloud.
- Write a message to the interviewers, which they then relay to the respondent.
- Implement a mixture of these.

The read aloud approach should be used whenever possible, as this makes the interviewer's task easier. There are no precise rules about what to say. Check texts should follow the standard questionnaire convention that lower case signifies material to be read aloud, while UPPER CASE is used for messages to the interviewer, such as instructions. Some examples of check messages are shown in the following example:

```
"The computer's asking me if I've put that in correctly - can I
just check, your weekly rent is {^RENT7}, is that right?  IF YES,
SUPPRESS WARNING AND CONTINUE"

"That's over 75 hours a week, is that correct?"
```

In a delicate or awkward situation, however, it may be preferable to tell the *interviewer* what the problem is, and let them decide how to handle it. The whole message should therefore be in UPPER case:

```
"INTERVIEWER: IT'S USUALLY NOT POSSIBLE TO WORK 30+ HOURS A WEEK
AND GET INCOME SUPPORT. TACTFULLY ENQUIRE IF BOTH ANSWERS ARE
CORRECT. IS IT 30+ HOURS?  IS IT I.S. OR SOME OTHER STATE BENEFIT?
[14]"
```

It can be useful for testing purposes to give each check message a unique reference number – see [14] in the above example.

Be succinct. Writing a check message should be like sending a telegram when you have a lot to say, but very little money:

- Start with a quick summary of the nub of the problem.
- Use simple words and short sentences.
- Re-draft check messages to cut out unnecessary material.

Hard Checks

Checks are either *soft*, allowing interviewers to suppress the warning and move on to the next question, or *hard*, requiring a change to be made.

Use hard checks sparingly. Very few responses are impossible. The respondent can be mistaken about an answer, but may nevertheless be quite convinced it is correct. A hard check forces them (or the interviewer) to change it. The issue is not "could the respondent *be in* a situation that would trigger the check?", but "could the respondent ever *think* they are in that situation?" If the answer is "yes", put in a *soft* check.

Use hard checks to pick up on impossible combinations of responses. A common example is where an interviewer makes an error-keying from a multiple choice list, entering *none of these* **plus** another answer code. You should routinely insert a hard check after such a question:

```
Ben1
"SHOW CARD P  Are you currently receiving any of the benefits on
this card?" :
SET OF
(is   "Income Support",
 jsa  "Jobseeker's Allowance"
 ssp  "Statutory Sick Pay"
 smp  "Statutory Maternity Pay"
 none "none of these")

{HARD CHECK:
 IF Ben1='none of these' AND any other answer is selected:
"'NONE OF THESE' IS AN EXCLUSIVE CODE"}
```

For contradictory answers, specify all question names and codes:

```
{HARD CHECK:
IF Ben1= smp and sex = male: "MEN CANNOT GET MATERNITY PAY"}
```

Note that there is no need to write a check to catch extreme values that fall outside the range already specified for a numeric answer. For example, if the range for Age is 0..120, it is pointless to add a check stating that Age must be greater than 0 and less than 120.

Soft Checks (Signals or Wwarnings)

Soft checks can be suppressed by the interviewer. Use soft checks to pick up implausible or unlikely responses. Soft checks on amounts are important, because keying errors commonly occur with these values. A soft check is shown in the following example.

```
Cig7  "How many cigarettes a day do you usually smoke?" : 1..100

{SOFT CHECK:  IF more than 80 cigarettes (Cig7>80):

"The computer's asking me if I've put that in correctly - can I
just check, you said {CIG7} cigarettes a day, is that right?
INTERVIEWER: IF YES, SUPPRESS WARNING & CONTINUE" }
```

Checks INVOLVING Other Answers

When specifying a check, you must state which answer(s) at which question(s) will trigger the check. In addition, you can also get the check to display other earlier responses to the interviewer, thus providing them with additional information, and allowing them to go back and amend any one of those earlier questions.

To do this, use the Blaise term INVOLVING to refer to responses that do not themselves trigger the check, but that you want to be displayed. Example: A check that arises if the respondent disagrees with a displayed computation of the "total money they spent on a trip," that calculated by adding together earlier answers about how much was spent on each component (travel, meals, drink, entry fees):

```
Totvis  "So that comes to a total of (TOTSUM) spent on that trip,
is that correct?" : (yes, no)

{SOFT CHECK, IF Totvis = no:  INVOLVING Travcost, Meals, Drinks

" INTERVIEWER: RESPONDENT DISAGREES WITH TOTAL: PLEASE CHECK EACH
AMOUNT (INCLUDING '0') WITH THEM"  }
```

Will appear on screen as, for example:

---------- Warning ----------

INTERVIEWER: RESPONDENT DISAGREES WITH TOTAL: PLEASE CHECK EACH AMOUNT (INCLUDING '0') WITH THEM

The following questions are involved:

TripBlock.Totvis = no
TripBlock.Travcost = 15.40
TripBlock.Meal = 11.00
TripBlock.Drinks = 0.00
TripBlock.Entry = 8.00

The interviewer can select any of these questions to return to and change the answer.

16. Computations

You can get Blaise to do behind-the-scenes math and text manipulations. This can be useful when you want to confirm with the respondent a figure they have supplied. The specification for this situation is very similar to a fill.

Use COMPUTE, and give a name to the computed variable, to tell the programmer your requirements:

```
{ask all}
Drink2 "In the last 7 days, how many times have you visited a pub?"
: 0..25

Drink3  "And how many times have you visited a wine bar in the last
7 days?" : 0..25

{IF Drink2>0 and Drink3>0:
COMPUTE ^NUMBER:= visits to pub, + visits to wine bar:
and ask Drink4}
Drink4  "That's a total of ^NUMBER separate visits to pubs and wine
bars in the last 7 days, is that correct?" : (yes, no)
```

Derived Variables

If you know which variables you will be deriving for data analysis, and if you have time, you can make room for the derived variables in the questionnaire. The advantage is that the variables - with the correct texts and code frame - will then be in the correct place for the analysis. (Derived variables created by SPSS are placed at the end of the data set). Also, it will enable analysis to begin more rapidly.

Obviously, you do not want the derived variables to 'come on route' during the interview, so ask the programmer to keep them off the route (using the KEEP command)

17. Page Appearance Specification

In the columnar page format you can specify where to place a label, start a new column (NEWCOLUMN), skip a place in the column (DUMMY) or start a new page (NEWPAGE). The following shows how to state this specification.

{NEWCOLUMN}
{Blaise page label}
"Household introduction"

{DUMMY before Building type}

The effect of these instructions is shown in Figure 2 in the right-hand column. There you can see that column headed by the label "Household information" and that there is a space in the column before *Building type*.

V. Specifying the Blaise Interface

There are several aspects of the interface that could or should be the subject of specification. Some of these aspects can be declared across surveys, including: Windows configuration settings for each computer, major components of the Blaise screen (as given in Figures 1 and 2), design of the Blaise page, including navigational issues and groups of items, and InfoPane elements. The organization doing the fieldwork may already have defined Windows display guidelines and their interviewers may be used to them. If there are special needs, probably the easiest, least expensive, and surest way to arrive at necessary special displays is to define special requirements as a deviation from a known working standard.

1. Windows Configuration

Only a few important Windows configuration settings can be addressed here. These include how date and time are entered, screen resolution, color sets, and whether the bottom task bar should be visible or hidden. It helps the organization hold down costs if it can establish certain Windows configuration choices as standards.

Date and Time Regional Settings

Blaise inherits the format and manner of entry of date and time fields in the instrument from Windows. Thus, an American interviewer can enter date in Month/Day/Year format while his British counterpart would enter in the Day/Month/Year format, using exactly the same instrument. Regardless of how dates are entered, they are stored internally in Blaise in the Year/Month/Day format.

Screen Resolution

Screen resolution refers to the number of picture elements (pixels) that are used to display information on the computer screen. Currently there are two major resolutions to consider. These are 800 x 600 and 1024 x 768. You should know your target resolution ahead of time, including whether you have to satisfy both (this can happen in a multi-site study). An instrument that fits just right on an 800 x 600 screen will take up only a large fraction of a screen using the higher resolution and all the elements on the screen will be much smaller. Fortunately, the Blaise configuration settings are held in external configuration files. So, using a mode library file suited to 800 x 600 resolution as a preparation/compilation standard, and adapting its settings to 1024 x 768 implemented in a runtime override, is one way of proceeding with the same instrument.

Color Sets

Not all computers have the same allowed colors. You should make sure you know the color set of the target computers. Low-end CATI workstations or laptops may not have all the color definitions of your powerful desktop machine. Make sure that any color choices you make will work well on the target machines.

Font Size

When deciding a font size standard, keep in mind that the physical size of a character on a screen depends on four factors.

- Font size.
- Font style, especially proportional vs. non-proportional fonts.
- Screen resolution.
- Physical computer monitor size.

Readability of characters on the screen also depends on font style. Microsoft®'s Tahoma font is a good choice for clarity.

Windows Task Bar

The Windows Task Bar, usually found on the bottom of the computer screen, can be set so that it is normally hidden until the mouse pointer is moved over that location. This gives the total screen to Blaise, removes a distraction, and allows more vertical space for the InfoPane and Blaise page to share.

2. Major Components of the Blaise Screen

The ten major components of a Blaise screen are illustrated in Figures 1 and 2. Of the major components, only four are required by the Blaise system. These are the Windows control buttons, the title bar, the menu, and the FormPane (page). The InfoPane is almost always used for question text and the answer list is almost always used for response choices. Another often-used component is the status bar. The other components are discretionary, and their use, or non-use, can be defined as part of the general specifications. For some long question texts, or questions with a large answer list, there can be tension between the need for space in the InfoPane and the desire to increase data density in the page. For this reason, the speed bar, the tabsheets, and the answer info area are sometimes eliminated to provide more vertical space for the InfoPane and page to share.

Sub-Components

Most of the major components have sub-components or other aspects that can be included, excluded, or configured. An annotated listing of all these possibilities with recommendations would take about 30 pages of space using small font size, and thus is the topic of another paper. To give one example, it is possible to include or exclude provided Blaise menu choices, or to add your own menu choices. For now, the best ways to learn about configuration possibilities for each major component is to study the Blaise Developer's Guide and to explore the dialogs of the Mode Library Editor and the Menu Editor.

3. Design and Specification of the Page

The design and specification of the page (the Blaise FormPane) is often neglected but is just as important as the design of the InfoPane. In some surveys, it is more important. The Blaise page is analogous to a page in a paper questionnaire. It organizes and displays related data elements together. There are several features you can specify in the page that enhance the presentation for the interviewer. The page enhancements illustrated in Figure 1 include specification of readable field

descriptions to identify each field, labels that group related questions, use of two columns in the page with eight data entry cells in each column, and size 10 font (for an 800 x 600 display). An important new feature of Blaise for Windows is the use of the field description in the page as opposed to the more traditional field name. The field description gives more flexibility, since you can include spaces in the description. It also can be multilingual. You can also use the field description in the edit jump dialog.

Thirteen Methods of Navigation

The term **navigation** refers to movement through the questionnaire. The most common method of navigation in Blaise is standard normal movement from question-to-question throughout the interview. This normal movement is governed by rules in the data model, and can accommodate complex skip patterns. However, an interview can be interrupted in many unanticipated ways, including when an edit is invoked, the respondent changes his mind, or there is a break-off. When this happens, the interviewer often has to navigate to other parts of the questionnaire. There are twelve other ways in which an interviewer can navigate through a Blaise instrument in order to accommodate these situations. These are described in Appendix A.

On those occasions when it is necessary to engage in ad-hoc navigation, well-labeled and organized pages with high data density enable the interviewer to go where needed in order to make corrections. In general, high data density is desirable. By increasing data density, an instrument can be presented in fewer pages. This allows the interviewer to form an effective cognitive map of the entire questionnaire. The best way to handle ad-hoc navigation is to give the interviewer as much information as needed to go where necessary. With high data density and readable field descriptions in a page, the arrow keys are very useful for navigating to another field within that page (short-range navigation). The Page Up and Page Down keys are very useful for mid-range navigation between pages, especially with high data density accompanied by frequent and descriptive labels in each page as illustrated in Figures 1, 2 and 3.

Specification of Groups of Questions (Item Types)

Given the page-based nature of the Blaise display, virtually every field (question) in Blaise can be considered to be part of an overall group of questions (also known as an *item type*). For example, in Figure 1, the individual fields *Street address*, *Apartment no*, *Locality*, *State*, *Zip code*, and *Phone number* can be considered to be part of an overall address information group or type. Similarly, the fields *Building type*, *Spec building*, and *Kind of locality* can be thought of as part of an overall building information group or type. Other kinds of multi-question types are optimally handled the same way in Blaise; that is by including all related fields in the same page, giving them appropriate names, and by providing effective labels for all question groups. Some of these other possibilities include quantity/unit combinations and series of similar questions.

Font Size for the Blaise Page

The size of Blaise page elements, such as size of the field description text, or the data entry cell, is based on a specified font size. The smaller the size of the font, the higher data density, you can have. It is quite workable to specify a slightly smaller font size for the page than for the InfoPane. In the examples used in this paper, the page font size is 10.

Field Panes and Columns

A **field pane** is an area where the field description, data entry cell, and other related elements reside within the Blaise page. You can choose from several different elements to make up a field pane including space for an enumerated label and a remark indicator. A column in the page is made up of field panes stacked up on one another. Two columns of field panes is normal in Blaise, though it is possible to have only one column (do not do this). In one major project, interviewers chose to have three columns of field panes because their complex survey requires a great deal of ad hoc navigation and the greater data density facilitates that.

4. Design and Specification of the InfoPane

General layout standards of the InfoPane should be specified. These standards concern the question text display and related components. There are options for font types, font sizes, and whether context information should be displayed. The idea is to provide the interviewer with necessary information without making the InfoPane too cluttered or difficult to understand. The question text should stand out from auxiliary text. The text that is displayed includes not only the question itself and context header, but also instructions to the interviewer, lists of includes and excludes, indication that help is available, or tabular display of previously collected data. It is possible to define a hidden frame that helps separate the question text from the upper and left margins of the InfoPane.

Font Size and Font Style Choice

A good font size for question text (for 800 x 600 resolution) is 11, assuming decent monitor size. You can get more information in the same InfoPane than with size 12 font, without compromising on visibility. You should consider bolded text

to be the standard for question text, as this can help in outdoor situations where there is bright sunshine. A good font style choice is Tahoma, a special font designed by Microsoft® for readable display.

VI. Testing the Questionnaire Program

In theory, it should be possible to understand every aspect of how the questionnaire works on screen – its routing, fills, tables, appearance, etc. – from a thorough scrutiny of the source code. But in reality, this is not a feasible option, and you need to run the executable program and create questionnaires to check that everything is works as it should.

1. Office Testing

The most common method in the early stages, once the programmer has written the source code for the first time, is office testing, where the researcher(s) work through the questionnaire, creating different types of household and respondent scenarios in order to put the program through its paces. The researcher keeps written notes (this is best done concurrently with testing, using Microsoft® Word) and the programmer uses these to make further changes.

It can be useful, even crucial, to ask the sponsor to also provide scenarios for testing, as they may have a good idea of the types of respondents / households are of particular interest for the research study.

Testing can proceed in stages by use of mini-data models for development.

2. Interviewer Testing in the Office

Once the questionnaire is functioning as a complete instrument, it can be invaluable to bring one or two experienced interviewers into the office for a day or two of further testing. One option is for the interviewers to work on their own, going through the questionnaires using different respondent/household scenarios provided by the researcher, and keeping note of problems. (See Newman and Stegehuis, (2000) for discussion of automated error reporting and error tracking.)

A better method is to have them conduct mock interviews with the researcher as interviewee. These will be stop-start affairs, as problems are discovered and noted, and solutions are discussed.

A further improvement is for the researcher to act purely as an observer of the interview, with another researcher or other member of staff acting as the interviewee, giving answers according to household / respondent scenarios sketched by the researcher, and improvising thereafter. Being simply an observer and listening in on the interview can reveal new flaws and ambiguities in questions, and problems with question sequences, that have not been seen before. (Many researchers have had the experience of only realizing a problem exists when hearing a question spoken aloud by an interviewer during the pilot briefing.)

The fresh perspective offered by interviewer involvement will reveal new problems and issues not found in earlier testing. The researcher must keep note of all problems, and (either then or later) write a specification for the programmer detailing what changes are needed.

It might also be possible at this stage to bring some ’real’ respondents in to the office and test the questionnaire on them, with the researcher observing and making notes. However, this tends not to happen, in part because of the practical problems of recruitment at short notice, but also because of the stop-start nature of the process.

3. Piloting

The field pilot is the traditional method for testing the survey process, including the questionnaire itself. It is particularly valuable in bringing in ‘real’ respondents, who are in situations not always envisaged by researchers during testing.

Interviewers should be encouraged to make notes of problems during their interviews. This might be done using the Blaise Notepad facility, or on paper. Keeping comprehensive notes in this way is not easy, and the interviewer should allow five to ten minutes to go over their notes after each interview, fleshing them out as necessary.

Researchers and sponsors should accompany interviewers for at least one day of work, if possible, and keep notes of any problems that occur.

The pilot comes towards the end of questionnaire development and is generally seen as the last chance to fine-tune the questionnaire before launch. Therefore pre-pilot testing must be as thorough as possible.

