INTEGRATED PROJECT MANAGEMENT INFORMATION SYSTEMS: THE FRENCH NUCLEAR INDUSTRY EXPERIENCE

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BACKGROUND

The French nuclear industry has experienced in the last 15 years several major changes in its environment:

- 1970 - 1974 was a period in which a yearly order for one pre-series 900 MW plant was placed by a single customer.
- 1974 - 1981 was a period in which 5 to 8 yearly orders for identical plants of two models (900 MW and 1300 MW) were placed, mainly by the French utility but also by foreign clients.
- 1981 - 1987 was a period of decreasing number of orders, but with a significant activity due to the completion of the plants ordered during the previous period.
- Post-1987 is a period of low orders in a difficult economic environment, without the previous large construction activity.

The Project Management Information Systems(PMIS) developed during these periods were adapted to the situation:

1970 - 1974: Mainly manual systems.

1974 - 1985: Computerized systems managed by the data processing division, with high emphasis on:

- planning and cost control (1)
- document control

as these were the most crucial problems. Materials control was a less urgent issue, as the series effect permitted ordering equipment and materials in large quantities and any surpluses could be used for the next plant and equipment shifted as necessary from one site to another. A rolling inventory was the answer in this context.

Furthermore, the state of the art in the data processing industry and the time pressure due to the high level of activity were such that the project management information systems were far from being integrated, and communications between adjacent systems were mostly manual.

In the early eighties, and in the French case from 1985, the development of the data processing industry has made the real integration of project management information systems feasible, and the database administration function has been extended to all facets of the engineering process.

The new systems had to take into account the existing ones which were still operating efficiently and the new problems encountered due to the changes in the environment.

One of these new problems was equipment and materials management, as the period of plants built in series had vanished, and the industry was obliged to build plants individually.

The challenge encountered by the French nuclear industry in terms of the project management information systems was to adapt efficiently to the new situation, and the purpose of the present paper is to describe the most significant elements of this adaptation. We will review :

- the objectives established by the company's general management
- the organization put into place to reach these objectives
- the main choices made
- the economics.

OBJECTIVES

The objectives given by the company's general management were broad :

- increase overall company productivity through the development of a comprehensive project management information system which should be:
  - cross-divisional
  - integrated into the company's management information systems masterplan
  - linked to existing computerized production tools

in order to insure coherent information, limit coordination work load and avoid unnecessary equipment and materials procurement.

THE ORGANIZATION PUT INTO PLACE

In order to reach these goals, it was felt necessary(2) to involve :

- all division managers so that they could take the necessary decisions as a management group and make them adhered to within their divisions.
- senior managers from all specialties involved in the design, procurement, construction and quality assurance of nuclear plants, under the leadership of an experienced project manager, and with the help of management information systems specialists.
- engineers in each specialty to study the details of the global engineering work (design, procurement, construction, quality assurance) so that the information system to be developed could be fully adapted to actual needs,
- database administrators who would later maintain the system in operation.

A four-level organization was therefore set up with the following characteristics (see Table 1).

TABLE 1

GROUP	MEMBERS	ROLE
STEERING COMMITTEE	Division Managers	To take all major decisions
PMIS WORKING COMMITTEE	Project Managers Senior Managers (design, procurement, construction). MIS Specialists	To define the needs To perform conceptual studies To structure the PMIS
AD-HOC WORKING GROUPS	Engineers in various specialties according to the group MIS Specialists	To perform detailed studies To produce detailed specifications of the PMIS applications
PMIS OPERATIONS COMMITTEE	Engineering Supervisors Database Administrator Project Manager	To eliminate all obstacles to efficient use of the system on the selected project To propose ergonomic adaptations

THE MAIN CHOICES MADE

The main choices have been:

- limitation of network-based cost/planning integration to construction activities (excluding design and procurement periods)
- re-use of recently developed systems
- development of integrated equipment and bulk materials tracking and milestones management systems.

Cost/Planning Integration

In order to achieve corporate goals, some outside consultants suggested that the solution to better efficiency relied mainly on the development of a global detailed network of the project and on total integration of cost and planning. After thorough investigation, that proposal was felt inadequate, as:

- the schedule of the projects were really under control with existing means and the extension of the existing construction network to design and procurement activities would not bring many benefits
- an important part of engineering costs is due to coordination, and it would be more profitable to put in operation adequate tools to limit the needs for these coordination activities. On the other hand, since production design is partly subcontracted on a lump sum basis and controlled through the subcontractor's management tools, an elaborate and decentralized cost management system existed and rendered the expected services.

