An Executive Information System for General Hospitals
Sabina Beullens - K. U. Leuven

At the University Centre of Statistics of the Catholic University of Leuven a project is currently running in which it is the purpose to develop an Executive Information System (EIS) for general hospitals affiliated to the Administration Centre Caritas (ACC). In summary, ACC is a non-profit organisation having as members private catholic health care and welfare institutions in Belgium. ACC its purpose is to assist in carrying out administrative and organizational activities of those member institutions.

After a short explanation of the background of the project, this paper will answer the following basic questions concerning the development of an EIS:

. What information do the prospective users want?
. Where is the data for the EIS to come from?

Finally, the features of the EIS system will be demonstrated by means of a few examples from the designed prototype.

Background

The Administration Centre Caritas, founded in 1962, has grown to a professional and progressive organisation with purpose the automation of the several activities of the private and catholic welfare institutions in Belgium. ACC specialised itself and has 30 years of experience in developing many-sided information systems. These systems offer a solution for the rapidly evolving automation of the administrative, medical, medical-technical and technical functions in that sector.

The AZIS system, an integrated hospital information system, is an information system for general hospitals and runs on an IBM AS/400 computer. It provides functions for e.g.

- general administration: patient registration, medical registration
- medico-technical services: clinical laboratory, pharmacy, kidney dialysis, meal distribution, ...

This system is an excellent basis for an EIS. Besides that the management needs an overview of the general performance of the hospital. Thus the addition of an EIS is one of the priorities of ACC.

In 1992 a project started with the K.U. Leuven to design an EIS based on the AZIS hospital information system. After a first period of discussion a prototype was made to demonstrate the planned facilities. This prototype was demonstrated on a seminar for the general hospitals in March 1993. At the moment the work has started towards the real EIS application.
The EIS System: output

The aim is to develop a system for the management, the director or the executives of general hospitals. The presented information must help in making the right decisions for the hospital and aid in future planning. This means the application should be able to:

- combine data from different sources (the AZIS system and external sources)
- produce reports and graphics that can be used in the board of directors, the works council, the medical council, ...
- use drill down principles in reporting of hierarchical structured data
- treat data with a two-dimensional or three-dimensional hierarchical structure
- signal exceptions
- compare different periods

Of the first importance is to process the following information:

- patient information: patient discharges, patient length of stay, patient average lengths of stay, ...
- internal organisation of the hospital: day of admission into the hospital, day of discharge, occupation of the hospital beds, ...
- market situation: number of patients coming from a certain city and market shares
- financial information: receipts and expenditures, expenditures versus budget, balance-account, financial ratio's, ...
- personnel information: functions, age, wages, ...

The EIS System: input

Most of the data are stored on an IBM AS/400. The EIS will be developed on a PC under OS/2 (or eventually under Windows). We could use SAS/ACCESS software to AS/400 to have a transparent access to the data in the AS/400's integrated database. Another way is to use the IBM product PC Support with which AS/400 data can be accessed as though it had been data on an additional local disk drive on the PC. However, the access is not transparent and a flat file is needed. Despite that, the second possibility will probably be used because of:

- This solution does not cost in additional SAS products
- ACC is already familiar with the use of PC Support
  For example, it is already used to download quality control data in the clinical laboratory (The statistical quality control is done with the SAS system under DOS).
- The EIS data must not be updated every day. The download procedure will probably be started once a month.
Giving it a concrete form, it results in the following procedure:
The user selects the period he wants to download to the PC. The period is always given in
months. For example, download the information from January 1993 until March 1993.
It has to be defined what is meant with this period. For example, for the patient information
it is defined as to take all the patients discharged during that period and all the patients in the
hospital at the last day of the period. This definition gives us the opportunity to count the
number of discharges for that period, as well as the number of admissions and the number of
nursing days.

After this selection, meaningful information with respect to the EIS is selected and put in a flat
file on the "virtual disk".
The data are now processed by the SAS System. They are manipulated and summarised into
different SAS data-sets that will be used by the EIS.
Remark that because it is possible that data are afterwards updated on the AS/400, the same
period can be transported to the PC more than once. But a limit will be built in to prevent that
users download old data because of very small changes that does not give significant differences
in the results.

Furthermore there are several external data sources of interest: Market figures are needed to
calculate market shares, sector data are needed to situate the hospital, ...
These data are to be delivered by the ACC as SAS data sets.