4. Amending the Program and Checking Changes

Testing and amending the questionnaire is usually very time-consuming. The reason is that it is not just a matter of trying to follow every possible course through the questions and correcting errors; it also involves sorting out problems and issues that were unforeseen when writing the original questionnaire draft, as well as making numerous small improvements.

Work Side by Side as Much as Possible; It Saves Time.

Note that this method would not be appropriate during the first stage of program writing, when the programmer has to build the source code from scratch, based on the paper draft. Here it would be a waste of resources for the researcher to be sitting alongside. Also, where a subsequent change involves major rebuilding work on a complex questionnaire structure, such as an event history or household grid, the programmer will probably prefer to do this work alone in the first instance.

However, much time can be saved if programmers and researchers work side by side when making changes to the source code, so that fixing the code is combined with testing the results. An efficient model is for the researcher to keep notes of problems found during testing, and to sit alongside the programmer while the source code is amended to fix the problems. Then, after each batch of changes, the programmer compiles a new version of the program and the researcher and programmer together run through it to test that the changes have been successful. If not, the source code is amended on the spot and the program recompiled and tested again.

This may seem *less* efficient than a division of labor into respective skill areas. But in fact it works much better than the alternative model, which is for the programmer to work alone, using the researcher's written notes to make changes to the source code, then supply executable programs for the researcher to test (alone). The disadvantage here is the strong likelihood of faulty communication and misunderstandings. Some common examples of this:

- The researcher's notes are ambiguous; the programmer interprets them in a different way than was intended. To discover and correct this requires a round of testing, a further written request, another amendment to the source code, an executable file to be supplied, and a further round of testing.
- Writing in haste, the researcher makes a minor error in specifying a change request. The mistake is realized when testing the new executable program, requiring a further written request, and so on (see above process).
- The programmer makes a simple mistake. This is picked up by the researcher in testing, who then writes another change request to correct it. (See above process).
- A researcher, having only an imperfect understanding of how Blaise works, spends some time writing an elaborate request for a change that is not technically possible or is better done in other ways.
- A researcher unwittingly requests a 'small' change that has significant knock-on effects elsewhere in the program and requires a lot of work to implement. If they had been aware of this, the request would have been modified or dropped.

VII. Special Topics

Instrument development in Blaise can be made relatively easy even for complex questionnaires, if you approach it correctly. This too-short section describes some approaches for instrument development.

1. Development of a Complex Data model Using a Simultaneous Bottom-Up and Top-Down Approach

Large or complex instruments can be developed efficiently using bottom-up and top-down approaches simultaneously. The bottom-up part of development refers to the use of mini-data models to develop sections of the questionnaire. The top-down part of development means programming at the instrument (or integration) level right from the start, using stubs to represent the various sections until they are complete. This dual approach allows work to proceed on easier block-level tasks by junior programmers, while a more senior programmer takes care of overall instrument integration (where the complexity often lies) at the same time. It allows for quicker development, since it is much faster to prepare a smaller data model than a larger one. This allows for more and quicker iterations in a given amount of time.

Mini-Data Models

Since Blaise III (the last DOS version of Blaise), where constructs known as **parameters** were introduced, it has been possible to develop blocks for complex data models by splitting the data model into mini-data models. Often this is done for section-level blocks or other major sections of the instrument. These blocks may themselves have sub-blocks that are not constructed in a mini-data model.

A mini-data model is one that contains the block to be developed and just the fields necessary to give the block needed information. Values from fields outside the block are assigned through parameters to the block under development. After the block is developed, it is inserted into the main data model. The only elements that are necessary to change are the parameter references.

Integrated Instrument

At the same time developers are working with mini-data models, an integration programmer can be working with the main instrument. This can be put together early in the project development with stubs for the blocks that are being developed through the mini-data models. As the blocks are finished, they are inserted into the main data model.

2. Prototyping Challenging Aspects of an Instrument

New types of surveys that are brought into Blaise for the first time quite often have special requirements. Some examples include the need for extreme ad-hoc navigation, many-to-many data relationships, complex data links between parts of the instrument, or accommodating unusual displays and navigation within a table. A good way to come up with solutions for challenging instrumentation problems is through prototyping. It is useful to separate these more challenging issues from the more common programming tasks and assign the prototyping tasks to a two-person team consisting of a senior programmer and a subject-matter expert. Their solutions can be shared with and implemented by more junior programmers. The mini-data model approach to instrument development lends itself nicely to this kind of prototyping.

3. Two or More Spoken Languages

Blaise has the natural capability to handle two or more spoken languages such as English and French. The following illustrations demonstrate this.

The *Phone number* field definition from Figure 1 is shown in English and French in the following example:

```
PhoneNum "Phone number of the home."
           "Le numéro de téléphone de la maison."
         / "Phone number"  "Numéro de téléphone" :
            STRING[12], EMPTY, DK, RF
```

The field definition has two entries for the question text and two entries for the description. All other components of the field definition are declared once.

Languages are set up in the instrument by declaring languages that are going to be used, as shown in the following example:

```
LANGUAGES =
  ENG "English",
  FRA "Français"
```

The interviewer switches languages either through a menu or through a function key. If the field description is used on-screen in the page, the visible field identifier switches languages too, as does the description used in the edit jump boxes.

Specification and Implementation of a Second Language

The translation and execution of a second spoken language in a Blaise data model can be complex. In addition to the field elements above, which are easily handled, there are texts for edit statements (in the rules), computations for text fills, and text for response choices. All of these text locations must be found and translated. Testing of a second language can be very tedious and perhaps done by only one or a few people fluent in the second language. When implementing a second language, you must leave enough time to adequately program and test the translations.

VIII. Alternative Approaches

While this paper assumes that there are at lease two parties involved in producing the instrument, a specifier and a Blaise programmer, there are alternative approaches. These are summarized.

1. Subject-Matter Experts Program the Blaise Source Code

This model has been used successfully in some organizations around the world (e.g., Manners, 1998). The block-level source code is often quite easy to program and can be done by a subject matter specialist with a few hours of training. A harder task in

complex data models is to assemble the blocks together so that they work with each other well. A senior and experienced Blaise programmer can do high-level integration, and from this, guidelines can be given to the block-level programmer about how the block will integrate with the overall instrument (see Pierzchala and Manners, 1997).

An advantage to this approach is that the overall specification and development time is reduced, because the original specification is done directly in Blaise, because there is no communication process between specifier and developer, and because the person programming the block can immediately prepare it and test it and make repairs.

It is essential in this kind of implementation that the organization arrive at agreed-upon instrument development methodology, programming standards, interface standards, and have standard high-level code for constructs such as kinds of tables into which the subject matter specialist can insert blocks.

2. Iterating to a Solution

In this model, a project specifier is teamed with an experienced and senior Blaise programmer who also has extensive survey experience. While there may be detailed field specifications and survey protocols, the way in which the instrument is put together is arrived at through iteration. In short, the specifier may verbally, or through brief written descriptions, tell the Blaise programmer what they are trying to accomplish. After discussion, the programmer develops appropriate prototypes (at the block level, at the integration level, or both), and comes back. Together they discuss necessary alterations. This process repeats until an agreed-upon instrument is produced.

With the right people, this method can work extremely well to produce high quality instruments at low cost. It can avoid the rigidity that can accompany programming to a specification. Especially important are the qualifications of the Blaise programmer. That programmer must understand how Blaise works best for the interviewers and other users, how it can fit into an existing survey infrastructure, and how solutions in similar surveys have worked out. Above all, this person must be expertly knowledgeable with the internal workings of Blaise and how to program robustly. Otherwise, you might get a mess.

3. The Paper Questionnaire as a Specification

If there is a paper questionnaire that is to be implemented in Blaise, the paper questionnaire should be a very good, if incomplete, Blaise specification. A paper questionnaire is typically an understandable document with well-labeled sections and sub-sections. Often there is a survey operations manual and an interviewer manual that can provide additional information. A paper questionnaire can provide a good overview of how the whole instrument works together, and can be helpful in identifying identical or similar data collection structures and question types. It is also helpful to talk with experienced survey operations people and interviewers to discuss how they go about collecting and processing the data. This overview can be very helpful in the overall design of the Blaise instrument.

Although the paper questionnaire can be a good starting point, is also an incomplete specification. It usually has question numbers and text, but it does not include SPSS or SAS variable names, field descriptions, valid values, or an indication whether a field can be EMPTY or can allow don't know or refusal. You can hand-annotate a paper questionnaire, noting Blaise blocks, question types, and similar concerns directly on the paper, or mark a reference on the paper that points to additional information in another document. This supplemental document can also provide information about text fills, edit checks, and other information necessary for an electronic instrument.

It is also extremely instructive to work with experienced interviewers, watch them conduct real or mock interviews with the paper instrument, and generally include them in the development and specification process.

4. Code Generation

It is possible to write a metadata collection instrument in Blaise or in a database system where a project person can state specifications. An auxiliary program, such as Manipula for Blaise or Visual Basic on another database system, can produce Blaise source code especially at the block level. Blaise fields are easiest to specify, while the within-block rules can be more difficult to handle.

The advantage of such an approach is that it eliminates much of the mundane specification and programming work associated with producing an instrument. There can be tradeoffs, however. For example, a programmer may make changes in the questionnaire source code after it is generated. If this source code were not used to repopulate the specification database, then the source code and the metadata database would be out of sync. It is not difficult to produce a parser to read field definitions back into such a database. It is much more difficult to parse the rules to repopulate the metadata database (since Blaise is a powerful fourth-generation language, it is possible to program rules in a way that metadata database does not anticipate, also the rules can be extremely complex). It is possible to produce a metadata database system that generates fields in a source code file that is separate from the rules, thus separating the issues associated with field metadata from the rules metadata.

The point of view of the metadata database and generation is extremely important. Many such systems have an item-based point of view that does not fully recognize block structure and type possibilities in Blaise. A better point of view for such a metadata system is a structure-based point of view that formally acknowledges the blocking structure of a Blaise instrument and can drastically reduce specification and development work. The National Agricultural Statistics Service in the U.S. uses such a point of view in a Blaise metadata database and generates over 40 complete questionnaires every quarter (Pierzchala, 1993, Schou and Pierzchala, 1993) in a highly specialized context.

The block-based point of view is illustrated in Appendix C, in the discussion of blocks and field names. In that example, if a field name were *MaizePAcres* this would be a specification with an item-based point of view. If the block were named *Maize* (or *Soybeans)* and the elementary field name *PAcres*, this is a block-based point of view, and this is what you should do.

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Appendix A: Navigation in Blaise

Navigation is powerful in Blaise, and the layout of the page can enhance or detract from this power. This appendix lists the major navigation methods in Blaise, how they are used, and how they can be enhanced.

Navigation facility	Use	Programmer Enhancement
Normal forward movement	Forward movement during interviewing is governed by RULES specifications in the instrument.	High data density in the page allows the interviewer to understand the flow and content of the instrument.
Edit jump list	Lists fields in the instrument that the interviewer can jump to in order to fix edit failures.	Use readable field names or field descriptions to represent fields in the edit jump list.
Paging with <Page Up> and <Page Down> keys	Medium range navigation through sections of an instrument. This is a major method of navigation. <Page Up> goes back one Blaise page (one FormPane). <Page Down> goes forward one Blaise page. You cannot page down past fields that have not yet been reached in the interview.	Enhanced with forms based approach: • Dense data display (important), and • Labels at the start of each column or set of fields. • NEWCOLUMN or NEWPAGE at the start of a section.
Arrow keys	Short range navigation within a page (FormPane). Arrow keys move one cell at a time	Enhanced with dense data display, column labels, and readable field names or descriptions.
Home key	Used to jump to the first field in the instrument.	Users often use this if they want to review the data in a form. Subsequent navigation is facilitated with paging down through well designed Blaise pages with high data density.
End key	Interviewing: Jumps to the next appropriate question, taking into account changes of route based on changed data. Editing: Jumps to the last question in the instrument.	In interviewing, <End> skips past questions with EMPTY attribute. Thus do not give an EMPTY attribute to questions you require. The End key is one of the most important navigation keys in Blaise.
Parallel block navigation: • Parallel block lister. • Parallel blocks on tab sheets. • Function keys to access selected parallel blocks. • Function key to return to main interview.	Breaks the linear progression of the interview, including appointments; non-response; concurrent household interviewing; or where sections are completed by different individuals.	Use descriptions for parallel blocks (define these in **Project>Data model Properties**.) Use conditions to determine when each parallel block is available. Tabsheets for parallel blocks are available with Blaise Version 4.1, as is the ability to assign a parallel block to a function key.
Jump box	Jumps to any field with a field tag. It is very effective for jumping to sections where a section label is supplied.	Use short field tags at the start of a section. For example, for *Section A*, use a field tag of (*a*). The use of dense FormPanes enhances the section review once the user has jumped to that section. This is especially used with paging and arrowing, as described above.
Edit lister for multiple edits in a form.	Allows an on-line review, where there are multiple edit failures in a form. You can jump to any field listed in the edit lister.	Use of meaningful name or description for the field name.

Navigation facility	Use	Programmer Enhancement
Remarks lister	Reviews all remarks made in the instrument. Can jump to the field associated with any remark.	Use of meaningful name or description for the field name.
Open field lister	Reviews all open fields in the instrument. Can jump to the field associated with an open.	Use of meaningful name or description for the field name.
Mouse click	Move to any eligible field or parallel block tab sheet.	Provide a mouse or other pointing device. Also, high data density in the page.

Appendix B: Example Specification, Household Enumeration Grid

This appendix illustrates a specification for a household enumeration table for a household survey. It gives the conventions used, states what is to come before the table, how the table is to operate, what each row of the table is to contain, and what follows the table.

1. Specification Conventions

Languages

The primary spoken language is English. A second spoken language is French. Translation from English to French will be done after the questionnaire is programmed. For now, an indication to include French question text and French description text is included in the field specifications below.

For some questions, help text is available through WinHelp. This is indicated in a field specification with the HLP language indicator. The text specified for HLP is a link to the WinHelp file. The client will provide the WinHelp file and will use the links specified below.

Pre-defined Types

Some question response definitions are used commonly throughout the instrument. The following are used in the field specification section. French translations will be provided later.

TYesNo = (YES, NO)
TContinue = (Continue "[INT] PRESS 1 TO CONTINUE")
TGender = (MALE, FEMALE)

Blaise Page Labels

For pages of columnar display, Blaise page labels are specified. An example:

{Blaise page label}
"Household introduction"

Interviewer Instructions

Interviewer instructions are marked by all uppercase text and are preceded by an indicator as demonstrated.

[INT] ENTER 999 TO INDICATE THAT THERE ARE NO MORE MEMBERS.

Fills

The following fills are used. The ^ indicates that a text fill is specified in the question text.

Fill	Options / examples	How
^your_SP	[your] [John's]	When talking directly to the subject, use **your**. Otherwise use the first name of the subject and add **'s**.
^you_SP	[you] [John]	When talking directly to the subject, use **you**. Otherwise use the first name of the subject.
^Do_Does	[Do] [Does]	At the start of a sentence, when talking directly to the subject, use **Do**. Otherwise use **Does**.
^do_does_ {note the trailing _}	[do] [does]	Not at the start of a sentence, when talking directly to the subject, use **do**. Otherwise use **does**.
^Is_Are	[is] [are]	If talking to the subject, or about more than one person, use **are** otherwise use **is**.

"What is ^your_SP job title?

Text Enhancements

Text enhancements are given by the @A (etc.) in the question text. You can have 26 defined enhancements. These can be used for bolding, underscore, font style, font size, tab stops, and so on. The following Text enhancements are used. The @A (etc.) is defined for types of text. What @A (etc.) represent on the computer screen is determined by a configuration file.

Text enhancement symbol	Applied to	Appearance in this survey
Default (i.e., no enhancement)	All question text not given any other text enhancement.	Tahoma, Normal, 11 point, black
@B	Emphasized text	Tahoma, Bold, 11 point, black
@I	Interviewers instructions	Tahoma, Normal, 10 point, blue
@/	Line feed in the info pane	

The specification question text for the following:

"Have you remembered to include @Ball babies and small children@B?"

becomes

"Have you remembered to include **all babies and small children**?"

on the screen.

Sample Field Specification

```
{IF Job = Yes}
NumJobs
"How many jobs ^do_does_ ^you_Sp have?"
FRA ""
HLP "NumJobsDef"
/
"Number of jobs"
FRA ""
: 0..5
```

Entities

Database entities are given at the beginning of each specification section below. The following database entities are valid for this instrument.

Entity indicator	Entity meaning
HH	Household relational database table
PER	Person relational database table
EMP	Employer relational database table
LOC	Location relational database table
DAY	Day relational database table
TRIP	Trip relational database table

Spacing indicators

The following are spacing indicators of various types in the Blaise page.

Spacing indicator	Meaning
DUMMY	Space in the column in the Blaise page
NEWCOLUMN	Puts next field at the top of the next column of the Blaise page. If already in the last column of the page, it will put the column at the start of the next Blaise page.
NEWPAGE	Puts the next field at the start of the next Blaise page.

DUMMY, NEWCOLUMN, and NEWPAGE are given just before the field they apply to in braces.

```
{NEWCOLUMN}
{Blaise page label}
"Household introduction"
```

Flow Specification

Flow or routing instructions are given just before or just after a field in braces.

```
{IF FName <> EMPTY and FName <> 999}

{ENDIF}
```

Hard and Soft Edit Specification

Hard and soft edit instructions are given just before or just after a field in braces.

```
{HARD CHECK:
NumJobs = 0 implies Job = Yes.
"[E HH01] I recorded that you have a job and that the job number is 0. Which is correct?"
FRA"[E HH01]"}
```

Computation Specification

Computation specifications are given just before or after the field, in braces.

```
{COMPUTE number of household members from the entries in the enumeration table.}
```

2. Household Enumeration Section

In this section we describe how to specify a table in Blaise. The example, a household enumeration grid, is something that is commonly used in household surveys. There are many ways this can be done. The screen shot in Figure 3 at the start of this paper is from the table produced from the following specification.