LINKS WITH EXISTING MANAGEMENT INFORMATION SYSTEMS

The company had previously established systems for:

- document control (production, approval, issue of technical documents)
- cost management (with its links with engineering workhour control, procurement and accounting).

These systems were giving satisfaction and were to be linked in one way or another to the new PMIS. These links could be automatic or manual, according to the importance given to the total coherence between the systems and to the profitability of the link automation.

Integrated Equipment Tracking

A survey of previous projects showed that the increasing time interval between projects demanded a close tracking of equipment from the time it appeared first on a process flow sheet to the time it was tested on site during the precommissioning period.

An integrated system will eliminate a lot of coordination activities, and avoid late orders which are always costly. Therefore the system was designed to track the equipment at the following stages :

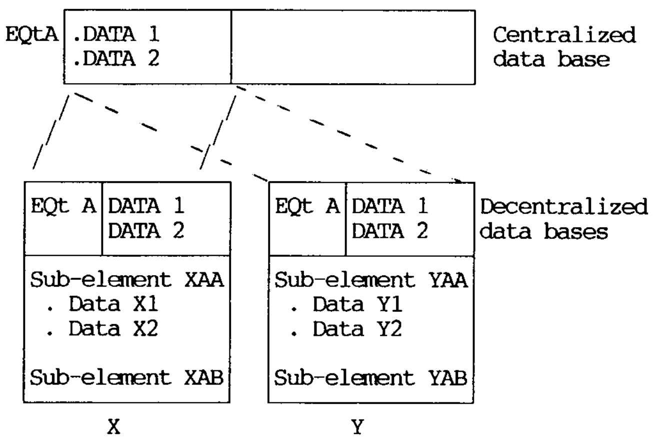
- at its birth on a flowsheet, where it is given a functional code (type of equipment, elementary system)
- when it is located on a general arrangement drawing (building, room)
- when it is specified, at which time it is grouped with other similar equipment for procurement activities
- when it is designed in detail, and all its subcomponents are identified and coded
- when it is fabricated, at which time it is

subdivided in sub-assemblies which follow different fabrication routes

- when it is inspected, where a piece of equipment is linked to a functional code
- when the above pieces of equipment are put into a crate for shipment
- when the crate is put aboard a ship and later arrives on site
- when the pieces of equipment are unloaded in the site store room and later installed in a given place
- when the equipment is tested (by system)
- when a system is turned over to the client for operation.

All along its life, the equipment is tracked by a centralized PMIS, with data fed by the party most directly involved (design engineer, buyer, quality inspector, traffic, site storeroom keeper, ...) and readable by all other interested parties. Therefore, a site supervisor is able, through the system, to know the exact status of a piece of equipment which he will have to install.

All data which is useful to users in other divisions is fed in the centralized system. For data which is particular to individual users, decentralized databases are created. If need be, a single piece of equipment in the centralized database is subdivided into subelements in decentralized databases according to local criteria. A given piece of equipment can be subdivided differently in different databases.



Furthermore, local systems automatically linked to the central database allow the production of internal or external documents, such as:

- equipment requisition
- suppliers' quotation comparisons
- customs invoices, etc.

Link With CAD System

Since the flow sheets are computerized, an automatic link has been provided between the equipment database and the CAD tool. Limits between the CAD system and equipment/materials tracking system have been clearly established:

- All technical data (technical parameters, set points, drawings, etc.), which are necessary for the equipment manufacturer and for the construction crew are part of the CAD database or remain on paper forms

- Only the data necessary for the management of the procurement and construction processes is fed into the equipment/materials tracking system.

This allows output such as:

- equipment appearing on flow sheets, but not yet specified or ordered

- equipment ordered which become free due to later modifications to the flow sheets.

Integrated Bulk Materials Tracking

As it also appeared in other major projects(3), tracking of bulk materials (and more specifically of quantities) from project inception is a key element of cost and schedule management. Of course, the problems encountered in this area are not specific to the nuclear industry.

The real problem is to follow quantities per type of material (piping, cable trays, cables, shapes, steel plates, etc.) with a variable degree of definition during the life of the projects:

- in type of material
- in the breakdown of quantities by system or location

Furthermore, the quantities of bulk materials can derive from quantities of standard items (fabricated support, for example) which have to be subdivided in elementary bulk materials to be purchased (shapes, plates, bolts).

