Modernizing Corporate MIS: from Information System Modelling to Implementation

Emmanuel Dheur, John Ferguson, Reinoud Martens, Achille Petrilli, Barry Smale

Abstract

This paper presents CERN's Advanced Informatics Support (AIS) project which aims at an innovative modernisation of all aspects of informatics applied to the administrative processes of the Laboratory. The project which began in August 1990 is based on a non propriety operating system (UNIX), a relational data base system (Oracle RDBMS) and scalable multiprocessor server hardware (Silicon Graphics).

An analysis of the existing applications environment and its weaknesses is given in the introduction. The objectives of the project are then described. A justification of the strategic choices is given in the CERN context. An Information System Study leading to a global data and function model for the Laboratory, followed by detailed area analysis of the top three priority areas (foundation, accounting, purchasing). An analysis is made of the benefits and disadvantages of the use of Oracle CASE in such a study and the compromises required when commercial applications packages were chosen for accounting and purchasing.
1. Introduction

1.1. Past environment and problems

In recent years an audit of the administrative computing environment of the laboratory revealed many problem areas and emphasized the need for a reorganization of the set of corporate administrative applications and procedures. Figure 1 shows the status of applications and the relations between them in 1990. The applications were based on multiple operating systems (VM, VMS, DOS/VSE,.....) on multiple hardware platforms (IBM,DEC,HP) using a variety of file and data
base systems (IDMS/R,DL/1,VSAM,ORACLE). The transaction volumes involved are: 50,000 Purchase Orders per year, 70,000 Invoices received per year, 40,000 Invoices generated per year, 10,000 claims per year, 40,000 Store items handled per month, 20,000 Suppliers registered, 4000 people on the pay-roll, for a total of over 1,000,000 financial transactions per year.

The problem areas identified included the following:

- Inflexible data structures and functions.
- Lack of integration between applications.
- Duplication of data, incoherence between systems.
- Double data entry.
- Incoherent user interfaces to various systems.
- Difficulties in exploiting data spread over various systems.
- Difficulties in providing management coherent and correct information.
- High maintenance overhead. Of the 800,000 lines of Cobol application code which were in production in 1990, more than 70% was developed at CERN.
- Some systems were obsolete from a technical point of view and were to be replaced as soon as possible. (e.g. the stores system dates from before 1968, and runs partly on a HP1000 and partly on the central IBM mainframe).
- Some systems no longer corresponded to the requirements of the users or the organization (financial system, purchasing system).
- Some systems do not exist at all, like an integrated budget and project management system.

Figure 2 illustrates the incoherent hardware and software environment. This incoherence led naturally to messy interfacing of applications based on multiple incompatible data bases and operating systems.
1.2. AIS project objectives

In the Summer of 1990 the Director General initiated the Advanced Informatics Support (AIS) project aimed at an innovative modernization of all aspects of informatics applied to the administrative processes of the Laboratory. The objectives of the project included the following:

- Reduce the dependence on hardware and software suppliers resulting in more cost effective and flexible solutions for information systems:
- Replace all administrative applications with a coherent set, resulting in
  - the reduction of maintenance effort for the support of a heterogeneous environment
  - the implementation of a homogeneous user interface
  - the ability to provide high quality management information (high quality implies quick and reliable replies)
  - the ability to react quickly to requests for new information systems, enhancements or modifications
- Reduce the informatics gap between IT specialists and the user divisions.
- Reduce administrative overheads to a minimum
  - introduce procedures which are innovative and simplified
  - implementing paper-less procedures (including electronic signature) based on electronic document creation, routing and authorization.
  - collecting data at the source
  - reducing data entry, by introducing Electronic Document Interchange (EDI) with third parties
- Strive at minimum in-house development, and maximum use of standard commercial packages for implementing the functions. (20% in house 80% bought)
- Add missing functionality to the current offering especially:
• Project management facilities
• Executive information systems, allowing planning, budgeting, and forecasting.
• Archiving of scanned and machine readable documents
• Maximize portability and ease sharing of data between corporate administrative applications and other peripheral applications by using a unique platform independent RDBMS.
• Introduce a modern highly user-friendly human interface (at least to casual users).

All the above is summarized in Figure 3 as opposed to Figure 2.