General

The sampling algorithm, and by extension the validity of the eventual statistical analyses, depends upon a complete and accurate listing of household members. Household membership depends on criteria that have evolved over several decades based on experience in this nation and others. These criteria are not necessarily known by the respondent. Current

methodological practice indicates that the best way to proceed is to have the respondent give information about each person he/she believes is a member of the household, and after that list is complete, ask follow-up questions. This helps to make sure that the list is complete by the criteria of the survey. If someone is missing, then the interviewer is to return to the household enumeration grid and add the missing person or persons. Only when all criteria are covered, is the interviewer allowed to signal that the enumeration is complete. At that time the sampling algorithm is executed.

Experience shows that the best way to collect household data is within a grid display with freedom of movement. Each member is listed in a row of the grid. The interviewer can see all information about all members of the household.

Note that all information collected in the enumeration table is necessary for the proper working of the sampling algorithm that takes into account Age, Gender, and number of jobs. Therefore these data do not allow DK or RF. If the respondent does not know the information, or refuses to give proper information, then the interviewer is to break off the interview appropriately (using the break off block) without antagonizing the respondent. At a later time a re-visit will be attempted.

The respondent is allowed to give a fictitious first name and to refuse the last name. However, if there are two identical first names, such as 'John', then use the last name field to make them distinct. For example, John Jones Sr. and John Jones Jr. or alternatively, John 1 and John 2.

Before the Enumeration Table

Entity is HH

Introduce the household enumeration section to the respondent.

```
{NEWCOLUMN}
{Blaise page label}
"Household introduction"

HHIntro
"I am now going to ask you for information on all the members of the household.
@/
For each member I will ask name, age, gender and whether the person has a job, and if so, how many.
@/
This will ensure that the survey is representative of the whole community."
FRA ""
/
"Household Intro"
FRA ""
: TContinue
```

Maintain a count of household members from the enumeration table. Do not ask for this number. Do not limit the enumeration of members based on the number in this field.

```
{COMPUTE number of household members from the entries in the enumeration table.}
HHNumber
"Count of household members."
FRA ""
/
"Number in household"
FRA ""
: 0..25
```

In the Enumeration Table, Across Member Rows

Entity is HH.

Allow up to 25 people in the household.

The person speaking is to be the first row in the household enumeration table.

There must be at least one person in the household. If there are no valid members in the household, the interviewer should exit the form through the break off parallel block.

The respondent/interviewer can give the information about household members in any order. For example, data entry can be in horizontal order for one person at a time, or it can be vertical across people. In the latter, the respondent may wish to give all first names first, surnames for all members, and so on, in that order.

To leave the household enumeration table, an indication must be given to the computer that it is finished. This is done with an entry of 999.

Since data entry order for this table is free, it is necessary to check that all required cells are filled in. Therefore as the interviewer leaves the table, check to make sure there aren't any holes in it. If there is a hole to fill in, the computer should give a way to arrive back directly at the cell in the table, with an appropriate error message to the interviewer.

Make sure that first name and surname, taken together, uniquely identify individuals. For example, John Jones Sr. and John Jones Jr. It is helpful for the proper conduct of the interview that enough information is gathered about the names in order to make it clear to the respondent who is being talked about.

It is possible that people are listed that possibly should not be listed. By deleting the first name entry, the information in the row shall be deleted and all subsequent rows will move up one row. If the person is later determined to really be a member of the household, then data entry for that person will be redone (we don't want the respondent to think we're keeping data that are apparently deleted).

In the Enumeration Table, Within a Person Row

Entity is PER.

The following specifies the composition of, and the execution of the data collected for a person.

```
{Note, answer required, even if 999 to indicate that enumeration is finished.}
FirstName
"What is ^your_SP's first name?
@I[INT] ENTER 999 TO INDICATE THAT THERE ARE NO MORE MEMBERS."
FRA ""
/ "First name"
FRA ""
: STRING[20]

{IF FName <> EMPTY and FName <> 999}
SurName "What is your_^SP's surname (last name)?
FRA ""
/
"SurName"
FRA ""
: STRING[20], RF

Gender
"@IASK ONLY IF NOT OBVIOUS
What is ^your_SP's gender (sex)? @I "
FRA ""
/
"Gender"
FRA ""
: TGender
```

```
Age
"How old ^is_are ^you_SP?"
FRA ""
/
"Age"
FRA ""
: 0..120

Job
"^Do_Does ^you_SP have a job?"
FRA ""
HLP "JobDef"
/
"Have Job"
FRA ""
TYesNo

{IF Job = Yes}
NumJobs
"How many jobs ^do_does_ ^you_Sp have?"
FRA ""
HLP "NumJobsDef"
/
"Number of jobs"
FRA ""
: 0..5

{HARD CHECK:
NumJobs = 0 implies Job = Yes.
"[E HH01] I recorded that you have a job and that the number of jobs is 0. Which is correct?"
FRA"[E HH01]"

{ENDIF}
```

After the Enumeration Table

Entity is HH.

The following questions will be asked to ensure that no one has been missed. If any of the following are answered No, then move the interviewer back to the table, at the next appropriate row, in order to fill in the missing person(s).

```
{Blaise page label}
"Household verification"

RemChild
"Have you remembered to include @Ball babies and small children@B?"
FRA ""
/
"Remember children"
FRA ""
: TYesNo

RemBrdr
"Have you remembered to include @Bany boarders@B? "
FRA ""
/
"Remember boarders"
FRA ""
: TYesNo
```

RemPrnt
"Have you remembered to include @Bparents who may be living with you@B?"
FRA ""
/
"Remember parent"
: TYesNo

RemRel
"Have you remembered to include @Brelatives who are staying here@B?"
FRA ""
/
"Remember relatives"
FRA ""
: TYesNo

RemFrnd
"Have you remembered to include @Bfriends who are staying here@B?"
FRA ""
/
"Remember friends"
FRA ""
: TYesNo

When all questions above are answered Yes, then invoke the sample algorithm.

Once the sample algorithm is invoked, close off access to the household enumeration table and following questions. Leave the household introduction question available to the interviewer (it’s a landmark to them).

Appendix C: Modifying a Block for Related but Differing Topics

This appendix illustrates two ways of using the same block definition, but adapting it for different topics. The two methods are compared and some guidelines are given on when to use which. Other methods of efficiently specifying related blocks are also given.

The most important point to remember about blocks and structure point-of-view is that it pays to separate within-block concepts from between-block differences. For example, if you specify crop fields as *MaizePAcres*, *SoybeansPAcres*, and so on, you redefine (and cause the programmer to reprogram) the same structure (but with different field names) several or many times. This latter practice, by itself, can increase the programming and maintenance burden by an order of magnitude or more in many instruments. In specification, it is crucial to recognize the parts of the code that can be generalized.

1. First Method, Standard Block with Variable Text and Edit Limits

To give an example from agriculture, one group of questions concerns crops. This example has questions *PAcres* (planted acres), *HAcres* (harvested acres), and *Yield*. The field *Production* is derived from *HAcres* and *Yield*. Its value will be shown on the screen for the interviewer's benefit, but it cannot be changed there. It could be hidden entirely.

Example

```
BLOCK BCrop
  PARAMETERS
    IMPORT
      UpperLimit : INTEGER
      Crop : STRING
  AUXFIELDS
    Label : STRING[20], EMPTY
  FIELDS
    PAcres "How many acres of ^Crop did you plant?"
                  / "Planted acres" : 0..100000, RF
    HAcres "How many acres of ^Crop did you harvest?"
                  / "Harvested acres": 0..100000, RF, DK
    Yield "What was your yield for ^Crop?"
                 / "Crop yield" : 0..1000, DK, RF
    Production : 0..100000000, EMPTY
  RULES                           {Within block}
    Label := Crop
    Label.SHOW
    PAcres
    IF PAcres > 0 THEN
      HAcres
      CHECK
      HAcres <= PAcres
     "Harvested acres must be less than or equal to planted acres."
      IF HAcres > 0 THEN
        Yield
        IF (Yield > 0) AND (Yield = RESPONSE) THEN
          SIGNAL
          Yield < UpperLimit
          Production := Yield * HAcres
          Production.SHOW
        ENDIF
      ENDIF
    ENDIF
ENDBLOCK
```

Notice how this structure is the same for different crops; for example, maize and soybeans. This can be programmed in Blaise through block reuse by giving the block two (or more) different names as shown below.

Example

```
AUXFIELDS
  UpperLimit : 1..100000
  Crop : STRING[30]

FIELDS                    {Define block Fields in terms of one
  Maize : BCrop            block definition}
  Soybeans : BCrop

RULES
  NEWCOLUMN
  UpperLimit := 130
  Crop := 'Maize'
  Maize(UpperLimit, Crop) {Call the Maize instance of the crop
                           block and pass in a specific edit limit
                           and a custom text element.}

  NEWCOLUMN
  UpperLimit := 55
  Crop := 'Soybeans'
  Soybeans(UpperLimit, Crop)  {Do the same thing for soybeans.}
```

While the concepts of planted acres, harvested acres, yield, and so on are the same for both maize and soybeans, there are differences in the question text, value definitions, edit limits, and downstream variable names. In the example, the parameters *Crop* and *UpperLimit* customize the same block structure for the different crops. The soft edit using a parameter *UpperLimit* is defined in a general way in the block but its value is changed before each instance of the block is called in the rules.

Two instances of the block were declared using block field names, one for maize and one for soybeans. Thus at the block level, it is possible to state additional metadata that can be used in conjunction with field-level metadata within the block. For example, Cameleon can be programmed to concatenate *Maize* and *PAcres* into *MaizePAcres* and also *SoyBeans* and *PAcres* into *SoyBeansPAcres* to uniquely identify field elements to downstream processes without destroying the reusability of a block definition. This is another advanced use of Cameleon.

The block can be arrayed. In the block below there are 10 instances of the same block or structure.

Example

```
FIELDS
  Crop : ARRAY [1..10] OF BCrop
```

2. Second Method, Different Fields Sections, Same Rules Sections

Sometimes the method considered above is not powerful enough. This can be the case where, for reasons of metadata export, you need to have more specific field-level metadata available. On the other hand, you do not wish to reprogram the rules for different metadata identifiers. This section describes an alternative that allows you to be more specific with specification at the field level, while allowing you to program the rules only once. Consider how the example of Blaise could have been implemented using the Blaise INCLUDE statement.

```
BLOCK BCrop
  PARAMETERS
    IMPORT
      UpperLimit : INTEGER
    IMPORT
      Crop : STRING
  AUXFIELDS
    Label : STRING[20], EMPTY
INCLUDE "BCrop.Fld"            {Include the fields section.}
INCLUDE "BCrop.Rls             {Include the rules section.}
ENDBLOCK
```

The example below shows how the fields section can change, but the rules section (the hard part) can stay the same.

```
BLOCK BMaize
  PARAMETERS
    IMPORT
      UpperLimit : INTEGER
    IMPORT
      Crop : STRING
  AUXFIELDS
    Label : STRING[20], EMPTY
INCLUDE "BMaize.Fld"            {Include the fields section.}
INCLUDE "BCrop.Rls              {Include the rules section.}
ENDBLOCK
```

and

```
BLOCK BSoyBean
  PARAMETERS
    IMPORT
      UpperLimit : INTEGER
    IMPORT
      Crop : STRING
  AUXFIELDS
    Label : STRING[20], EMPTY
INCLUDE "BSoybean.Fld"            {Include the fields section.}
INCLUDE "BCrop.Rls                {Include the rules section.}
ENDBLOCK
```

Where BMaize.fld is the following:

```
FIELDS
  PAcres (101) "How many acres of maize did you plant?"
               / "Maize planted acres" : 0..100000, RF
  HAcres (102) "How many acres of maize did you harvest?"
              / "Maize harvested acres": 0..100000, RF, DK
  Yield (103) "What was your yield for maize?"
              / "Maize crop yield" : 0..300, DK, RF
  Production : 0..100000000, EMPTY
```

And where BSoybean.fld is the following:

```
FIELDS
  PAcres (201) "How many acres of soybeans did you plant?"
               / "Soybean planted acres" : 0..10000, RF
  HAcres (202) "How many acres of soybeans did you harvest?"
              / "Soybean harvested acres": 0..10000, RF, DK
  Yield (203) "What was your yield for soybeans?"
              / "Soybean crop yield" : 0..100, DK, RF
  Production : 0..100000000, EMPTY
```

Note that in both *BMaize.fld* and *BSoybean.fld* the *FieldName*s are the same but that the *FieldTag*, *FieldText*, *FieldDescription*, and *FieldValue* have all changed. For both field sections, the rules structure, as held in BCrop.Rls, is the same.

```
RULES                           {Within block}
  Label := Crop
  Label.SHOW
  PAcres
  IF PAcres > 0 THEN
    HAcres
    CHECK
    HAcres <= PAcres
   "Harvested acres must be less than or equal to planted acres."
    IF HAcres > 0 THEN
      Yield
      IF (Yield > 0) AND (Yield = RESPONSE) THEN
        SIGNAL
        Yield < UpperLimit
        Production := Yield * HAcres
        Production.SHOW
      ENDIF
    ENDIF
  ENDIF
```

Methods 1 and 2 are two different ways of accomplishing almost the same thing. In the first, the block is more generalized but there is less flexibility in handling of field-level metadata. In the second, the fields section is different between the two crops, but the rules section is the same. One point is that there is a big payoff if you can specify in generalized terms to reduce the amount of programming and maintenance. A second point is that there are many different ways you can be creative in Blaise in order to cut down on the amount of specification, programming, and maintenance.

3. Specifying Variations on a Theme

Methods 1 and 2 above show different ways of adapting the same block structure to different situations. However, there can be blocks with similar structure. It is possible to specify one block as a variation on an already-defined block. Consider the block definition of BCrop above. This has fields *PAcres*, *HAcres*, *Yield*, and *Production*. A similar but larger block would have the fields *PAcres*, *HAcres*, *Yield*, *Unit*, and *Production*, where *Unit* is needed for some crops because there are alternate units of production (e.g., for Maize, tons versus bushels). Instead of specifying the whole blasted thing from scratch a second time, the specification for the second block can be based on the first "insert *Unit* between *Yield* and *Production*" and then give additional rules specifications that determine how to calculate the value of *Production*, based on yield and the unit given.

4. Super Blocks

For the two kinds of crops mentioned in 3 above, the only difference was that a field *Unit* was specified for one of the block types. An alternative approach is to define one block type for all crops, but where the *Unit* field is not needed, just route around it, with appropriate specification for computation of *Production*. This 'super block' will be more complex internally than either alternative mentioned in 3 above. On the other hand, there is now less code to maintain. This method should not be used very often.

5. Specifying in Terms of a Prototype

When there is a new and difficult data collection challenge, the best approach may be to construct several prototypes to see what the possibilities are. This is an iterative process, but when you arrive at a solution, one method of specification is to say, "program the table for topic X just like prototype 5". This will give your documentation people conniption fits, but they can document from the prototype the same time the programmer is implementing your survey in Blaise.

6. Specifying Commonly Used Structures

It is possible that a measurement block can be used several or many times in a survey. For example, Frey (2000) discusses the construction of 6 'time-spent' blocks that between them are used several thousand times in a data model. Each TimeSpent block contains several fields that measure how long a person was doing something. If you have such a situation, it may be possible to specify in the following way:

Exhaust "Were you exposed to exhaust fumes on your job?" : TYesNo
{IF Yes}
{Topic = Exhaust, Phrase1 = 'exhaust fumes'}
{Call TimeSpent1}

This way you can avoid having to repeat the specification of many fields and can be as efficient in specification as the programmer can be in the source code. ***Caution***, this is such a powerful method of specification that it is easy for the specifier to define a much too large questionnaire without realizing it.

Appendix D: Data Export Possibilities

This appendix discusses the three options for data export, and advantages and disadvantages of each. It also mentions Open Blaise Architecture that will give another option or options soon.

1. ASCII Export

ASCII export is suitable for small or medium sized data files of less than 32,000 characters in width. It produces one rectangular flat file. The Manipula program that does the export is just a few lines of code that can be constructed in a few minutes with a Manipula wizard in the developer's environment. The ASCII file description can be easily generated with standard Cameleon setups for SAS or SPSS from the Blaise field-level metadata. On the other hand, this simplest and easiest export method will not work for large data files. If there are arrayed fields (or arrayed blocks of fields), then Cameleon must make the field names unique in the output description. It does this by truncating the field name to 5, 6, or 7 characters and adds a number to the end (such as *Phone1*, *Phone2*). If the Blaise data model is large, or if its structure is not suited for flat file export, then you'll need either to ASCIIRELATIONAL output or a custom output. If you use ASCII export for a highly structured data model, you'll likely get a sparsely filled in data set. (Note, starting with version 4.5 of Blaise, there will not be any limit to the ASCII record readout length. Version 4.5 has not been released at the time of writing this paper.)

