OPTIMAL PROJECT CONTROL FOR MAKE-TO-ORDER CAPITAL PLANT

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Project management (PM) techniques exist for planning and controlling project schedules, resources, costs, and performance. With the advance of information technology, these techniques have been automated by the development of PC-based project management software (PMS) packages, thus generating many significant benefits for managing projects. However, due to the sophistication of certain industrial operations, the selection of PMS packages has to match the user's specific requirements. This paper demonstrates a systematic process for selecting a PMS package, and a detailed plan for implementing the PMS in a fire protection contracting company.

Introduction

The application of PMS for controlling large engineering projects has been extensively studied in the past. This involves using high-cost software programs specially designed for mainframe or minicomputer systems. However, for most make-to-order companies with small or medium sub-contracting projects, manual methods and spreadsheets are commonly used. Myriad PC-based PMS packages have emerged for sophisticated applications with relatively low installation and running costs. Although the functionality of PMS packages has been greatly enhanced, two major problems are found, namely that the packages are too difficult to learn and complex to use (Rushinek, A. and Rushinek, S., 1991; Dykeman, 1993,). This paper presents an effective approach to the selection and implementation of a PMS package in a fire protection contracting company.

Background

Existing Project Management System

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Wormald Ansul UK, as part of the world's largest fire protection company, designs, manufactures, and installs fire protection systems for domestic and overseas use in power generation, petrochemical, offshore and general industrial applications. The provision of timely information for effective project planning and control is vital for completing projects on time, within budget and to specification. In the past, these tasks were accomplished by using manual methods, spreadsheets, databases and different drawing packages in separate areas of the company. This limited the effectiveness and flexibility of project control, as well as increasing the potential for contractual disputes.

Possible Problems

Some possible problems are identified as follows:

- *In the tendering stage*, tender programmes are constructed with inadequate information on the availability of future manpower. This means the programmes have to be revised when orders are received, resulting in late starts. In addition, tender costs estimated with a conventional bill of quantities (BOQ) do not provide realistic estimates of task durations for design and site operations.
- *In the planning stage*, no effective tools are available for conducting "what if" analysis. This might result in projects not being planned in the most practical and effective ways.
- *In the execution stage*, project progress data is not integrated for performance assessments, thus giving no early warning signals for project managers to take timely correction action. The effects of project variations cannot be adequately assessed, causing serious knock-on effects on all aspects of project execution as well as generating conflicts with clients.
- *In the completion stage*, insufficient records exist for conducting post-project reviews. Consequently, the use of past project experiences to improve future project operations is limited.
- Considerable time and cost is needed for calculating, compiling data, and generating the reports required throughout the project control process.

Company Solutions

To resolve these problems, the company envisaged a PM system for effectively integrating PM staff with project information. This involved collaboration with Total Technology at UMIST. The major tasks involved an analysis of the company's requirements, and the selection and implementation of a PMS package. This would gradually standardise all project control operations and enhance the knowledge and skills of all PM staff, thus increasing their effectiveness in making commercial, managerial and operational decisions.

System Specifications

Company Requirements

Prior to selecting a PMS package, a detailed analysis of the existing PM system was carried out. The purpose was to identify the main features of the PM system, so as to ensure that specifications constructed were consistent with company requirements. Areas analysed were a) PM organisation structure and responsibilities, b) project

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characteristics and PM methodology, c) project control and reporting procedures, d) existing computer systems and facilities, e) the knowledge and skills of PM staff in using project control techniques and computer systems, f) the objectives of PM staff in using the PMS packages and their attitudes towards implementation, and g) top management commitment.

Several methodologies were applied in conducting the analysis, involving the Viable System Model (Beer, 1981) for diagnosing the PM organisation structure, and Data Flow Diagrams (DFDs) for analysing project control procedures. The results suggested that some adjustment of existing project organisation structure and operational procedures was desirable to create a suitable environment for the new PMS package. This would involve recruiting a skilled planner to centralise the major part of project information control, changing the existing PM organisation structure from a functional matrix to a project matrix (Galbraith, 1971), and redefining reporting procedures. The following key areas were identified:

- Integrating accounting cost data and materials procurement data, both being generated from a mainframe database system.
- Exchanging site progress data, created from different spreadsheet software packages by site engineers.
- Creating "planning-driven" cost estimates for comparison with those compiled by estimators through the use of conventional BOQ methods.
- Assessing the cost implications of incoming variation orders.
- Integrating global manpower resource information for better resource planning.
- Standardising programmes for planning repetitive work.
- Producing timely and effective reports for different levels of PM.
- Providing training for all PM staff to improve project control knowledge and skills.

System Requirements

Much has been written about how to select PMS packages, such as Rushinek A. and Rushinek S. (1991), Farid and Kagari (1991), and Hannigan (1993). It is emphasised that the match of a PMS package to the company's requirements is paramount. Therefore, based on the preceding analysis, the following prerequisites were identified:

- *Ease of use and ease of learning*. It was intended that the PMS package would be used by staff in all aspects of project management. Therefore, ease of use would be a major criterion to be considered.
- *Ease of customisation*. This would allow standardisation of reports and automation of operating procedures, thus reducing expenditure of time and money on repetitive work.
- *Ability to exchange cost, material, and progress data*. Data from other sources could be exchanged (e.g. site progress reports, accounting cost data, material status).
- *Multiple project control*. Variation control and resource planning were two major management concerns. With this function, linking multiple projects, project schedules, costs, and resources could all be better controlled.