1.3. Strategic Choices and their justification

• UNIX as an operating system (petrilli)
• decentralized processing (petrilli)
• scalable hardware SILICON (petrilli)
• client server architecture (petrilli)
• A single relational data base management system. ORACLE was also chosen since
  • ORACLE was already widely used by the scientific population of CERN,
  • ORACLE provides portability over nearly all the hardware platforms used at CERN
  • ORACLE expertise is available on site, a lot of ORACLE experience was acquired by CERN staff over the years.
  • ORACLE was considered to be sufficiently performant, reliable and mature for critical administrative applications.
• No distribution of data, but distribution of processing. Data is kept in central locations and can be shared by distributed applications. A CERN corporate data base which is both centralized and integrated will provide a sound foundation on top of which a coherent set of (distributed) information systems can be built. Since CERN has no remote sites, there is no need for a distributed data base. Several data base machines can exist, but the core information that is shared between many applications is residing on one machine.

• Use CASE to produce and maintain a global data and function model to ensure consistent and complete information and to eliminate duplicate data entry. Coherence must be obtained and maintained by the use of a central dictionary or encyclopedia, which contains the definitions of all important information and functions. For the support of the production phase of the application lifecycle, the system should also contain all relevant information on the usage of the data and functions, allowing cross referencing, and impact analysis, follow up of bug reports, enhancement requests, etc. This is essential to reduce maintenance cost and risk.

2. What and how we did it.

2.1. What

The strategy study and detailed area analysis for the various business areas were conducted using the structured approach for systems development as outlined in the ORACLE CASE*Method.

The tasks and deliverables of the methodology have been adapted to match the Terms of Reference of the AIS project.

The detailed analysis phase succeeded the Information Modelling phase, which resulted in a corporate information and function model. According to the adopted methodology the next phase should be ‘DESIGN’. In our case due to the policy decision to aim at a 80% bought, 20% in house development solution, the next phase was to be ‘package selection’. Then followed detailed specification of missing functionality, build of some critical functions, and transition software, user documentation and training, transition and production.
2.1.1. Information System Modelling, the CERN view

2.2.1. First Phase Activities

The CERN administrative services has as its principal aim to create excellent working conditions to support the scientific research of the Laboratory. In order to meet this challenge, flexible procedures and systems need to be in place.

Flexible, open, integrated information systems can provide decision makers with information required for daily tasks as well as support for the planning required to cope with changing conditions. The objective of the first phase of the Advanced Information Systems (AIS) project was, to provide the basis for information systems and their development that CERN administrative needs now and in the future in order to maintain and build upon the success that the Laboratory currently enjoys.

We started the Information System Modelling (ISM) (Strategy Stage of the CASE*Method) during the Summer 1990 in order to determine the functional and information requirements of administrative support. The Information Modelling study was initiated as a joint project between Oracle Corporation and CERN's Management Information Services group (MIS) and started on 17th July 1990. After a scoping exercise, the following objectives were identified for the Information Modelling study:

- Identify and document CERN's business functions
- Identify and document CERN's administrative information needs
- Provide an integrated information and function model
- Identify a logical path for application system development
- Identify organization and Information Technology (IT) issues related to system development

ISM resulted in the definition of a high level information systems model. This corporate model should serve as a basis for the implementation of the various information systems and should assure coherence throughout.

After two months of hard work the models, the findings during the elaboration of the models, and proposed systems were presented to CERN management. The final report describing the CERN information needs was published the September 19th. Thirteen potential applications were identified:

- Asset management,
- Budgeting and planning,
- Finance, Foundation,
- Health and Safety,
- Human Resource,
- Management,
- Logistics,
- Pay-roll & Claims,
- Project Management,
- Purchasing,
- Resource allocation/usage,
- Service Directory/Tracking,
- Stores management.

CERN management chose to tackle 4 of the 13 identified potential information systems with high priority.

2.2.2. Conduct of the Strategy Study

Two briefing sessions were held, outlining the steps to be taken during the study, following which 24 interviews were conducted with senior managers involved in the administrative activities carried out at CERN. The information gathered in these interviews was consolidated at regular intervals and any issues arising from these sessions were taken account of in subsequent interviews.

The business models (business direction, function and information) were derived and became the subject of two feedback sessions, conducted one and a half month after the briefing sessions, involving the study team members, interviewees and other members of CERN's management.

An Information Systems Strategy was developed taking into account the priorities defined by the Management Review Committee and logical dependencies derived from the function and information models. This was presented, along with estimates for the required development resources, to representatives of CERN's Divisions two months after the start of the study.

This report is the formal deliverable of the Information Modelling study containing conclusions and recommendations along with supporting detailed information.

2.2.3. Summary of findings, recommendations and potential benefits.

The Strategy study lead to the following conclusions:

- Some application systems have been built in isolation from one another. This has led to poor integration and usability of information as well as redundant or wasted development effort.
• New applications should be developed within the framework defined by the Information Modelling project and the models held in the development dictionary.