A partial example of a downstream metadata description in SPSS for a small data model is given below.

```
TITLE       'NCS07'.
FILE HANDLE  Ncs07
             /NAME='Ncs07.ASC'
             /LRECL=14380.

DATA LIST    FILE = Ncs07 /
             Region              1 -     2
             Stratum             3 -     6
             SampleNu            7 -    10

. . .

             PostCode          596 -   605   (A)
             PhoneNum          606 -   617   (A)
             KindHome          618 -   618

VAR LABELS
             Region          'Region'
             Stratum         'Stratum'
             SampleNu        'Sample number'

. . .
             PostCode        'Zip code'
             PhoneNum        'Phone number'
             KindHome        'Building type'
. . .
VALUE LABELS
             KindHome        1 'Single family unit'
                             2 'Townhouse or duplex'
                             3 'Small apartment building'
                             4 'Large apartment building'
                             5 'Other kind of dwelling'/
```

2. ASCIIRELATIONAL Export

The Blaise ASCIIRELATIONAL export generates several or many ASCII files according to the pattern of *embedded* and *unembedded* blocks in the data model. The EMBEDDED keyword, when used in a block declaration, means that Blaise will store that block's data with those of its parent block. In ASCIIRELATIONAL export, every unembedded block's data will be exported in a separate ASCII data file. The Manipula program that does this is simple; the only difference between this setup and the one for ASCII export above is that the word ASCIIRELATIONAL is substituted for ASCII.

Generating metadata descriptions for each ASCIIRELATIONAL output file is more complex and more time consuming. The idea is that a sub-data model has to be constructed for each unembedded block. Cameleon can in fact produce these sub-data model definitions. Recent improvements to this process has automated this step (before, there was still considerable handwork that had to be done in order to prepare (that is, compile) each sub-data model). Once each sub-data model is prepared/compiled, then an SPSS or SAS Cameleon script has to be run on each. When that is done, then each output file will have a metadata description. As mentioned, this whole process can now be automated, but for a very large data model, the automated process can take well over an hour on a fast computer.

There are a few issues with ASCIIRELATIONAL export. There is a wide class of data models where ASCIIRELATIONAL export more or less approximates a true relational representation of the data in a relational database sense, and thus this method of export is suitable. However this is not always the case. In a relational database, there are *entities* and there is usually one database table per entity. In a transportation survey, entities may include *Household*, *Person*, *Work Place*, *Location*, *Day*, and *Trip*.

Let us consider the *Person* entity. It is possible, that for considerations of methodology and operability during data collection, that person-level data are collected in several blocks, each of which is unembedded (which is proper). In this example, you can have several export files that logically belong to one entity. In ASCIIRELATIONAL export for this data model, you have several different export files for this entity. A conclusion that you should draw is that the database structure that is suitable for data collection does not always have the same structure of the desired study database. When this is true, then the data model specification and programming should anticipate this difference.

Another issue with ASCIIRELATIONAL export is the way that linking is done internally in the Blaise proprietary database. Blaise uses downward pointers to link blocks, that is, the parent block points downwards to child blocks. This is not the way that relational databases do their linking. So there has to be a translation step if the data are to be imported into a true relational database. On the other hand, the method of Blaise linking may not make a difference if other downstream packages are used. One way to handle linking when exporting data to a relational structure, is to explicitly declare links between blocks within the data model, and use the data model's rules to assign appropriate (upward pointing) links to these fields within blocks. This is true for hierarchical as well as many-to-many data relationships.

3. Custom Export

A custom-built Manipula setup can be used when the structure of the Blaise data model does not correspond well to that of the output data files. This must be done on a block-by-block, or worse, on a field-by-field basis. For a data model of any size, the instructions to handle this translation can number in the hundreds or thousands of lines. Such a program can be developed by hand. This is the hard, prone to error, and is difficult to maintain. For example, if the data model definition changes, then someone must adapt the hand-programmed export setup as well.

A better way to produce the required custom export programs in Manipula is to let Cameleon generate them, based on metadata specification in the Blaise data model. This is what the National Agricultural Statistics Service does. As noted in section VII, 4 above, this organization generates over 40 CATI and Interactive Editing Blaise instruments every quarter based on a metadata specification. In addition to the generated instruments, the surrounding Manipula infrastructure for data import and export is also generated, using Cameleon, based on the generated data models. This is a high-level advanced technique, however it is worth considering where ASCIIRELATIONAL export does not suffice. See Pierzchala (1992) for details.

In order to enable this specialized technique, you have to consider how the field-level metadata should be stated, and someone has to write a generalized Cameleon setup that can interpret the Blaise metadata, in turn producing the required custom Manipula programs. If this is executed correctly, there are huge benefits. First, no one has to program huge Manipula setups. Second, if the data model changes, you just re-execute the Cameleon scripts to re-generate the Manipula programs and you're off and running. This is an example of letting the Blaise metadata drive the downstream processing. It is an enormously robust method of operating.

4. ASCII representation of Don't Know and Refusal

Where DK or refusal is a permitted response, Blaise extends the permitted range of answers to allow for them. So if you have five substantive answer categories (or a numeric range 1..5), Blaise will reserve code **8** for refusal and **9** for DK. If you have specified 9 as the top limit for the substantive answers, Blaise will reserve **98** and **99**. If you use, say, **1..120**, it will reserve **998** and **999**. So the DK and Refusal codes are always the final two digits of whatever range you specify. When exporting data, the Cameleon generated data descriptions always take into account extended field length due to DK and RF specification. For numeric questions, a common practice is to reduce the top number by 3 in order to avoid extended field lengths on output. For example, if 10,000 is an upper limit, then for all practical purposes, you can specify 9,997 as the upper limit. If it is possible that 9,997 will be exceeded, then it is possible that 10,000 would be too, and that the original specification is too low.

5. Open Blaise Architecture

A new capability called Open Blaise Architecture (OBA) will be released in version 4.5 sometime after the writing of this paper. OBA will have a new option or options for data export. You should check on these options when that version is released.

From DOS to Windows: Usability Issues for Interviewers

Diane Bushnell

Abstract

Social Survey Division (SSD) of the Office for National Statistics (ONS), UK employs approximately 700 interviewers at any time. The interviewers use laptops and computer-assisted interviewing for the vast majority of data collection. Since the late 1980s we have been using the Blaise software as our questionnaire development and interviewing tool, and all interviewing and support systems have been DOS based.

With the increasing use of Windows and Windows-based software, ONS are now at the stage of considering a move to the Windows operating environment for interviewing. This paper looks at the issues around a move to Windows, in terms of its usability by interviewers. It discusses new possibilities and constraints of using Windows-based software; interviewer views on usability; and training options for interviewers.

Keywords : Usability; Windows; Interviewers; CAI

1. Introduction

The majority of surveys carried out by the Social Survey Division (SSD) of the Office for National Statistics (ONS) are completed using computer-assisted interviewing (CAI). CAI, using Blaise software, was introduced for the Labour Force Survey in 1990 and for the majority of its other surveys from 1994.

The Windows operating system has been the ONS office standard for some time but the systems used for carrying out surveys remain DOS based for various reasons. A Windows version of Blaise, Blaise 4 Windows (B4W), has been available since the beginning of 1999. It has now been thoroughly tested and is used for survey data collection in Europe and in the USA. For the last few months we have been considering whether to move our interviewing systems to the Windows environment and if so, which issues need to be addressed.

In considering an impending move, ONS carried out a brief review of the move from Blaise 2 to Blaise III. This revealed some unanticipated problems at the time of the move, not particularly with the Blaise software, but mainly concerned with co-ordination of all the interviewing systems and with the amount of change occurring. Although we had thought that the transition would have little effect on interviewers, as there were only minor changes in the Blaise interface, in fact they were affected a great deal.

Two valuable lessons learnt from this exercise were that

- the implications of change must be considered for the whole interviewing process and not just for the part which is changing;
- interviewers' needs must be considered a high priority: the quality of our data is dependent on their ability to work with the interviewing systems.

These two points appear repeatedly in research on usability of CAI systems. Rather than reinventing the wheel, we thought it would be useful to work with usability guidelines and testing techniques when contemplating any further changes to interviewing systems.

This paper reports on the early stages of an ongoing project to manage the introduction of Blaise 4 Windows in Social Survey Division.

2. Why Move to Windows?

Over the last year, ONS has been evaluating the pros and cons of a move to the Windows environment for interviewing, and in particular a move to Blaise 4 Windows. Upgrading to new software is often thought to be rather straightforward and not worth worrying about. However, significant changes to software can sometimes lead to large costs in reprogramming and/or retraining. Unless the benefits from an upgrade are substantial then there may be good reasons not to change: after all, if something works why change it?

A paper presented at the 1998 International Blaise conference (Bushnell, 1998) discussed the costs and benefits of upgrading to new CAI software and the tools and strategies which could be adopted to facilitate an upgrade, reviewing the move from Blaise 2 to Blaise III and looking forward to the move to B4W.

Blaise 2 to Blaise III

Several years ago, the team at Statistics Netherlands responsible for producing Blaise decided that Blaise should move to a Windows environment but survey organisations using Blaise did not have the appropriate infrastructures for such a move. Improvements to Blaise 2 were long awaited so the Blaise team developed Blaise III as an interim measure. Blaise III was intended as a stepping stone to a Windows product: it is DOS based but was written so that it could be easily converted to Windows and the 'look and feel' was very similar to Windows applications.

Although the costs of moving to Blaise III were fairly large (substantial changes had to be made to every CAI questionnaire), the benefits were also large: the ability to build very large questionnaires, increased functionality in programming language, improvements in dealing with data external to the interview (e.g. lookup tables or coding files), improvements in movement through the questionnaire, new data formats for recording times, dates and verbatim responses to name a few.

Blaise III to B4W

A move to B4W would not net as many gains as the move to Blaise III, but the costs should be a lot lower. B4W and Blaise III were designed so that programs and data are fully compatible between the versions: i.e. a questionnaire written in Blaise III can be run in B4W and vice versa. The first version of B4W was intended to have exactly the same functionality as Blaise III so that it could be released quickly. However, in the end, some new features were included: vastly improved multi-media capabilities and a built in audit trail.

A move to the Windows operating system itself seems rather more problematic than the move to B4W. As well as considering the CAI software, we must also consider the surrounding support systems, such as case management and transmission systems. All our existing systems are DOS based and would need to be rewritten. In addition, the interviewers' laptops would have to be upgraded to cope with the increased demands of Windows applications.

The main costs and benefits of a move to B4W are summarised below.

Benefits	**Costs**
New features of B4W: the multi-media changes would allow us to use Audio-CASI[1] and the audit trail would enable us to reconstruct lost or damaged data	Interviewers' laptops must be upgraded or replaced
Improved developer's environment: questionnaires can be written and tested more easily and quickly than in Blaise III	Interviewing support systems must be rewritten
Maintain or improve competitiveness in survey research market	Potential for data quality to be jeopardised while interviewers get used to new system
	Interviewers must be trained in new interviewing systems

Conclusions

Our first impression was that the benefits of upgrading to B4W were outweighed by the large costs involved. However, a review of software looking at Year 2000 compliance revealed that one of the components of the interviewing support systems would have to be rewritten. A decision was made to rewrite the system as a Windows application and so this meant that all the support systems would also have to be rewritten for Windows. In addition, routine replacement of interviewers laptops was already scheduled and these new laptops would have to be suitable for use with the new Windows support systems.

Since two of the major constraints on the B4W upgrade were effectively removed, and the cost of upgrading to B4W itself would be minor compared to replacing laptops and rewriting support systems, a decision was made to move to B4W as soon as practicable, subject to further evaluation of the impact on interviewers.

3. Usability

Couper (1994) notes the potential interviewers have to impact the data collection process but the minimal training they receive in the computer hardware and software and the diversity of their computer skills and knowledge.

The interviewer should therefore be considered an important, if not the *most* important, user of a CAI system since they are our primary link with the data source, the respondent.

In 1994, Couper proposed the idea of using research from the human-computer interaction field to evaluate CAI instruments. Since then studies have been carried out on particular aspects of CAI questionnaires, both for interviewers in standard CAI surveys and for respondents in self-administered survey instruments (e.g. Hansen, Fuchs & Couper, 1997; Hansen, Couper & Fuchs, 1998; Caspar & Barker, 1999).

[1] It is thought that the increased privacy resulting from the use of Audio-CASI (Audio computer-assisted self interviewing) can increase reports of sensitive or socially undesirable behaviour. The respondent is able to listen to a recorded voice playing through headphones and can enter responses directly into the laptop. Audio-CASI may also be used for populations with low levels of literacy where normal computer-assisted self interviewing would not be feasible.

Definitions of the usability of a system include

- "the focus of our attention turns from the system to the user. This means person-centred design rather than system-centred design" (Couper, 1994)
- The ability of users to "perform required use, operation service and supportive tasks with a minimum of stress and a maximum of efficiency (Woodson, 1981)
- "users can work with the application to easily and quickly achieve their goals" (Caspar and Barker, 1999)
- "how easy or difficult it is for users to interact with their CAI instruments and systems" (Hansen, Fuchs, Couper, 1997).

Our aim is to ensure that the transition to B4W is as easy as possible for our interviewers, rather than to look at the usability of Blaise as a CAI system. With that aim in mind, we have started to identify usability issues for a move to Windows and B4W; we will ask interviewers what usability means to them and we will use usability testing techniques to evaluate alternative ways of working, screen designs or training methods. In Sections 4 and 5, I will outline some of the work we have done to date. In Section 6, I discuss work planned for the coming months.

4. Usability Issues for a Move to Windows

Issues to consider when moving to Blaise 4 Windows fall naturally into two components: those issues arising from a change to a Windows environment and those particular to B4W.

Windows specific issues

1. Mouse or keyboard

One of the principal considerations for a move to Windows is whether interviewers should use a mouse for moving around the questionnaire or whether they should continue to use the keyboard, as in DOS-based applications.

The Windows environment is based primarily on using some type of pointing device, such as a mouse or trackball. Although key combinations can be used to achieve the same result, they are often very cumbersome and not always easy to discover. It is fairly obvious that using a mouse whilst interviewing will not be particularly easy: the interviewer may be holding the computer on his/her lap or on the arm of a chair so there may be no suitable place to use a mouse. Interviewers work in a wide variety of household situations where they have little control over the environment. In poor lighting conditions the interviewers may have trouble locating the cursor on the screen: in this case a trackball will be no better than a mouse.

Ultimately, the interviewer is only interested in interviewing and recording the answer given by the respondent and does not want to be distracted by searching for the cursor or trying to minimise or move windows about the screen. We have decided, since there are no clear advantages to using a mouse, that interviewers will continue to use key presses for moving around the questionnaire and accessing Blaise functions.

2. Ability to easily swap to other Windows applications

Although it may be useful for interviewers to have access to wordprocessing packages or email, the drawbacks are many. The ability to swap applications may also lead to accidental swapping out of the CAI software. For maximum gain from working with Windows, we would need to train interviewers to cope with opening, closing and swapping windows, recovering from an accidentally closed window and so on. This would greatly increase training costs. Moreover, it does not seem desirable to train interviewers to recover from problems caused by the software which have nothing to do with the interviewing process: it seems to detract from their task of interviewing.

3. Ease of loading new software

Software loaded by interviewers onto laptops could cause all sorts of problems with viruses or simply with incompatibility of applications. It would make the task of resolving queries from interviewers more difficult if we do not know the exact

configuration of their laptops and software. Some survey organisations in Europe permit interviewers to load personal software onto their laptops as long as it is checked by headquarters staff first. In ONS, this is simply not an option: we would not be willing or able to find resource for checking interviewers' software. We also need to know that all the interviewers are using the same methods for collecting and coding the data: we do not want interviewers to experiment with alternative applications.

4. Consistency of screen design and functionality across applications

Consistency across Windows applications can be very useful for everyday computer users. However, CAI software has a very particular purpose and specialised users. Interviewers are not likely to have access to other Windows software, especially if we decide to limit access on interviewing laptops, and so it is of little importance whether B4W looks and behaves similarly to other applications.

5. Ability to customise worktop, e.g. change colours, fonts, add icons etc.

The flexibility of Windows and the ease with which users may customise their workspace allows users to feel they have some control over their environment, and with respect to usability in general, is a desirable property of most software. However, we must remember that the aim of interviewing is for all respondents to receive a standardised interview. If each interview has a different look and feel to their questionnaire then interviews may no longer be standardised.

Changes to the font size may cause problems with questions 'falling off' the bottom of the screen so that the interviewer misses part of the question, instructions or response list or the font may be so small that it is difficult to read in some situations. Changing colours may mean that some parts of the screen cannot be seen properly or that parts of the question are unintentionally highlighted (or not highlighted when they are supposed to be).

So, it appears that the usual advantages associated with using Windows applications are not particularly relevant when using CAI software, and in some instances, these 'advantages' may actually be a disadvantage.

B4W specific issues

1. Consistency of key mapping

Generally, ONS's policy is to use the defaults provided by Blaise wherever possible unless there is a very good reason not to (e.g. in the move from Blaise 2 to Blaise III the default action attached to the function key F2 changed from <Save Data to disk> to <Delete case> – we decided there was serious danger of interviewers (or developers) deleting data if we used the new key mapping so we reverted back to the original). Blaise provides the possibility for questionnaire developers to change the defaults for function keys, menus, screen layout and some navigational functions but this can be a rather time consuming job. There is also scope for the introduction of errors if these changes are not passed on to the interviewer correctly. In order to take advantage of some of the flexibility in Blaise but to ensure consistency over all surveys, standard settings and configurations are provided for both developers and interviewers (Manners, 1998).