- *Multi-user applications*. Most of the company's software packages now run on a computer network. This allows access for regular use by multiple users.
- *Ability to run on IBM compatible PCs*. The majority of computers used in the company are IBM compatible; hence a PC version package would be preferred.

In addition, general software characteristics were also considered, such as prices, networking, project handling capacities, scheduling features, resource levelling, cost control, progress monitoring and tracking, reporting, graphics capabilities, etc.

System Selection and Implementation

Selection of Software Packages

Five steps were taken for selecting a PMS package, involving:

- *Reviewing recently published reports*. Many assessments on the latest PMS packages were available in computer journals, thus giving general comparisons of popular selling packages (Levine, 1990; Mayor, 1993, Personal Computer World, 1994).
- *Contacting software suppliers for test packages*. Test packages were requested from suppliers, allowing potential users to make their assessments.
- *Using live projects for testing performance*. This was useful in assessing overall functionality and performance, and in judging suitability for the specific application.
- *Consulting other experienced users*. Experienced users in academia and industry were consulted on their experiences of using the packages.
- *Conducting detailed cost analysis*. Cost information was collected and evaluated concerning purchasing and installing software and hardware.

From these five steps, a package called CA-SuperProject 3.0, from Computer Associates, was selected. The main features included reasonable prices, convenient on-screen help and tutorial, and flexibility for customisation and data integration under Windows environments. It also provided internal macro commands and external programming languages for easy automation of users' tasks and procedures, saving time and cost. Nevertheless, the most important consideration was that much of its functionality will fit the company's requirements.

Implementation Process

The factors fostering success in implementing a PMS package were identified as a) selling benefits to all PM staff, b) obtaining top management commitment, c) constructing detailed training programmes, d) involving all levels of PM staff in the training programmes, e) using live projects for training purposes, f) developing standard operating procedures, and g) evaluating feedback results (Weitz, 1989; Enrico, 1991).

After demonstration of application on several live projects, PM staff were convinced of the potential benefits, so the company decided to go ahead with a pilot implementation on the project, named "Hands-On". This would be undertaken by all contract managers, contract engineers and planning engineers, along with the estimating manager. Three stages of training programmes were constructed, the aims of which were depicted:

- *Stage one*: to achieve familiarity with basic scheduling techniques (e.g. Work Breakdown Structure (WBS) and networking), and to practise software operations by applying to existing projects on a single project basis.
- *Stage two*: to achieve familiarity with resource and cost control techniques (e.g. resource levelling, conflict resolving), and to standardise reporting formats.
- *Stage three*: to achieve familiarity with multiple project control and data exchange, and to conduct advanced performance assessment (e.g. Earned Values).

The overall programme was to last twenty weeks. Each week, a three-hour training course would be undertaken, containing three main subjects, namely theories and techniques, computer software applications, and practical application. In addition, results would be evaluated and necessary modifications made.

This programme emphasised a step-by-step approach, integrating PM methodology with practical application on live projects. Also, macro programmes developed with external languages (e.g. Visual Basic and CA-REALIZER) were constructed to automate users' operating procedures. These greatly enhanced the learning process, as well as facilitating the integration of the new PMS system into the existing PM system.

Conclusions and Acknowledgement

The "Hands-On" project is receiving a good response from the PM staff. The company views the benefits as promising in terms of a long-term investment. This has given the authors encouragement to continue the work, with the objective of customisation for company-wide project integration. The authors would like to express their gratitude for the company's support, without which, this work could not have been progressed so successfully to this stage.

References

Beer, S. (1981), *Brain of the Firm*, 2nd edn. Chichester: John Wiley.

Dykeman, J. B. (1993), *The State of Office Applications Software*, Managing Office Technology, Vol: 38, No: 6, Jun., pp: 40-44.

Enrico, J. F. (1991), *Project Control - Data, Information, and Computers*, AACE Transactions, pp: SK.3.1-SK.3.7.

Farid, F. and Kangarri, R. (1991), *A Knowledge-Based System for Selecting Project Management Microsoftware Packages*, Project management Journal, Vol: 12, No:3, Sep., pp: 55-62.

Galbraith, J. (1971), *Matrix Organisation Designs-How to Combine Functional and Project Forms*, Business Horizons, Feb., pp: 29-40.

Hannigan, B. M. (1993), *Selecting Project Management Software-The AECL-CANDU Solution, Cost Engineering*, Vol: 35, No: 12, Dec., pp: 19-23.

Johnson, R. V. (1992), *Resource Constrained Scheduling Capabilities of Commercial Project Management Software*, Project Management Journal, Vol: 12, No. 4, Dec., pp: 39-43.

Lai, J. H., Tompsett, M. H. and Leonard, R. (1995), "*Optimal Project Control for Make-to-Order Capital Plant*", Proceedings of the Eleventh National Conference on Manufacturing Research, Taylor & Francis, London, pp361-365.

Levine, H. A. (1990), *Graphical Interfaces Give Power to Users*, Software Magazine, Nov., pp: 87-93.
Mayor, T. (1993), *Wise Choice*, CIO, Dec., pp: 70-72.
Personal Computer World (1994), *Just Managing*, Sep., pp: 298-308.
Rushinek, A. and Rushinek, S., *A Production Evaluation and Selection System for Project Management Software*, Computer in Industry, Vol: 16, pp: 289-301.

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