• The current systems do not contain all of the functionality required to support administrative decision making, especially when particular data views are required across functional areas, such as in manpower planning. Current systems do not provide the flexibility of information retrieval required.

• The phased development of the applications should be made with reference to the logical dependencies between application areas. This will be necessary in order to create a fully integrated information system consistent with the models designed to support organization-wide views of the data.

• The new applications should be built on a relational corporate data base according to the Information model.

• The existing applications usually do not satisfy the need of end users for user-friendly tools.

• Development and implementation of interface standards which meet users requirements should be integral to the design of all new applications.

• The existing systems contain some amount of duplicated, redundant information and functionality, leading to potential data integrity problems.

• Application development should be based upon the information held in the central data dictionary. Existing systems should evolve towards the definitions held in the dictionary. Coordination and control of this central resource should be via a Data Administrator (DA) and a Database Administrator (DBA).

• A lack of consistency in definitions for data and the assumptions underlying the data held in various systems has made it difficult to attempt CERN-wide analysis of information.

  Agreement on the use of terms within CERN administration (for example, "precommitment", "project") is required. Data definitions for the information systems should be held centrally in a data dictionary.

• Due to the lack of integration between many systems, the flow of data in the organization has not been sufficiently rationalized.

• Organizational methods and procedures related to implementing efficient information systems need to be closely examined in order to rationalize and make more efficient the organizational procedures related to new systems. (One example might be the flow of authorization signatures.)

• The development of applications has not been driven by an integrated view of the functions and information required to administer CERN.

• A phased development of applications should be undertaken upon completion of a full analysis of the functions and information models derived in the Information Modelling project.

• Existing systems do not provide complete functionality to meet the requirements of CERN administration.

• Applications should be built in the order of the priorities stated by the CERN Management Review Committee, to satisfy missing functional requirements, and the logical interdependences of the applications. The proposed applications are:
  - ASSET MANAGEMENT/INVENTORY
  - BUDGETING/PLANNING
  - FINANCIAL
  - FOUNDATION
  - HEALTH AND SAFETY
The potential benefits to be gained by implementing the recommendations are:

- Information systems are created in an integrative, planned development process based on one corporate data model which spans all of the functional areas of CERN's administration.
- Comprehensive views across data will be available for decision support in budgeting, planning and tracking (for example, indirect and direct cost-tracking).
- Flexible systems for ease of information retrieval.
- Rationalization of the flow of data can be achieved with the new applications given concurrent simplification of procedures.
- Elimination of redundant data entry operations and provision of more efficiency in the information systems.
- The applications will be capable of supplying timely and accurate information.
- A central data dictionary will hold systems design information, reducing maintenance overheads, providing impact analysis for system changes, and of most importance, providing controlled development for the applications.

2.1.2. Detailed Area Analysis

Three Detailed Area Analysis (DAA) (Analysis Stage of the CASE*Method) teams started in parallel during Fall 1990 on the Foundation, Financials and Purchasing&Logistics business areas. These studies were completed on schedule during March 1991.

Detailed Area Analysis resulted in a detailed information and function model, which specify the information system that cover the needs of a business area. Transition issues, fall back, security, audit, backup and recovery were also addressed during DAA. Our aim of DAA was to enable the detailed evaluation and specification of a package solution, in contrast to a normal DAA that is followed by an inhouse design and build.

Some specific requirements of the new applications (apart from supplying adequate functional support for the business areas) were:

- flexible information retrieval
- comprehensive views across business data
- timely and accurate delivery of information
- user-friendly interface
- ease of enhancement and maintenance.
2.3.1. Preparation

A user committee was established for each of the areas, with representatives of all the major categories of users of the future applications. Aims of the 1 hour user committee meetings were: reporting progress made by the study team; verifying that the study is going in the right direction; and resolving business issues which arise during the study.

The scope of the study was defined and agreed by the user committees which met every two weeks to decide on pending issues and to comment and contribute to the area analysis results.

The scope contained the following paragraphs:
- Major planned facilities of the future application.
- Benefits of the future application.
- Related current and future systems
- System dependencies
- High level planned system functions from the corporate function model
- Major Information entities from the corporate information model
- Deliverables
- Priorities
- Methodology
- Tasks of the various actors (team, user committee, other committees)
- Assumptions and critical issues for the timely completion of this phase
- A list of interviewees, together with a matrix showing the coverage of the functions
- A detailed planning

But the most important paragraph was the one listing the items that were definitely outside the scope of the study.