A continuation of our policy of using defaults will mean that interviewers will have to be trained in the new function keys and navigational behaviour, for no particularly good reason, other than that it is easier for questionnaire developers. Consistency over time is interrupted and may result in a brief increase in errors made by interviewers.

Another drawback of using the Windows compatible functionality is that it is more complicated than the previous DOS behaviour. The keystrokes are more complex, nearly all requiring two key presses, e.g. Ctrl-S, instead of using a single function key, e.g. F2. Interviewers are also required to act more often than in Blaise III, that is, in Blaise III they may only have to press Enter to accept the default choice whereas in B4W they often have to use press one or more keys. This drawback seems to imply that the usability of the software will decrease rather than increase.

2. Screen layout and design

B4W allows more flexibility with using colours and fonts for question text, instructions and so on, than Blaise III. Within the Blaise application, restrictions can be imposed so that only questionnaire developers may make changes and not interviewers:

this ensures consistency across all the interviews but allows us to take advantage of improved screen layouts and designs. The default font size in B4W is rather small so it is very likely that we will pick a larger, more legible font. We are also likely to allow some use of different colours to distinguish between different parts of the screen, e.g. interviewer instructions, question text and so on. Any changes to fonts or colours will be standard across all surveys and questionnaire developers will not be permitted to add their own customisations without making a specific case. We do not want interviewers to be bombarded with lurid screen designs nor to be confused about what particular colours signify.

We have found, when introducing colour for some telephone unit interviewers, that there can be problems with certain colour combinations, either inducing headaches or migraines or with people who are colour blind. We therefore plan to test some colour schemes before making a final decision. We may be able to allow interviewers to select from a small choice of colour schemes, but the disadvantage of this is that developers would have to check their questionnaire in all the schemes to make sure that questions were appearing as intended.

5. What Does Usability Mean to Interviewers?

Brown (1988) comments "One of the most useful design philosophies for developing user-oriented human-computer interfaces considers the computer system simply as a tool to aid the user in performing tasks". Usability, by definition, is all about user-centred design. It seems sensible, therefore, to ask the interviewers, the users of the CAI systems, what usability means to them.

To get some initial ideas, I consulted a group of five interviewers with varying degrees of expertise in interviewing and in computing. After an initial introduction, I asked the interviewers:

- What are the goals you are aiming to achieve?
- What will enable you to reach those goals easily and efficiently?
- What can be done in the move to B4W which will make life easier?
- How should any training for the move be carried out?

The Goal of Interviewing

Interviewers considered their goals were:

- to collect accurate information, quickly and easily AND
- to transfer information accurately and quickly into the Blaise questionnaire.

As well as interviewing, ONS interviewers also complete some work at home: they may complete coding (e.g. of occupation and industry); enter paper diaries (e.g. travel diaries for all members of the household); complete administrative details (e.g. the outcome of the call, number and timing of calls to the household); or submit pay claims.

Therefore, it is important to consider the work done by interviewers at home as well as interviewing completed in the household.

What Enables Interviewers to Reach Their Goal Easily and Efficiently?

The most important issue for the interviewers was that rapport should be maintained with respondents throughout the interview. Anything which detracted from concentrating on the interview was undesirable. Interviewers felt that

- the software should not demand so much attention that eye contact was restricted
- movement around the questionnaire should be straightforward and fast
- it should be relatively difficult to delete data (either at questions or whole interviews)
- there should be a clear differentiation between question text (which is read to respondents) and interviewers instructions

- it should not be possible to switch the laptop off by mistake (this followed from a problem with a particular make of laptop)
- there should be a clear reason why questions are asked (sometimes questions are apparently replicated and interviewers are confused by this)
- there should be more training in the laptop systems (e.g. using modems, case management systems) rather than a concentration on the questionnaire
- training instructions and help desk replies should be in plain English, without making assumptions of interviewers experience or knowledge of computers
- function keys should be the same in all the laptop systems (e.g. the mechanism for making a note should be the same in the questionnaire as in the case management or pay claim systems)

Moving to Blaise 4 Windows

The interviewers discussed a variety of issues under this heading. The two issues generating most discussion follow were:

a. Function keys

One of the main decisions to be made in moving to B4W concerned the mapping of functions, such as adding interviewer notes to the data file. Since using a mouse or pointing device of some sort has been ruled out for the moment (see Section 4) the interviewers must continue using function keys or key combinations for a variety of situations. I asked the interviewers whether they would prefer to keep the key functions the same as they are now in Blaise III; move to the new B4W defaults which are Windows compatible; move to a new system especially devised to be as consistent and logical as possible; or move to a menu-based system.

My hypothesis was that the interviewers would prefer as little change as possible. In practice, the interviewers thought that the existing key functions were not particularly easy to remember or use and were not especially attached to them. The majority liked the idea of a menu-based system, which they had some experience of from the case management system. They thought menus would be particularly useful for working at home: they would not have to remember every function – only the ones used most often in interviewing.

Most of the interviewers were also keen on moving to Windows-based function keys. They thought that the office should keep up with progress rather than staying with the past.

The interviewers' reactions were somewhat surprising, although the explanations they gave for choosing these options were very logical. Without actually consulting the interviewers, we may have ruled out these options without trying them. We will test the practicalities of these options later in the year.

b. Screen customisation

Some of the interviewers thought that it would be useful to use colours more in designing screens. They thought it would enable distinctions to be made more easily between question text, interviewer instructions, question help and so on. None of the interviewers were particularly interested in customising their own colour combinations and could see that this might cause problems.

Interviewer Training

Options available for B4W training are:

- personal training
- home study
- no training.

Personal training could be presented by headquarters staff or by local field managers. Home study could comprise video or audio presentations, an on-line tutorial, comprehensive paper notes, short notes on basic changes or some combination or these options.

Personal training is a very expensive option, especially when carried out at headquarters (HQ) office in London. The time spent producing, presenting and receiving the training, as well as interviewers' travelling costs and time must be paid for. Local training by field managers would reduce some costs but would also require that field managers receive extra training. This could result in variation in the training received by interviewers, depending on the extent to which the field managers are able to master the training themselves, and on their abilities to train others in computing issues. The advantage of personal training, of course, is that each interviewer is guaranteed to receive a standardised training package and that they will complete the training. There is a possibility with home study that interviewers may stop part way through or miss some sections. With personal training, the trainers can cater for all levels of expertise and can ensure that any interviewers with problems are followed up.

Home study is much cheaper: time will be spent preparing the training and interviewers will be paid study time but there are no costs of travelling or subsistence. However, with home study it is more difficult to get the right message across and to cater for individual needs; it is not possible to see where interviewers are getting stuck and, as mentioned above, interviewers may not complete the training programme. On the plus side, apart from costs, interviewers can proceed at their own pace and at their own convenience.

A combination of personal and home study may be the best option: interviewers could complete some home study and be assessed by field managers or by completing a 'test' questionnaire, interviewers requiring further training could receive extra tutorials. However, this is also likely to be the most expensive option and as such, the least feasible.

The option of providing no formal training at all is, on the face of it, the cheapest option of all. Interviewers could be sent some training cases for the surveys they are currently working on and left to figure out the changes on their own. However, this could lead to interviewers losing confidence in the interviewing system and in their own ability to conduct a high quality interview. In the worst case, it could lead to interviewers making mistakes in data capture and therefore to a decrease in data quality: these are costs we would not be prepared to disregard.

When asked which training presentation they thought would work best all the interviewers preferred home study. Their preferences for training methods were:

- video training – although this could prove fairly expensive one interviewer had the idea that each local field manager could receive a video and arrange to loan the tape to individual interviewers in his/her area. S/he could then find out how they had got on with the training and any problems they were having
- on-line tutorial – a tutorial could be written in Blaise itself and presented on the laptop
- brief notes outlining the basic changes, combined with a template which they could carry around with them, perhaps followed later by more sophisticated instructions once the basics were mastered.

6. The Next Stage: Usability Testing

In the next few months we will be consulting more interviewers about usability, talking to field management staff and carrying out some experiments to test various ideas.

Windows

In Section 4 above, I discussed the various issues surrounding the use of Windows for interviewing. Our initial reaction is that the safest way forward is to restrict access to Windows as much as possible. There are all sorts of aspects to the Windows environment which are likely to cause interviewers problems and which we feel would detract from the interviewers task.

Ideally, we would like to replace the Windows default shell (desktop) with our own interface so that when the interviewers switch on their they will go straight to the case management system. We will switch off access to a pointing device and prevent interviewers closing or minimising windows.

In future years we would like to incorporate access to wordprocessing software or other windows options into the case management shell so that the interviewers can use some Windows applications but under controlled conditions.

Blaise 4 Windows

We plan to carry out some usability trials based on comments made by the interviewers: we will compare different colours and font sizes in the screen design and look at whether choosing from menus can be used during the interview and at home.

We will need to check that the decisions made on function keys, fonts etc. made for B4W are also carried through in the surrounding laptop systems, such as the case management system.

When decisions have been made on the various options, standard configuration files will be constructed and these will be used by all questionnaire developers to ensure consistency for all interviewers and surveys.

Interviewer Training

In the next few months we hope to carry out an experiment to compare different training methods and materials with small groups of interviewers. Depending on the resources available we would like to compare groups receiving

- No training, and
- Basic training – template of function keys; short note on changes

against one or more of the following

- On-line tutorial
- Audio tutorial
- Video training package.

After completing the training at home, the interviewers would complete a mock interview (via audio or video tape or over the telephone, as yet undecided) and the resulting interview would be transmitted back to the office. B4W has the facility to allow an audit trail of the interview so that the keystrokes and functions that are used by the interviewer can be recorded and analysed. The length of the interview and time spent in various sections of the interview or using certain functions can be examined; also whether particular functions were used and how successful interviewers were in using them. The outcome measures proposed by Shneiderman (1992) may be used.

Ideally, these interviewers would then be invited to headquarters so that they could complete some more interviewers and be examined in person, or even videoed so that further analysis could be completed later and interviews compared.

By comparing interviewers who receive no training, basic training and some more complex training package we can evaluate the outcomes against costs and ask interviewers which methods they prefer. We may find that interviewers are able to pick up on changes to the software with no training at all but that it has an impact on confidence or that interviewers receiving advanced training show no difference in outcomes from those receiving basic training (at much less cost).

7. Summary

Despite applying usability principles and guidelines on rather a modest scale in comparison to some other organisations, ONS has already found them to provide a valuable framework for evaluating the move from a DOS to Windows based environment for interviewing.

In the next few months, we will proceed with our evaluation and carry out some small scale usability trials. We hope also to expand our testing to include the whole interviewing system, rather than just B4W. It is of little relevance to interviewers to know that they are using three or four different software applications in order to complete their interviewing task: they are simply using a laptop and software to carry out an interview and enter data.

It is our task to make the interviewing process as easy as possible for interviewers: we hope to achieve that task by continuing to be guided by usability principles.

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THE TADEQ PROJECT, STATE OF AFFAIRS

Summary: National Statistical Institutes, research institutes, and commercial marketing research organisations are more and more using computer-assisted interviewing (CAI) systems for collecting survey data. The growing possibilities of computer hardware and software have made it possible to develop very large, and complex electronic questionnaires. Unfortunately, it also has become more and more difficult for developers, interviewers, supervisors, and managers to keep control of the content and structure of CAI instruments. The TADEQ Project aims at developing a tool to make a readable and understandable documentation of an electronic questionnaire. This contribution presents an short overview of the project, and describes the current state of affairs.

Keywords: Electronic questionnaires, Documentation, XML

1. Introduction

National Statistical Institutes, research institutes, and commercial marketing research organisations are more and more using computer-assisted interviewing (CAI) systems for collecting survey data. They replace paper questionnaires by a computer program that guides respondents through the questionnaire and checks the answers on the spot. The growing possibilities of computer hardware and software have made it possible to develop very large, and complex electronic questionnaires. Unfortunately, it also has become more and more difficult for developers, interviewers, supervisors, and managers to keep control of the content and structure of CAI instruments.

The TADEQ Project aims at developing a tool to make a readable and understandable presentation of an electronic questionnaire. TADEQ stands for Tool for the Analysis and Documentation of Electronic Questionnaires. It is a Fourth Framework Research Project of the European Union. Institutes from five different countries co-operate in this project: Statistics Netherlands, the Technical University of Vienna (Austria), the Office for National Statistics (UK), Statistics Finland, and the Instituto Nacional de Estatística (Portugal).

TADEQ will be an open tool. It will offer facilities to create interfaces to various computer assisted interviewing systems. However, the focus is on Blaise. The open approach requires a neutral way to describe how an electronic questionnaire is executed. For this purpose the Questionnaire Documentation Language (QDL) has been developed. It is based on XML.

The documentation tool must be able to produce human-readable documentation both in paper and electronic form. On the one hand, this tool must be able to show

the global structure of the questionnaire, and on the other, it must provide means to focus on the details of parts of the questionnaire. A particular challenge of the TADEQ project is to display the routing graph of large and complex questionnaires. Due to the limited size of a sheet of paper and a computer screen, this is not a simple task. It must be accomplished without affecting the readability, so a lot of attention must be paid to layout issues.

Questionnaire documentation will be used by different people involved in the survey process. Examples are the questionnaire developer, who wants to document his work, the survey manager who has to give a formal approval for carrying out the survey, and the interviewers, who want paper documentation of the questionnaire to help them in the preparation and execution of their fieldwork. Different users mean different formats of the questionnaire documentation. So, a proposed documentation tool must be flexible. Users of this tool must have some control on adjusting the documentation. Research must be used to show what is required by whom.

The TADEQ project aims at developing a documentation tool that is at least capable of generating two types of documentation. In the first place, there will be textual documentation. It focuses on giving detailed information on all questionnaire objects (questions, checks, computations, etc). Routing information will be taken care of by attaching a condition to each questionnaire object. The questionnaire object will only be executed in situations in which the conditions are satisfied. A good example of this approach is the BAD system developed by the Office for National Statistics in the United Kingdom, see Andersen (1997).

The second type of documentation to be produced by TADEQ is a representation of the routing structure in graphical format. This type of documentation focuses more on the routing structure, and less on the details of the questionnaire objects. A limited amount of textual information can be displayed in the graph. Depending on the CAI system used, there is a choice: question identification names/numbers, question text (possibly in different languages), specification of the type of accepted answers, etc. The available amount of space in the graph is too limited to display all this information. Moreover it might affect readability. Therefore, a documentation tool must provide means to select the information shown, and possibly also means to display information in different ways, e.g. adjacent to the graph.

Some more information about the TADEQ project can be found in Bethlehem (1999).

2. The Questionnaire Documentation Language

To be able to describe what can happen during the execution of an electronic questionnaire, it is important to distinguish the different types of events that may occur and the conditions under which they occur. Examples of events are:

- Asking a question;

- Checking a relationship;
- Carrying out a computation.

The conditions under which these events happen are defined in the routing structure of the questionnaire. Depending on the type of computer assisted interviewing system, two approaches can be observed:

- GOTO oriented routing. These routing structures can either be unconditional (if attached to the answers to closed questions) or conditional (if attached to the outcome of logical expression). An example of such a CAI system is CASES.
- IF-THEN-ELSE oriented routing. This is more structural approach. The execution of blocks of questions depends on the value of a logical expression. An example of such a CAI system is Blaise.

The Questionnaire Definition Language (QDL) must be capable to cope with all possible events and routing structures. QDL is based on XML (Extended Markup Language). XML can be seen as the future successor of HTML, the language that is used to make web sites. HTML has the disadvantage that it is a mix of describing structure and layout. Moreover, the language is not extensible. XML is much more powerful. Users can define their own language elements, and structure is separated from layout. It is becoming more and more clear that XML is not only a powerful language for designing web sites, but that it is also very useful for defining the structure of data files. See also Boumphrey et al. (1998), or Morrison et al. (2000).

The XML language allows for the definition of the different events one might encounter in the execution of an electronic questionnaire. In QDL such events are called questionnaire object. Examples of questionnaire object are questions (various types), checks, computations, route instructions, sub-questionnaires, etc. Each object has a number of attributes, like a question text (for questions), logical expressions (for route instructions and checks), and arithmetical expressions (for computations).

TADEQ expects the questionnaire definition to be in QDL format. Because QDL is an XML application, the information can be processed in various ways. One way is to make use of an XML parser offered by Microsoft. This parser comes for free with the Internet Explorer 5.0 browser. It is a DLL-file (called MSXML.DLL), which can be used in a C++, Delphi, or Visual Basic program.

For textual documentation, another way is to make use of *style sheets*. They offer a means of defining layout for an XML document. One way of doing this is using XSL (Extended Stylesheet Language). The advantage of a style sheet is that it is fairly simple for users to define their own layout formats. However, style sheets have their limitations. The approach of creating a dedicated layout module using the XML parser offers more possibilities. TADEQ will only offer some basic examples of XSL style sheets. Of course, users can always create their own XSL style sheets.

To illustrate how TADEQ works, we will use a simple example of a Blaise questionnaire. The data model for this example is presented in figure 2.1. It contains a number of nested IF-statements and a check.