The quantities to be purchased are usually different from those derived from the detailed drawings to take into account such parameters as commercial lengths available, minimum economic quantities, contractual coefficients, waste during fabrication, etc.

The system allows:

- the input of estimated quantities at various detail levels according to the information available

- the automatic breakdown in materials to be purchased

- the issue of bill of quantities for bid invitations and orders

- the direct input of real quantities with breakdown by system and location, from CAD tools

- the comparison between estimated, real and forecast quantities

It is completed by local tools to produce bid comparisons and purchase order and, on site, to monitor the actual usage of bulk materials during construction.

Some of the detailed design activities are subcontracted. The type of data to be integrated in the base is usually a sum of more detailed data developed by the subcontractor as part of this work. When he is equipped with a CAD system, a link is made between his CAD system and the central database. When he is not, he is asked to input directly the data in the central database through a work station put at his disposal.

Integrated Milestones Management

Rather than developing a complete detailed network planning, the choice has been made to select milestones significant of actual progress of the project which should be closely monitored at project management level.

Based on the major milestones indicated in the contract with the client, and on the overall schedule prepared by the project manager, each division is responsible for establishing its own schedule, network-based or not. The necessary coherence between divisional schedules is controlled by the project planner.

All formalized exchanges of information between divisions, with engineering subcontractors and with the client are considered as milestones to be monitored by project management. For procurement activities, a standard list of milestones is selected for each purchase order.

For each milestone the following dates are monitored in a central database:

- Contractual date: applicable for those milestones that the client has decided to monitor

- Need date: established by the project planner, it corresponds to the date at which the information or equipment is needed to execute a given task

- Target date: derived from the need date by application of a float duration agreed upon between project manager and divisions

- Forecast date: fed into the system by the scheduling tools in the divisions

- Actual date: fed in the system by the person responsible for the milestone

Each milestone is automatically linked:

- to a document (or a group of documents) in the document control database
  or
- to an item (or a batch of materials) in the equipment (bulk material) database

Within each division, the milestone database can be expanded in order to monitor local milestones.

Site Management

The document, equipment, bulk materials and milestones databases are made available to site. With this data, the site feeds its own tools to manage stores, the detailed construction work, construction progress, etc.

This part of the PMIS is not further developed in this paper.

THE ECONOMICS

The economics of the implementation of such a PMIS are not easy to quantify, either in terms of expenses or of rewards.

Expenses

The expenses are of different types:

- hardware
- basic software
- application development
- management rules development and work process modifications
- user information and training

As can be expected, the costs directly linked to hardware and basic software represent a low percentage of total costs. The two major items of expenses are:

- management rules development
- application development

The introduction of these new computerized systems necessitated a precise review of all the details of the work done by design, procurement and construction teams, and adaptation of their working procedures to draw full profit from the new systems. Furthermore, the total commitment of the operators has to be obtained in order to make sure that the system will used.

In application development, great care has to be taken to integrate the various applications to ensure that a given data is inputted in the system only once and that it is made available to other users at the right time.

These two items of cost represent more than ten work years of work over a two and a half years period.

Rewards

The rewards are of three kinds:

- reduced coordination activities
- reduced equipment and materials costs
- reduced construction costs

The total system makes it possible to obtain in a matter of seconds from the computer, answers to questions which would take hours or days to obtain through manual processing of information. On a typical nuclear project, several work years of project engineering can be saved. Furthermore, data input workhours are reduced as each data is inputted only once, as compared to several times when nonintegrated applications were the rule.

In the absence of rigourous equipment and materials tracking systems, the only alternate solution to avoid problems during construction is to order more than strictly necessary. Through the use of the systems, this extra ordering is greatly reduced. Furthermore, last moment purchasing, which is terribly expensive, can be almost completely avoided.

Having the right information available at the site concerning the forecast arrival dates can optimize construction activities.

CONCLUSION

Integration is a magic word in the present times. But, it may have very different meanings according to the person you talk to. In the project management world, integration of cost and planning is not sufficient and in many circumstances is not the first priority. Project management needs also and above all integration of CAD tools and PMIS data bases, of engineering teams and subcontractors systems, of PMIS and corporate systems, of document/equipment/planning data (Table 2).

TABLE 2
INTEGRATION

- of CAD and PMIS
- of design, procurement and construction activities
- of documents, equipment/bulk materials, milestones
- of PMIS and previously existing databases
- of main contractor and subcontractor systems.

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