2.3.2. Conduct

The detailed area analysis was done according to the methodology using the ORACLE CASE tools. Since we knew we had to go for a package solution, we paid more attention to certain aspects than we would have done under normal circumstances. Another particularity of the CERN situation is, that we were migrating from existing information systems solutions to other more modern solutions. The existing systems were all tailor made, and the individual users were in general happy with the current systems. Our objective was to replace the tailor made systems with standard packages for strategic reasons, which the end users did not necessarily understand. This is why we paid a lot of attention to the transition.

2.1.3. Applications selection

A long checklist was established (far over 100 points per application) for each of the applications. Every item on the list was weighted by its ‘importance’ (from 1 to 3) and classified according three categories:
- a functionality is indispensable and cannot be developed at CERN
- b functionality is indispensable but can be developed at CERN.
- c functionality is not indispensable but desirable.

The tests were performed either at CERN on at the suppliers location, always with the assistance of representatives of the package suppliers.

The results of each of the tests was expressed in a mark between 0 and 10. A simple calculation would give the match between our requirements and the package under evaluation.
Items subject to evaluation

- Functionality
- Ease of Use
- Audit/Security
- Information Technology
- Implementation/Maintenance
- Vendor Suitability/Track Record

The function model from the detailed area analysis was used to establish the functional check list. The information model was only incidentally used for a better understanding of the functions. A spreadsheet was used to register and comment the results and to perform the calculations.

The results of the evaluations were written down in a report, containing a final section devoted to critical weaknesses observed and a recommendation.

An outside consultancy firm performed quality assurance on the testlists and the final reports.

The financial and purchasing packages were selected end April 1991.

2.1.4. Specification, build, documentation and training.

From April to December three teams worked together with the package supplier to fit the packages to the CERN requirements. The foundation application was developed at CERN and the purchased packages were adapted to use the foundation information (suppliers, addresses, people information, etc.). Around 150 CERN employees were affected by the introduction of the new applications. A very significant amount of work went in the writing of user documentation, and the preparation of the training courses, which were held from September till December 1991.

2.1.5. Transition

The transition strategy, which aims at reducing the risks to a minimum given the time and resource constraints imposed upon us, was agreed end June 1991 by the users. The decision was taken based on a 40 page report containing a detailed description of all options to reduce the risks, together with resource requirements and other costs. Issues like parallel running, double data entry, regression scenarios, training plans, go/no go decision points, were treated in detail. A detailed transition plan was included.

The goal that was to be attained was the replacement of the financial and purchasing systems\(^1\) with two tightly coupled applications running on ORACLE and UNIX. Since all purchase transactions, goods deliveries, invoice acceptance and payments, and all other financial transactions of CERN go through these systems, it was critical that the transition from the old to the new systems did not heavily disturb the functioning of CERN.

About 120 users were affected in the way they do their daily work by this transition.

The following alternative strategies have been investigated:

- parallel
- double data entry

\(^1\) both running on different data base systems and loosely coupled via custom built ad hoc interfaces
• single data entry, but special interfaces between the old and new systems
• sudden death

Parallel operation in either of its forms is very costly in our case for a number of reasons that were developed in the report. The sudden death strategy implies more risk. In spite of the fact that parallel operation is the safest solution, finance division has decided to adopt the sudden death strategy due to resource constraints. Naturally risks will be reduced to a minimum where possible.

The actual transition started mid November and lasted till end January. Special interfaces were developed to copy information from the old to the new systems. By careful planning there was very little need for duplicate data entry. The plan was tightly constrained by the yearly financial bookclosing dates.

We expect to invest several manyears during 1992 in the consolidation of the new applications.

2.2. How

2.2.1. Oracle CASE

We have chosen the ORACLE CASE*Method and the ORACLE CASE tools, since after a market survey we did not find any other method or tool that was significantly better and which was running on the platforms available to us, We were looking for a methodology from the 'Information Engineering family of methods, since this is the most widely used method covering all phases from strategy till implementation. The following were the main criteria used to evaluate the different tools to support the methodology

- Contents/Structure of dictionary
- Multi-user support of dictionary
- Security of dictionary
- Reporting on dictionary
- Import/Export of data from dictionary
- User extendability of dictionary
- DBMS support (ORACLE, Others)
- Quality
- Integration of graphics tools and dictionary
- HW platform (MAC, PC, UNIX)
- Supported methodologies and available models (ERD,DFD,ADD,PSD,....)
- Dynamic links (explode)
- Support for phases in the lyecycle (Strategy, Analysis, Design, Implementation, Production)
- Performance and Cost (Software&Hardware)

The major tools we evaluated were:

- Blues
- Data Modeller
- DEFT
- IDE
- IEW
- ORACLE*CASE
- PACBASE
- Team Work
2.2.2. Merging the CASE model with applications

3. Conclusions