Figure 2.1. The Blaise data model

```
DATAMODEL Commuter "The Commuting Survey"

FIELDS
  Sex        "What is your sex?": (Male, Female)
  Age        "What is your age?": 0..120
  MarStat    "What is your marital status?":
             (NeverMar "Never married",
              Married  "Married",
              Divorced "Divorced",
              Widowed  "Widowed")
  Work       "Do you have a paid job?": (Yes, No)
  DistWork   "What is the distance to work?": 0..300
  TypeWork   "What type of work do you have?": string[40]
  LookWork   "Are you looking for a job?": (Yes, No)
  School     "Are you still going to school?": (Yes, No)
  DistSchool "What is the distance to school?": 0..300
  Activity   "What is your main activity?": string[40]

 RULES
   Sex Age MarStat
   IF Age < 15 THEN
     School
     IF School = Yes THEN
       DistSchool
     ELSE
       Activity
     ENDIF
     MarStat = NeverMar
   ELSE
     Work
     IF Work = No THEN
       LookWork
     ELSE
       TypeWork DistWork
     ENDIF
   ENDIF

ENDMODEL
```

To be able to process the metadata, TADEQ must translate the data model into QDL. It should be realised that QDL not meant to mimic the Blaise language or the authoring language of any other CAI system. The objective of QDL to describe what can happen during the execution of an electronic questionnaire. So it is a description of the events that can happen and the conditions under which they can happen.

The basic building block of QDL is the Questionnaire Object. Examples of Questionnaire Objects are question objects (various types), navigation objects (IF-THEN-ELSE, GOTO, Loop), computation objects, check objects, etc.

Figure 2.2 contains an example of a question object. It is a closed question with two possible answers. Each Questionnaire Object has a unique name and sequence number. In this example there is only one question text, but QDL allows for more than one. The attribute `max` of the `<closed>` tag indicates how many answers are allowed. For each possible answer the specification contains an `<item>` tag. Note the use of CDATA to specify plain text. This prevents special symbols in the text to be interpreted as XML tags.

Figure 2.2. A question object in QDL

```
<qobject number="1" name="Sex">
  <question>
    <text><![CDATA[What is your sex?]]></text>
    <closed max="1">
      <item code="1" name="Male">
        <text><![CDATA[Male]]></text>
      </item>
      <item code="2" name="Female">
        <text><![CDATA[Female]]></text>
      </item>
    </closed>
    <status><![CDATA[ask]]></status>
  </question>
</qobject>
```

Figure 2.3 shows how an IF-THEN-ELSE structure is specified in QDL. Such a structure is identified by means of a `<split>` tag. The logical expression to be evaluated can be found between the `<condition>` tags. If the expression turns out to be true, part of the questionnaire between the `<if_true>` tags is executed, and if it is false, the part between the `<if_false>` tags is carried out. Note that a `<text>` tag will be included after the `<condition>` tag if an explanatory text is added to the condition.

Figure 2.3. An IF-THEN-ELSE structure in QDL.

```
<qobject number="4" name="Condition">
  <split>
    <condition><![CDATA[Age < 15]]></condition>
    <if_true>
      <qobject number="5" name="School">
        <question>
        . . .
        </question>
      </qobject>
      . . .
    </if_true>
    <if_false>
      <qobject number="10" name="Work">
        <question>
        . . .
        </question>
      </qobject>
      . . .
    </if_false>
   </split>
</qobject>
```

A final example of a QDL object is the check specified in figure 2.4. The attribute `type` of the `<check>` tag indicates whether this a hard check or a soft check (signal). Although this example does not show it, a list of involved questions can be included in the specification. Also an explanatory text can be included.

Figure 2.4. A check in QDL

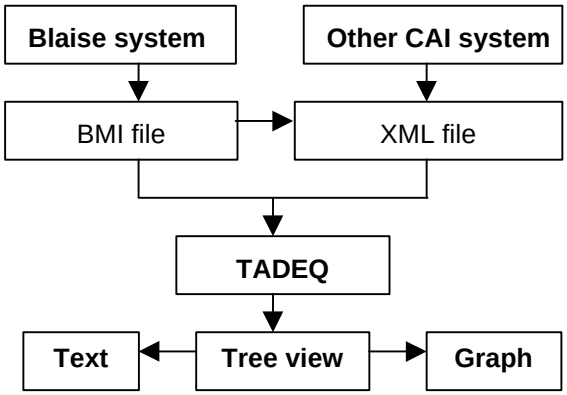
```
<qobject number="9" name="Check">
   <check type="hard">
     <condition><![CDATA[MarStat = NeverMar]]></condition>
   </check>
</qobject>
```

The questionnaire specification in QDL forms the input for TADEQ. The subsequent sections describe what TADEQ can do with this input.

3. The architecture of TADEQ

TADEQ must be able to produce textual and graphical documentation both in electronic and paper form. Starting point always is the electronic version of the documentation. The users can interactively set display and layout settings, and fold or unfold sub-questionnaires. If they are satisfied with the result, they can instruct the program to print the documentation. Figure 3.1 below summarises the current architecture of TADEQ prototype.

Figure 3.1. The architecture of the TADEQ prototype



TADEQ accepts two types of input:

- A Blaise metadata file. For the Blaise system, there is a direct link between TADEQ and Blaise. TADEQ is able to read a Blaise metadata file (a so-called BMI file). Internally, TADEQ converts the BMI file into a QDL file using the Blaise API.
- A questionnaire specification in the form of a QDL document. This is an XML document satisfying the syntax rules specified in the TADEQ Data Type Definition (DTD).

The second type of input will serve all CAI packages, with the exception of Blaise. It means that for all these packages a conversion tool must be offered capable of

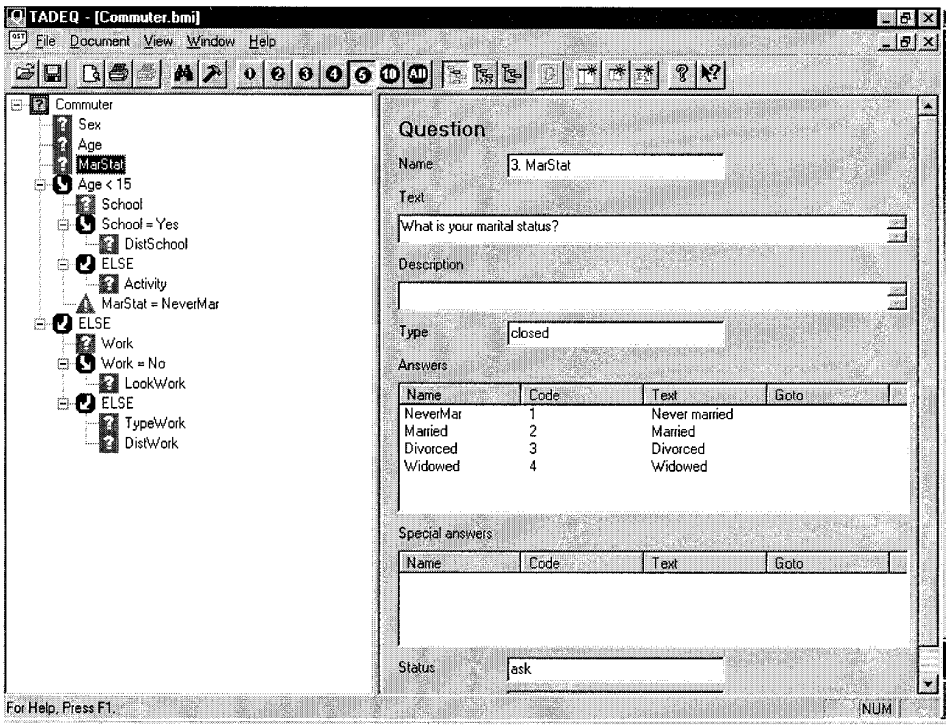
transforming the dedicated questionnaire definition format into an QDL document. This will be the responsibility of the developers of these packages.

Whatever the source of the information (Blaise or another CAI package), TADEQ will store the information always in an XML-document. Consequently, all parts of TADEQ producing output are able to read XML.

Microsoft has made available a DLL containing routines for parsing and processing XML files. The name of this file is MSXML.DLL, and it is available for free in the Internet Explorer Version 5 environment. This DLL can be used in a C++, Delphi, Visual Basic, Java, or Java Script program. TADEQ has been written in C++.

After reading in a QDL file, or reading a Blaise BMI file and transforming it into an QDL file, TADEQ will present the information on the screen in the form of a tree. See the left hand side of figure 3.2 for an example.

Figure 3.2. TADEQ screen with the questionnaire tree



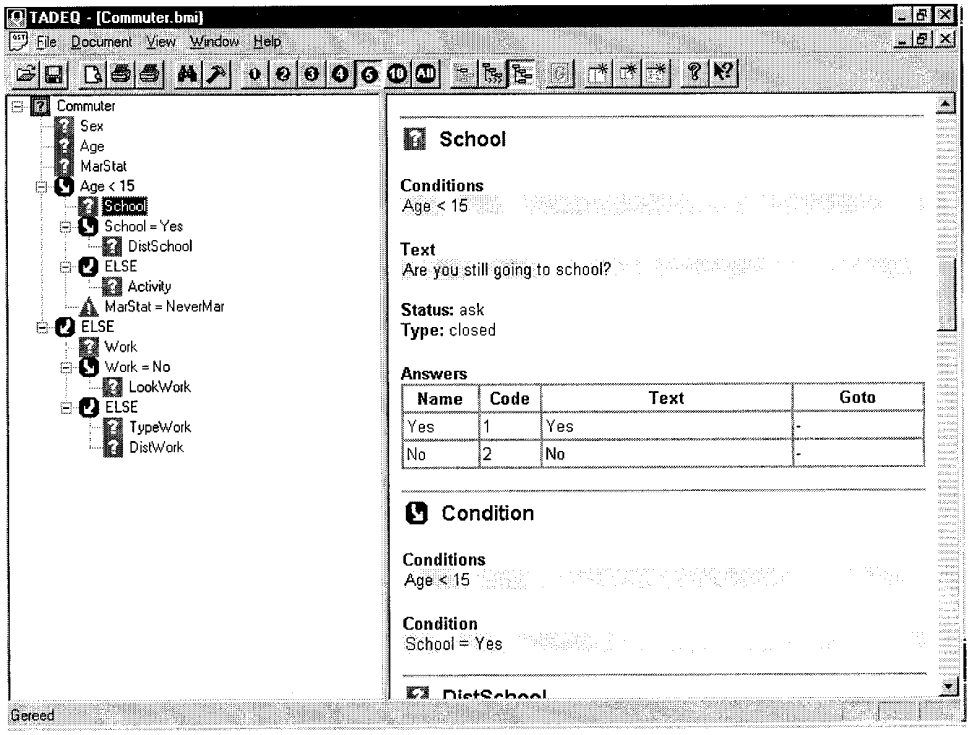
Each questionnaire object is represented by a small icon and a name. The various branches of the execution tree are indicated by means of indentation. Sub-branches may be *collapsed* (i.e. closed so that they are temporarily invisible) or *expanded* (i.e. opened so that the become visible). The tree can be used to navigate through the questionnaire, expand or collapse branches, and focus on specific parts of the questionnaire.

For the right hand side of the screen, the user can make a choice between two alternatives. The first one is *object information panel*. This panel displays all details of the object which has the focus in the tree on the left hand side. The right hand side

of figure 3.2 shows the information displayed for the question object MarStat. All tag and attribute texts of the question object can be found by scrolling through the panel.

An alternative for the right hand side of the screen is the complete *questionnaire documentation panel*. A choice for this panel will produce complete questionnaire documentation in HTML format. See the right hand side of figure 3.3 for an example.

Figure 3.3. TADEQ screen with HTML documentation



The user can scroll through this panel to see other parts of the document. If a questionnaire object contains a reference to another questionnaire object, the user can jump to that object by means of hypertext links.

Each object description starts with a list of conditions under which it will be executed. For example, the question School in figure 3.3 is only asked of people of age less than 15.

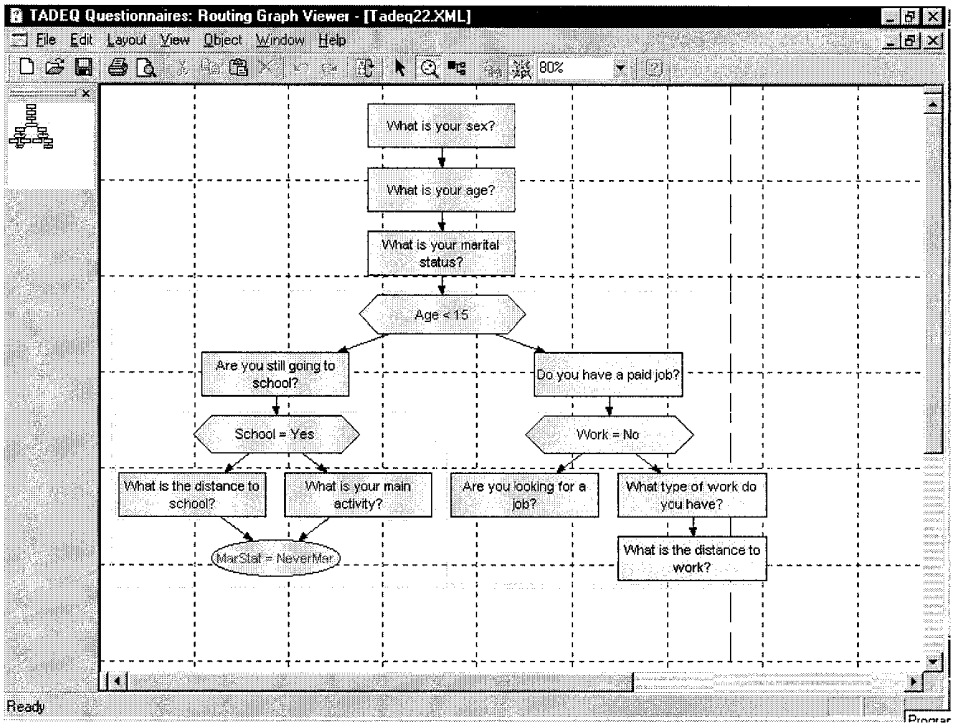
TADEQ has numerous display options. The tool supports multilingual questionnaire, so one can set the language of the documentation. It is also possible to set a filter controlling the type of object to be displayed (question, check, computation, etc). Another option allows the user to see only the last condition leading to the current object, or to display the complete list of conditions from the start of the questionnaire leading to this object.

The HTML documentation can be saved in a file for later use, like e.g. printing. The layout of the documentation is determined by a Cascading Style Sheet (CSS). By editing the CSS file, the user can change the appearance of the information in the files (font, font size, font colour, etc).

The HTML output of TADEQ can be read by MS Word. Once available in this word processor, the information can be easily turned into printable documentation. Note that MS Word sees object names as section headings. This allows for the creation of a table of contents with one mouse click.

To get more insight in the routing structure of the questionnaire, TADEQ can generate graphical output. For this it makes a call to a graph drawing routine (QDRAW). This routine uses the QDL file for input. Figure 3.4 shows an example of such a graph.

Figure 3.4. TADEQ screen with graphical output



The rectangle denotes a question. The hexagonal shape represents an IF-THEN-ELSE object where the left branch is followed if the condition is true and the right one if the condition is false. The oval shape denotes a check object.

The user will have a choice for displaying two types of information:

- A more technical and compact representation uses question names and mathematical expressions in the flowchart symbols;
- A more non-technical and readable representation will use question texts and explanatory texts in the flowchart symbols.

Like in the tree view, one can by simple clicking collapse or expand branches in this flow chart.

For this simple example, the graph fits on the screen. For larger questionnaires one can scroll through the graph. The small navigation in the upper left corner of the screen gives the user the possibility to quickly move to a different part of the graph.

The graph can be printed. Since the size of a sheet of paper is finite, printing poses special problems. Algorithms will be implemented in TADEQ to divide the graph over a number of sheets in a neat way, without cutting too many lines. Also, special reference symbols will be included, so that users can quickly find the spot on another sheet where a specific line is continued.

4. Future developments

TADEQ is still in development. One of the things that will be added is a number of analysis functions. With these functions one can obtain more insight in the structure of the routing. Several types of functions are considered.

There will be basic statistics, like frequencies of occurrence of the various types of questionnaire objects. Also, there probably will be statistics on the (weighted or unweighted) lengths of the various paths through the questionnaire. If the weight is the expected time to ask and answer a question, this may provide information about expected duration of interviews, and the variation in interviewing length.

More thorough analysis is possible if information is available on the frequencies with which questionnaire objects are encountered in interviews. Such information can be generated in two ways: (1) before the field work starts by randomly generating interview data that satisfy the routing conditions, and (2) after the fieldwork has been completed by processing the data file. Research is been carried out whether it is possible in a simple way to include such information in the QDL file. It implies every questionnaire will get an extra `<freq>` tag. It is probably not too difficult to fill the this tag for question objects, but more interesting analysis can be carried out if this tag can be filled for the decision objects (IF-THEN-ELSE, GOTO).

Another interesting function could be to evaluate all expressions encountered on a path through the questionnaire. This gives information about the characteristics of persons following this path. And it may even turn out that no one will be able to follow this path, because conditions contradict one another. Thus, this type of information would help to develop more balanced questionnaires. Unfortunately, this asks for developing a complete expression evaluator, which comes more or less down to re-building Blaise. One may wonder whether this is worth the effort. Another complication is that some expressions are impossible to evaluate because information is required that is not available at the time of testing (like values from external files).

Another the analyse the routing structure could be to reduce questionnaire tree to only those objects that play a role in routing decisions. This would result in only displaying the decision objects and the questions determining the value of the routing conditions.