The EIS System: prototype

The prototype was made with the developer's release of SAS Version 6.08 under Windows. It
uses the products SAS/BASE, SAS/GRAPH and SAS/AF. The application consists almost
entirely of FRAME entry's.
The user doesn't need the key-board. The application can be used with a mouse only.
Let us discuss three examples.

1. Financial information: expenditures

The problem here is that there are three different structures in the data:

. kind of expense (working-expenses, financial costs, …)
  with a dependent hierarchy of three levels
. place of the expenditure (hospitalisation services, medical-technical services, …)
  with a dependent hierarchy of three levels
. element of the cost price (maintenance, heating, administration, …)

The user wants to have the ability to go from one structure to another at every level in the
hierarchy. For example, it must be possible to show the working-expenses at the laboratory (a
medical-technical service) with administration as element of the cost price.
The constructed FRAME entry looks like this:
The main part of the entry is an extended table. The first column is the first level of the kind of expenditure. The second column is filled up with the expenditures for 1991 (The label says "DEC1991" but the figures are cumulative). The third column gives the figures for 1990 and the last column shows the percentage differences between the two years. To get the absolute differences, the user has to select the push button "Aanpassingen" and click on the right line on the pull-down menu he gets. Traffic lighting is used to report the differences. The user has the ability to drill down to the following level by clicking on a line in the first column.

At any time the user can go to the other structures (place of the expenditure and element of the cost price) by means of the push button "Aanpassingen". For example, pushing on "Bedrijfskosten" gives the different kinds of working-expenses. At this time, he can ask for a division of costs according to the place of the expenditure. This will be done for the working-expenses only because of its selection.

At the top of the right-hand corner we have different rectangles. The large one has the same meaning as the rectangles used in the objects of SAS/EISTM. It is used to drill down, to do a lateral drill, a drill without subsetting and to display a previous report.

The rectangle labeled "Maand 1" is designed to change the month of the second column. The first pair of arrows changes the date with one month. The pair of arrows underneath it changes the date with one year. The rectangle labeled "Maand 2" is the analogue for the third column. With the push button "Drukken" the report will be printed. It is possible to print more than two years and to include or exclude the differences. The reports are produced with PROC REPORT.

<table>
<thead>
<tr>
<th>Expenditure Type</th>
<th>DEC1991</th>
<th>DEC1990</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedrijfskosten</td>
<td>1,135,272</td>
<td>1,024,614</td>
<td>11</td>
</tr>
<tr>
<td>Financiële kosten</td>
<td>27,187</td>
<td>30,636</td>
<td>-11</td>
</tr>
<tr>
<td>Uitzonderlijke kosten</td>
<td>19,461</td>
<td>12,272</td>
<td>59</td>
</tr>
</tbody>
</table>
2. Patient information: number of patient discharges

The user gets a horizontal bar chart of the total number of patient discharges with year as midpoint variable and ward (surgery, medicine, paediatrics,...) as subgroup variable.
This graph is made at the moment the downloaded data are processed on the PC to construct the different SAS data-sets and is stored as a GRSEG catalog entry. It is displayed within a SAS/GRAPH output object. Clicking on a year changes the display in a horizontal bar chart for the selected year only but with month as midpointvariable. A lateral drill through the different years is possible.

As is the case for the first example, also here a report that compares several years is possible. As drill down variables are defined: ward, month and medical attendant.

3. Market situation

The FRAME entry gives a map of the area of medical attendance of the hospital. This area is defined as all the municipalities where the market share of the hospital is more than 5% or where the number of patients coming from that municipality is more than 5% of the total number of patients. Clicking on the name of a municipality results in detailed information on the number of patients and the market share.
Conclusion

This paper discussed the project currently running at the K.U. Leuven in which an Executive Information System must be designed for general hospitals on a PC with SAS Version 6.08. Most of the information is stored on an AS/400. Special care must be taken to define the relevant information and to the procedure to retrieve the information on the PC. Making a prototype is an important part of the discussion. The FRAME entry type of SAS/AF, which enable you to create a graphical user interface, is an excellent tool to use in developing such systems.

For further information, please contact:
S. Beullens
University Centre of Statistics
K.U. Leuven
De Croylaan 52A
B-3001 Heverlee
Belgium

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