5. References

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Papers Submitted but not Presented

Displaying a Complete Call History to Interviewers
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Central and Local Survey Administration through communicating data systems
Philippe Meunier, Insee

Displaying a Complete Call History to Interviewers

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Introduction

Interviewers and supervisors at the Iowa State University Statistical Laboratory prefer to have a complete call history available before dialing, particularly in studies where respondents are difficult to find and tracking of phone numbers is necessary. Although it is possible to display the dial results from CatiMana on the dial menu, only the results from the first call and the last four calls are available. For difficult studies, a paper Record of Calls is often kept so that all call attempts can be viewed, rather than using the autoscheduler available with Blaise.

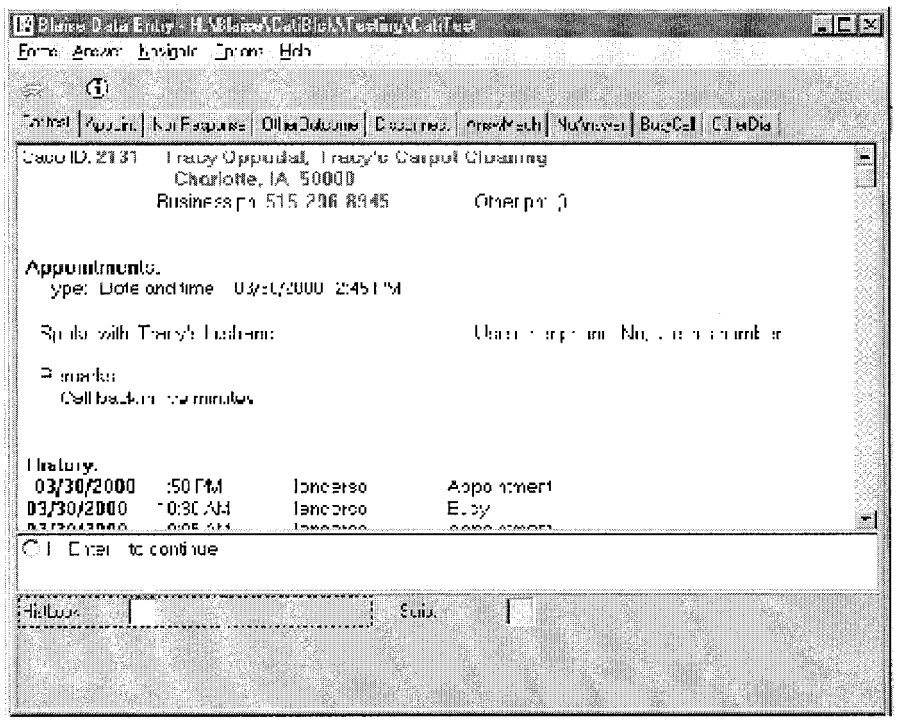
In an effort to provide interviewers with a complete call history, two approaches to this problem were explored. The first reads the history (.~th) file into a Blaise external file. This approach is not ideal because the external file can be updated only periodically, and information from the most recent dial attempts is not available to the interviewer. The second approach makes the call history part of the main data model, updating it after each dial. Both approaches display the call history for the case, together with details of the last appointment (from CatiMana) and other information in the appointment block, on one of the first infopanes.

In this paper, the two approaches are described. Details on programming statements are outlined to facilitate implementation.

Dial screen and call history screen

So that interviewers will view the history screen before dialing, Questionnaire was left as the only dial result option on the dial menu. After viewing the information on the dial screen, an interviewer enters the questionnaire, views the information on the call history screen, then moves to the introductory screen. Information displayed on the dial screen includes completion status of the interview, telephone, case ID, name, address, some personal information, and a possible comment from supervisors or interviewers. On the history screen (Figure 1), information displayed includes general information (case ID, name of respondent, address, and telephone number), appointment information (appointment type and time, with whom the interviewer spoke, and remarks), and the call history (date and time, who called, and dial result, starting with most recent dial). At the introductory screen, interviewers can choose one of the dial results, which are available as parallel blocks in tab format.

Figure 1. Call history screen (HistLook).



External file approach

Since the history (.~th) file, containing the complete call history, was already available, the first approach was to read it into an external file. Normally, these data may be viewed in the Blaise history viewer sorted by interviewer or date, but not by case. Reading it into an external file makes it possible to view all history records relating to a case when a form is opened.

The case ID, DialDate, DialTime, CallNumber, DialNumber, WhoPhoned, and DialResult fields from the history (~.th) file are read into the external file. Case ID, CallNumber, and DialNumber make up the primary key for the external file. DialDate and DialTime are the secondary key. The SEARCH and READ external file methods are used to find all records relating to a case.

A Blaise external file must have the Intranetware file properties of read-only and sharable. To update this file the read-only property must be changed to read-write and changed back after the ascii file is read in. If this is attempted while interviewers are working, the Blaise external file becomes unreadable. The history file must be updated while interviewers are not working (probably between shifts), and all dial attempts made during a shift will not be shown to the interviewers during that shift. This process could be put on a scheduler to run late at night, but during interviewing times it is not feasible because there is no set time for a shift to end.

Data model approach

The second approach of including all call history data as part of the data model ensures that the call history is always up-to-date and eliminates the read-in process. The data structure used for this is a nested array. In Blaise, a call is usually the set of all dial attempts made in one day. The block BDial stores information from the most recent dial attempt in fields DialNumber, WhoMade, DialTime, and DialResult. The block BCall stores information from all dials in one call, using the field DialStore, a nine-dimensional array of BDial. Finally, the field CallStore stores information from all calls as a 25-dimensional array of BCall.

This information is obtained from the Blaise CATI block CatiMana, which stores the results of the last four calls and the first call in the array CatiMana.CatiCall.RegsCalls. The most recent dial attempt information is in CatiMana.CatiCall.RegsCalls[1], which is overwritten on the next dial attempt in the same call.

Each new dial result must be stored in the proper instance of BDial within the proper instance of BCall. To prevent overwriting an instance of BDial which contains data from a previous dial, data are written to that instance only if the DialNumber field of BDial is empty or if it is equal to CatiMana.CatiCall.RegsCalls[1].NrOfDials. If DialNumber is empty, then nothing has been written in that instance of BDial. If DialNumber is equal to CatiMana.CatiCall.RegsCalls[1].NrOfDials, then the information in that instance of BDial is a busy dial, which by itself does not constitute a dial. A set number of busy dials constitute one dial. If one busy dial is made, and the next dial is no answer, the no answer dial will have the same dial number as the busy dial and will overwrite the busy dial. The fields WhoMade, DialTime, and DialResult within the block BDial are assigned the corresponding values from CatiMana.CatiCall.RegsCalls[1]. The DialNumber field is assigned the value of CatiMana.CatiCall.RegsCalls[1].NrOfDials after the other fields are written.

Similarly, the CallNumber field in BCall prevents writing current dial results to an instance of BCall which contains data from a previous call. CallNumber stores the value CatiMana.CatiCall.NrOfCall. If CallNumber is not empty and it is less than CatiMana.CatiCall.NrOfCall, then that instance of BCall contains results from a previous call. The import parameter Sgnl in BDial is set to 0 for all nine elements of DialStore in that instance of BCall to prevent writing current dial results. If CallNumber is empty or it equals CatiMana.CatiCall.NrOfCall, then that signifies that either this is the first dial of a new call or it is another dial of the current call. The import parameter Sgnl in BDial is set to 1, allowing it to write the new dial information in the first empty instance of BDial for the current call. CallNumber is then set to CatiMana.CatiCall.NrOfCall.

The following statements from the RULES section of BDial illustrate how DialNumber and the parameter Sgnl determine whether information will be written to an instance of BDial. The KEEP method (WhoMade.KEEP) saves information that is already stored in a field. DialNumber.KEEP makes that information available for use in the following IF statement. Information will be written if this instance of BDial pertains to the current dial of the current call.

```
RULES
  DialNumber.KEEP
  IF ((DialNumber <> EMPTY) AND
  (DialNumber < CatiMana.CatiCall.RegsCalls[1].NrOfDials)) OR (Sgnl = 0) THEN
     WhoMade.KEEP
     DialDate.KEEP
     DialTime.KEEP
     DialResult.KEEP
  ELSEIF Sgnl = 1 THEN
     WhoMade := CatiMana.CatiCall.RegsCalls[1].WhoMade
     DialDate := FirstDay +(CatiMana.CatiCall.RegsCalls[1].DayNumber) +(-1)
     {*** to prevent empty time field showing as 12:00 AM ****}
     IF  CatiMana.CatiCall.RegsCalls[1].DialTime <> EMPTY THEN
        DialTime := CatiMana.CatiCall.RegsCalls[1].DialTime
     ELSE DialTime := EMPTY
     ENDIF
     DialResult := ORD(CatiMana.CatiCall.RegsCalls[1].DialResult)
     DialNumber := CatiMana.CatiCall.RegsCalls[1].NrOfDials
  ENDIF
```

In the block BCall, a FOR..DO loop uses the statement DialStore[I].KEEP(0) to set the parameter Sgnl to 0 for all instances of BDial in a previous call. For the current call, looping from 1 to the current NrOfDials sets the parameter Sgnl to 1, allowing information to be written. The statements above prevent overwriting previous dials in the current call.

```
BLOCK BCall
   LOCALS I : INTEGER

   FIELDS
      CallNumber : 1..25
      DialStore : ARRAY[1..9] OF BDial

   AUXFIELDS
      NrOfDials : 1..9

   RULES
      CallNumber.KEEP
      IF (CallNumber <> EMPTY) AND (CallNumber < CatiMana.CatiCall.NrOfCall) THEN
         FOR I:= 1 TO 9 DO
            DialStore[I].KEEP(0)   {**** prevent writing in previous call****}
         ENDDO

      ELSEIF (CallNumber = EMPTY) OR (CallNumber = CatiMana.CatiCall.NrOfCall) THEN
         IF CatiMana.CatiCall.RegsCalls[1].NrOfDials > 0 THEN
            NrOfDials := CatiMana.CatiCall.RegsCalls[1].NrOfDials
            FOR  I := 1 TO NrOfDials DO
               DialStore[I](1)
            ENDDO
            CallNumber := CatiMana.CatiCall.NrOfCall
         ENDIF
      ENDIF
 ENDBLOCK
```

Displaying call history information on infopane

To represent the values for the enumerated field DialResult (from the external file) and AppointType and DayOfWeek (from CatiMana) as text on the infopane, three VAR arrays were created, with a text value for each element of the array assigned in the RULES section. The numerical value of the field, returned by the ORD function, was used as the index of the array to assign the proper text value.

For example, ApptFill is one of the VAR arrays. There are four possible values for AppointType, so ApptFill has four elements, each of which is assigned a text value. If the code for AppointType = 2, it is stored temporarily in the auxfield ApptType as 'Date and Time:'. This is illustrated in the following statements.

```
VAR
  DialRFill : ARRAY[0..8] OF STRING[17]
  ApptFill : ARRAY[1..4] OF STRING[30]
  DayFill : ARRAY[1..7] OF STRING[9]

RULES
  ApptFill[1] := 'No Preference'
  ApptFill[2] := 'Date and time:'
  ApptFill[3] := 'Period:'
  ApptFill[4] := 'Day of week:'
  ApptType := '  ' + ApptFill[(ORD(CatiMana.CatiAppoint.AppointType))]
```

All information is combined in temporary string auxfields, which are inserted as fill in the text of the auxfield HistLook. ApptType, ApptTime, and Days are auxfields holding information from CatiMana.CatiAppoint. Info is an array with one instance for each call number. Nested FOR..DO loops concatenate information from each dial within a call into one instance of the array, with line breaks between each dial.

```
FOR C := 1 TO CatiMana.CatiCall.NrOfCall DO
   Info[C] := ''
   FOR D :=  1 TO 9 DO
      IF HistKeep.CallStore[C].DialStore[D].DialTime <> EMPTY THEN
               Info[C] :=  '@B' +  DATETOSTR(HistKeep.CallStore[C].DialStore[D].DialDate)
                  + '@B' + '@|' + TIMETOSTR(HistKeep.CallStore[C].DialStore[D].DialTime)
                  + '@|@|' + HistKeep.CallStore[C].DialStore[D].WhoMade + '@|'  +
                   DialRFill[ORD(HistKeep.CallStore[C].DialStore[D].DialResult)] +
                   '@/ ' + Info[C]
      ENDIF
   ENDDO
ENDDO
```

Each instance of the array is then used as fill in the text of the auxfield HistLook, starting with the last or most recent dial, and is displayed on the infopane for HistLook.

Conclusion

Interviewers and supervisors believe they are better prepared to make a call when they have the complete call history of a case. It is helpful to know, for example, that a large number of no answer dials have been made, or that more than one appointment has been made in the past, or that none or few dial attempts have been made. Comments from interviewers on the external file approach have been very positive. The call history has given them the security of understanding the context of each call, which increases both their comfort level and their ability to handle the case appropriately.

So far, only the external file method has been put into use. When a case with a hard appointment comes up fifteen minutes after the scheduled time, it is useful to know that it was tried at the scheduled time and it was busy. With the external file method, that information will not be available. We plan to put the data model method into use so that the freshly updated information can be viewed by interviewers.

Acknowledgements

I would like to thank Mark Pierzchala of Westat for his suggestion of making the call history part of the main data model and Jim O'Reilly of Westat for suggesting a method of presenting the value of an enumerated field as a string. Thanks also to Dianne Anderson, Jan Larson, Allison Tyler, and Karen Fliehler for their comments and for help in testing the software and to Sarah Nusser for her comments.

CENTRAL AND LOCAL SURVEY ADMINISTRATION THROUGH COMMUNICATING DATA SYSTEMS

SUMMARY

Like any new data processing system, CAPI, which is used for household surveys at INSEE (Institut National de la Statistique et des Etudes Economiques - the French national institute of statistics and economic studies), has significantly changed the work of the various people involved: survey designers, survey administrators and interviewers.
The purpose of this contribution is to present INSEE's reflections regarding the organisation of the work of survey administrators following the reduction in data cleaning tasks linked to the introduction of CAPI. It involved evaluating the possibility of centralising data cleaning at the national level.
Some 150 administrators are employed in INSEE's 18 regional offices (RO) in Metropolitan France who manage a network of household interviewers (the 2 overseas regional offices have a specific organisation of their own). Their task is to organise the collection of data, manage the interviewers and clean the data collected at the questionnaire level.

The two main advantages of CAPI, compared to a questionnaire in hard-copy form, are data capture and verifications at source (on the interviewer's laptop).
The staff who were previously responsible for these two functions in the regional offices have either seen their activity disappear as far as data capture is concerned, or in relation to checking the data collected have seen a significant change in their work.
As the checking process now mainly takes place at the level of interviewers, the survey administrators' task relating to checking and correcting data from the questionnaires – data cleaning - has become extremely limited.

In the case of the administrators employed in the regional offices, data cleaning using CAPI consists in checking the data on the questionnaires collected from the households by the interviewers and correcting the data, where necessary. Each statistician-survey designer defines the checks to be carried out for his survey. They may be carried out mainly by means of:
- non-blocking checks confirmed at the time of collection;
- supplementary checks carried out on the administrator's workstation (with a different data model than the one on the collection device);
- "don't knows" or "refusals to answer";
- average interview time;
- the interviewers' comments attached to the questions, or a general comment attached to the questionnaire.

In the case of certain surveys, a second-level data cleaning, carried out by the statistician who designed the survey, is implemented in respect of certain questionnaires selected on the basis of predefined criteria. A third variant of the data model may be necessary if the checks are different from the ones to be used by the administrators.

Thus INSEE's first idea was to centralise this work at the national level (or in some regional offices), which would only consist of dealing with complex problems that had not been resolved by the checks on the interviewer's laptop. This work would necessitate a limited number of specialised staff. This organisation was expected to engender operational savings and improvements in quality (due to the skill of the personnel and the increased uniformity of the processing). The survey administrators in the regional offices would have at their disposal statistical tables for each interviewer for monitoring the collection and the quality (number of questionnaires answered, refusals to answer, questionnaires out of scope,...; average number of inconsistency messages ignored and unanswered questions, ...; average interview time, ...). They would not have access to the questionnaires, which would be transmitted directly to the national centre by the interviewer.

The heads of the regional household survey departments and statisticians-designers were consulted about this proposed new organisation of the work.

The results of this consultation revealed that the survey administrators' two main tasks - monitoring /evaluating the interviewers and checking data - were closely intermingled: data cleaning is an indissociable component of monitoring the interviewers' work. Through data cleaning, the administrator evaluates and checks the quality of the collection work. The administrator can then authorize the payment of the questionnaire.

The consultation showed that nationally centralised data clean would not spare regional administrators the necessity of checking some questionnaires, and would in fact lead to the duplication of work that is often closely

related: the opening and analysis of questionnaires, at the national level for the checking and possible correction of data, and at the regional level for monitoring the interviewer's work (particularly by means of accompanying interviewers during the survey and by *a posteriori* checking with the interviewees, by post or telephone). If the administrators could not have access to the questionnaires, then a system for returning information to them would be necessary, and this would be complex and expensive. Lastly, the administrator's access to the questionnaires and his knowledge of the interviewer's errors is an essential part of human resource management. The interviewer knows his administrator, who is nearby (thus precluding administration at national level) and he goes to that administrator for support and advice. The administrator therefore needs to be in a position to monitor and know about the whole of his work. INSEE took the view that this was essential for preserving and enhancing the quality of data collection by its network of 850 interviewers.

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The results of the study are set out below. These present firstly the problems raised if nationally centralised data cleaning is implemented in place of the current decentralised system divided between the regional offices. The second section compares the two systems, and shows that centralised data cleaning cannot be brought into general use for all types of surveys.

The plan used is as follows:

I. - THE PROBLEMS RAISED BY CENTRALISED ORGANISATION OF DATA CLEANING

1. - 1 The need for the regional collection offices (RO) to be able to consult and keep all the questionnaires
1.- 2. The needs for return of information from the data cleaning centre to the collection RO
1.-3. Contacts between the data cleaning centre and interviewers for data cleaning purposes
1. - 4. Contacts between the data cleaning centre and the collection RO

11 - COMPARISON OF THE TWO DATA CLEANING SYSTEMS: CENTRALISED OR DECENTRALISED

II. - 1. Data cleaning as a factor of monitoring the quality
II- 2. Data cleaning at the heart of survey management tasks
II - 3. Quality of the checking and correction of the data collected
II - 4. Diversified organisation of data cleaning depending on the survey concerned

I. - THE PROBLEMS RAISED BY CENTRALISED ORGANISATION OF DATA CLEANING

I. - 1. THE POSSIBILITY FOR THE COLLECTION RO TO CONSULT AND KEEP THE QUESTIONNAIRES

It seems essential for the questionnaires to be transferred to the collection RO, and kept there, in parallel with their transmission to the data cleaning centre, **to ensure that the interviewers' work is monitored** and for getting them to correct their errors during the survey - as soon as possible after the start of data collection. It is necessary for the questionnaires to be available in the collection RO to enable interviewers to be accompanied and the *a posteriori* checks to be carried out. It should be noted that organisation of a centralised data cleaning process would preclude the collection RO from modifying the questionnaires.

IT development work necessary would remain limited, and would be directed towards sequential transmission, with the collection RO receiving the questionnaires several hours after the site RO. Transmission after data cleaning is excluded, which although it would reduce the burden on the circuits would nonetheless result in the loss of a significant factor by preventing the RO from having the questionnaires as soon as they were transmitted by the interviewers.

I - 1.1. **The quality indicators,** necessary for pinpointing the questionnaires that need to be checked, **might not eliminate the need to consult questionnaires** for more detailed analysis. Moreover, the RO should be able to read any comments attached to the questions and the general comment, which generally denote a problem. The comments system in CAPI must be used fully by the interviewers. Its aim is to inform the administrators of their difficulties and their choices, for monitoring and data cleaning purposes.

In the "Assets" survey, the reason for a particular interviewer's short average interview time was explained, after his questionnaires were opened, by the fact that he was conducting his interviewing in HLM (social housing), where there were few positive replies regarding the holding of financial assets. In the "Journeys" survey (regional and paper-based, not in CAPI) an indicator of the mobility rate appeared low in the case of one interviewer in comparison with the average: after consulting the questionnaires, it emerged that a large proportion of retired people with a lower mobility rate than the average of the population, lived in this district. An indicator of a quantity of "don't knows" in reply to important questions makes it essential to consult the questionnaires, as does a quantity of non-blocking ignored checks.

A widespread custom in the regional survey departments - often on the instruction of the statistician-designer - is to analyse each interviewer's first three questionnaires, which he has to transmit rapidly, except where applicable in the case of recurrent surveys. This method is used to ascertain that the training has been assimilated and to correct any errors very quickly, particularly in the case of interviewers who have shown difficulties during the training. This analysis is the (or a) determining factor for deciding which interviewers to accompany at the beginning of the data collection. The experiences derived from actual cases will be kept for use in future training programmes (in the case of periodic surveys).

I 1.2. **The availability of the questionnaires in the collection RO is also important for its relations with the interviewers**. The interviewers need to know that they can obtain advice there. They may need to discuss certain questionnaires or certain problems encountered, over and above the comments procedure. More generally, it is important for the interviewers to know that their collection RO receives the product of their work. It is the ROs that manage them and supervise them. This consideration also has to be taken into account by the administrators.

I.1.3. In an organisation with a centralised data cleaning process, we have shown **the need for the RO to be able to consult the questionnaires. But they would not be able to modify them** - a task that would be carried out by the national centre(s).

Many of the people consulted think that this separation of the tasks is a factor of demotivation for the administrators in the regional survey departments. Opening the questionnaires, possibly spotting errors in them without being able to correct them themselves can be frustrating and may finally discourage them from consulting them. Moreover, the discovery of errors in the questionnaires should be notified to the national data cleaning centre.

In fact we are faced with what may appear to be duplication: the collection RO and the national data cleaning centre will each open questionnaires that raise problems, the former for monitoring the interviewers, and the latter for the

possible correction of data. One person consulted has devised a substantial range of monitoring and quality indicators to preclude the collection RO from opening the questionnaires. But would not this amount to installing a parallel system, using up equivalent resources?

Another suggestion is to consider that the consultation of questionnaires is different in character: general in the case of the collection RO, and highly targeted (on the variables to be checked) in the case of the national centre.

I. - 2 RETURN OF INFORMATION FROM THE DATA CLEANING CENTRE TO THE COLLECTION RO

I. - 2.1. The return of information is considered to be **just as essential as the transmission of the questionnaires** and for the same reasons, which **relate to monitoring the interviewers' work and quality**. It must comply with strict management rules establishing regular returns, especially at the start of collection, to enable reaction with the interviewers. The accumulation of knowledge resulting from the data cleaning will also be used for subsequent training programmes: in the case of the "Employment" survey, the collection ROs use lists of anomalies from the previous year (imprecise profession, incorrect adress of the firm, etc.) for the current year's training programmes. The administrators rely on cases encountered during data cleaning. One RO estimates that a quarter of the training time is devoted to examining and correcting errors committed the previous year.

This return of information might be done in the form of standardised detailed tables, each having a single objective (rate of data cleaning per interviewer, questions raising problems, etc.) and enabling comparison with other external data (e.g. division of the population by sex). But if the information is subtle, the administrative workload would be heavy for the national centre. Lastly, the fact that the RO would only have the original of the questionnaires (before any modifications made in the course of the data cleaning process) may be a disadvantage, for example for *a posteriori* checks.

The definition of these specifications would be a difficult task (the quality monitoring indicators would certainly have a subjective component), as would the IT developments necessary. The data transfer circuits would be encumbered by these returns to the RO, especially if there are several national data cleaning centres.

Lastly it would also be necessary to take into account in the RO's workload, the transmission to the national centre of errors that the RO have discovered during the consultation of the questionnaires, since they will not have been able to modify them.

The notion of data cleaning shared between the national centre and the collection RO, for example by having easier cases processed locally and complex cases by the centre, has not been envisaged. Apart from the difficulty of assessing the nature and importance of each of the cases, the complexity of the IT circuits to be implemented would rule this idea out altogether.

I. - 2.2. It should also be possible to standardise **the necessary, final information return phase to the interviewers** to a certain extent. The present situation differs from one RO to another. Some publish tables detailing each interviewer's errors. Further, the centralised organisation of the data cleaning process and the necessary return of information to the local centre would lead to increased saturation of the circuit from national centre - via collection RO – to interviewer, and this problem would have to be solved.

I.- 3. CONTACTS BETWEEN THE NATIONAL DATA CLEANING CENTRE AND THE INTERVIEWERS FOR DATA CLEANING PURPOSES

The consultations reveal that direct dealings between the national centre and the interviewers would be detrimental to the smooth running of the survey network, which is based on the unique relationship between the collection RO and the interviewer.

The collection RO should be the interviewer's one and only contact for relationship-related reasons on the one hand, and for reasons of organisation and efficiency of the work, on the other hand.

I. - 3.1 ASPECTS CONCERNING CONTACTS WITH THE INTERVIEWERS

It is essential that it is the individuals who have usual direct personal contacts with the interviewers who get in touch with them for the needs of data cleaning, in other words the person in charge of the survey or their direct

administrator, that is the unit that manages them. An interviewer can only receive instructions from someone near, that he knows. At present problems with interviewers result from lack of proximity. And proximity procures better quality.

Only the collection RO can ensure that requests for information are accepted by the interviewers, since the RO knows them, it trained them and it pays them. It is their immediate superior. Not to abide by this principle would represent a risk for quality, by weakening the team spirit built up between the collection RO and its interviewers. There is a strong psychological component in the relationship with the interviewers. It is necessary to know how to talk to them, to know their character and personality so as to avoid upsetting them. The national centre would simply look like a controller, and receiving criticism from such a person would be a bad experience for the interviewer. He would also be disconcerted by these two levels of administration and would wonder by whom and how his work is to be judged.

Moreover, **direct contacts by the national centre with the household are not considered desirable**. It has to be the interviewer who calls the household because they know each other already and relationships of trust have been established. Otherwise, it would have to be the RO to which the interviewer was attached, because the national centre is distant and can engender suspicions on the part of the household. Moreover, the interviewer as well as the collection RO would be bypassed.

I. - 3.2. ORGANISATION AND EFFICIENCY OF THE WORK IN THE NATIONAL CENTRE AND IN THE COLLECTION RO

Independently of the reasons set out above, direct contacts by the national centre with the interviewers would result in the national centre achieving lower productivity in its work of collecting information from the interviewers than the collection RO achieve:

- as the centre does not know the interviewer, it would have greater difficulty in obtaining satisfactory replies;
- it does not know the interviewer's timetable, hence when he can be contacted - the RO already have difficulty in contacting their own interviewers;
- as interviewers often work on several surveys at a time, they would experience an increase in the number of people contacting them that they would not know;
- the answers to the questions asked of the interviewer might perhaps have been obtainable from the collection RO.

The interviewers' relationships with the collection RO would also be distorted, thus damaging the quality of their joint work: on the one hand, the RO would lose their "power" over the interviewers, while on the other hand, the interviewers would tend to consider the national centre as their only contact.

The interviewers would accordingly be naturally prompted to build up a single relationship, as was seen in the RO when they applied directly to the RO's computer services department for loading the applications: they stopped visiting the survey department. The collection RO would then run the risk of having no return of information. It would have no knowledge of conversations between the interviewer and the national centre, and would no longer be able to monitor the interviewer correctly.

I.- 4. RELATIONSHIP BETWEEN THE NATIONAL DATA CLEANING CENTRE AND THE COLLECTION RO

We have just seen the negative consequences of possible direct dealings between the national centre and the interviewers. Unless it is decided that data cleaning must be done solely in the office, in other words autonomously within the national centre, the centre will have to obtain the necessary information from the collection RO - we have already seen the disadvantages of direct contacts with the interviewers, or even the households - , with the RO having the task of contacting the interviewer (or the household) where necessary.

The consultation has shown that **such relationships would be complex, posing the question of the benefit procured by centralised organisation of data cleaning, and that they would run the risk of rapidly ROying up, culminating in fact in data cleaning in the office at the national centre.**

The data cleaning process in CAPI is significantly reduced in comparison with traditional data cleaning, because the checks are integrated into the collection procedure. However, while the problems posed at the time of data cleaning are few, they are more complex. The national centre will have to find the relevant contact in the RO, who will not always be available (absent, part time, busy, etc.).

II - COMPARISON OF THE TWO DATA CLEANING SYSTEMS, CENTRALISED OR DECENTRALISED

As has been already pointed out in the previous section, ***the tasks grouped together under the word "data cleaning» have two functions: on the one hand to check and correct the data; and on the other hand, to monitor, evaluate and correct the work of the interviewers. These two functions are aimed at a single objective, quality.***

The monitoring of interviewers can only be done at the level of the collection RO, because it calls into play human relationships that call for reciprocal knowledge and proximity. This point has also been referred to above.

With centralised data cleaning, the national centre provides for the first function alone, sometimes with recourse to the collection RO. The regional office provides the second function, if there is a return of information.

It seems that we end up with an alternative: time saving versus quality. Indeed, in order to guarantee quality, the RO must be able to consult the questionnaires and exploit returns of information. In other words virtually do data cleaning work.

But data cleaning can be organised in more than one way and be adapted to the particular features of each survey, while at the same time an arrangement can be set in place that is as simple as possible, for reasons of rationality, in particular concerning IT developments and maintenance.

II. - 1. DATA CLEANING AS A FACTOR OF QUALITY MONITORING

For the collection RO, consulting the questionnaires pinpointed by the monitoring table indicators and comments, in fact boils down - at least in part - to carrying out a data cleaning task, except that they cannot modify the questionnaires. This work would continue during the exploitation of the returns of information in the case of centralised data cleaning.

In CAPI traditional data cleaning is reduced. But at the level of the collection RO, good interviewer monitoring necessitates consultation of the comments and confirmed checks, which will also be used as part of the content of subsequent training programmes (periodic surveys). Data cleaning enables malfunctions to be spotted in the course of collection so that the interviewers can then correct them. "*One becomes aware of the quality of the interviewers when one cleans data* ". When an interviewer is being accompanied by an administrator from the survey department (for the purpose of advice and evaluation), the administrator already has an impression of the interviewer's work, which he has been able to evaluate during the data cleaning process.

II. - 2. DATA CLEANING AT THE HEART OF SURVEY MANAGEMENT TASKS

Data cleaning is the last phase in the process of preparation, carrying out and monitoring a survey entrusted to an administrator. This process is a comprehensive whole which makes it possible to follow a survey operation from A to Z, right up to the supply of the data files to the designer. **For the administrator, centralised data cleaning would represent an amputation of part of his work**, which would mean that he would no longer be able to clearly appreciate the whole picture, and which would dispossess him, deprive him of responsibility and demotivate him.

The reduction of the data cleaning tasks linked to CAPI might lead to increased diversity of the administrators' tasks, which would be enriching and in the long run beneficial for the RO. Conversely, centralised organisation would be like assembly line work, with repetitiveness of tasks - especially in the case of ongoing surveys.

So far as training programmes in data cleaning are concerned, centralisation would reduce the costs of this. However, should one not take the view that training for a survey is a whole, and that data cleaning aspects answer questions that all the survey's administrators need to know, for advising and monitoring the interviewers?

II. - 3 QUALITY OF THE CHECKING AND CORRECTION OF THE DATA COLLECTED

Some of the people consulted consider that, in the case of those surveys that are still in the form of paper questionnaires, decentralised **data cleaning outside CAPI** in the various RO (for most surveys), results in **disparity in the quality of corrections**, and in saying this they are not calling into question the competence of the

personnel concerned. Centralised data cleaning would guarantee uniformity of processing, and would perhaps ensure a more rigorous follow-up of the data cleaning instructions. It should concern only difficult cases: significant number of inconsistency messages ignored, where a variable far exceeds the relevant threshold (e.g. rent > FRF 10,000), etc. Such cases might call for a very specialised skill, which all the RO might not have for all types of surveys.

Conversely, **data cleaning in CAPI automatically imposes a strong uniformity of processing**, hence fewer discrepancies in quality between the RO. On the other hand, a higher ranking administrator would be needed for supervising the work of the RO, for example the statistician-designer or a specialised RO, who oversees several hunROeds of questionnaires during the collection process (e.g. looking at how the RO processed the "don't knows" during data cleaning).

The section relating to the consultation of questionnaires by the RO (§I.-1) has shown by means of examples, the importance of proximity for better monitoring of the interviewer's work. This also applies to data cleaning as such. In a survey on household living conditions, where an interviewer has collected data on attacks and thefts incorrectly - and even if he appeared reliable when accompanied on the survey - this is only likely to be discovered by the local administrators, because they know the district where the interviewer operates. Likewise in the case of data relating to rent.

In return, the RO should pass on any problems of correction they have encountered to the designer, so that everyone benefits from the experiences of cases already dealt with.

II. - 4. DIVERSIFIED ORGANISATION OF DATA CLEANING DEPENDING ON THE SURVEY CONCERNED

Beyond the general views on data cleaning presented above, the consultations with certain survey designers have highlighted differing opinions, which can be explained by the particular characteristics of their surveys.

This leads to the concept of different data cleaning arrangements depending on the survey concerned.

In the opinion of the designers of the "Household assets" surveys and ongoing surveys of living conditions, the data cleaning process should be done at local RO level.

The designer of the "Rents and charges" survey is in favour of centralised data cleaning. His reasons seemed linked to the specific characteristics of that survey:

- Depending on the regional office concerned, the survey is run either by the survey department or by the prices department, which have different constraints. This leads to lack of uniformity in data cleaning which would be eliminated with centralisation.

- The deadlines are short, linked to the production of the rents - and prices - index every three months, leaving no time to go back to the interviewer to inform him of his errors, at least for the survey wave in question. The interviewer takes the comments into account for the following quarters. Occasional telephone calls are made by the administrators to ask for details. Moreover centralised data cleaning would undoubtedly save time, a fundamental aspect for the designer concerned.

- The (quarterly) survey takes place over one month, with 300 interviewers. Half of the interviewers have fewer than twenty questionnaires. **Hence the monitoring is only done on a small number of questionnaires**. It should be noted that provision would be made for consultation of the questionnaires by the RO.

- In small regional offices there is only one administrator for the survey, on account of the small number of questionnaires and the light workload that each represents. This poses the problem of the **minimum staff and workload required.**

- Lastly, data cleaning is humdrum work, of less interest to administrators than, for example, the ongoing survey of living conditions, part of which is different each quarter. Moreover, after the interviewers' CAPI apprenticeship period (rent bill posts), they will do very little data cleaning, and the designer will take charge of it.

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