Issues in implementing ERP: A case study

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Abstract

Information technology/systems play a major role in improving the competitiveness of organizations. There are numerous enterprise information software packages available in the market. One of them is enterprise resource planning (ERP). ERP can provide significant improvements in efficiency across a company, but only when implemented correctly. Otherwise, an ERP system could be a curse and drag the whole enterprise into spiraling inefficiency. Planning for ERP systems and their implementations requires an integrated approach to meet the requirements of various functional areas. With a brief overview of ERP implementations, this paper describes some experiences of an ERP implementation in a water corporation. The case study reveals some of the intricacies during the planning and implementation stages that may occur in any company in any part of the world. Suggestions are offered in resolving the issues of implementing ERP.
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1. Introduction

Information technology and systems have tremendous impact on the productivity of both manufacturing and service organizations. Companies have implemented systems such as enterprise resource planning (ERP), MRP, EDI, etc. over time for improving their productivity. However, ERP systems have received much attention lately for their potential in more effective decision-making. Many companies are implementing ERP packages as a means to reducing operating costs, increasing productivity and improving customer services (Martin, 1998; Pliskin and Zarotski, 2000). Ironically, this very ERP system can cripple a company, if not implemented properly. There are horror stories concerning implementations gone astray (Laughlin, 1999; Bancroft et al., 1998).

Implementing ERP systems successfully calls for strong leadership, a clear implementation plan, and a constant watch on the budget (Wagle, 1998). From a project managers' point of view, the most important consideration is a clear implementation plan and a strategy to implement that plan. The plan and strategy, however, should evolve through systematic consideration of the company's require ments and its ability to manage changes that would be required under the new situation. Some

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of the questions to be considered in the planning stage are:

- What are the specific information needs at the operational and managerial levels for various functional areas?
- How will the proposed ERP system integrate with the existing information systems?
- What is the schedule for adaptation of the new system?

Questions such as the above should be considered seriously for successful implementation of an ERP system. An organization would also need to develop an implementation strategy. Such a strategy, either step-by-step or 'Big Bang', will determine how the related changes can be successfully absorbed at various parts of the organization. Cooke and Peterson (1998) found that the organizations that had no SAP implementation strategic plan performed poorly 90% of the time compared to those who had a plan. ERP implementation cases from countries around the world demonstrate that success is essentially conditional on adequately managing the complex context of the implementation, which necessitates change management across various key areas related to business processes, IT structure, and management systems (Al-Mashari and Zairi, 2000). This paper highlights some of the practical issues associated with the implementation of ERP systems. As an example, the case of a water company (referred here as the Water Corporation) is presented. The Water Corporation started implementing SAP in 1997, and it is believed it has been a success story. This paper focuses on the chronological developments, particularly in its project management branch (PMB).

2. Implementation of ERP systems

ERP has grown as an integration tool where the aim is to integrate all enterprise applications to a central data repository with easy and discrete access to all relevant parties (Black, 1999). SAP R/3 has been installed in over 20,000 locations in over 107 countries (Bhattacherjee, 2000). Companies such as Geneva Pharmaceuticals (Bhattacherjee,

2000), Eastman Kodak (Stevens, 1997), Lucent Technologies (Francesconi, 1998), Farmland Industries (Jesitus, 1998), Du Pont (Stevens, 1998), Digital Equipment Corporation (Bancroft et al., 1998), Owens Corning (Bancroft et al., 1998), and Dead Sea Works (Pliskin and Zarotski, 2000) are using SAP R/3 to track cost and resource information, monitor service levels and expenditures, and provide front-line workers with the information needed for better decision-making. By creating a centralized database and standardizing corporate data flow, ERP can make changes and efficiencies take root in a firm (Kirschner, 1997). Even with such advances project managers often wonder "what are the ingredients of successful system implementation?"

For successful implementation three basic requirements should be met: a clear business objective, comprehension of the nature of changes and understanding of the project risk. Strong leadership and constant watch to budget are two other requirements as stressed by Wagle (1998).

The "iterative evolutionary method" for developing an enterprise-wide information system (Bailey, 1998) is an important method. This enables the system developers and their customers to communicate effectively with each other to evolve the system towards some defined objective. This method is useful from an IT project's implementation point of view due to the following characteristics:

- It is difficult to visualize from project specification or design how the IT system will work or will impact on the organization.
- It may be necessary to change the way people do things, or even their views of what they really need, with the introduction of IT systems.
- It is more likely that IT projects fail because of poor communications between technical experts and customers than results of technical problems.

Bailey (1998) also attempted to link planning approaches to change characteristics. He observed three approaches to planning for project management and they are linear, exploratory, and personal. Linear planning is associated with the planning and management of a project through the

identification of a detailed set of related tasks and deliverables. Exploratory planning is associated with the use of an iterative approach to evolve a product toward a defined end goal. Personal planning is associated with the setting of targets and time scales for managing organizational and personal change.

Cleland (1991), Skelton and Thamhain (1993) stressed the "concurrent engineering method" in developing an ERP system. It requires simultaneous involvement of several functions with joint responsibilities for the development, as a time-based management innovation directed for shortening the ERP delivery time. Parsaei and Sullivan (1993) stated two basic approaches for implementing concurrent engineering—team-based and computer-based approaches. In the team-based approach, the application of concurrent engineering to design improves the development of the system. The team approach also facilitates technology transfer because relevant parties are involved in the development process. The team-based approach has been enhanced by the computer-based approach. Application of computers enables design justification. However, it is necessary to acquire, represent, integrate, and coordinate the requisite concurrent engineering knowledge in information system design.

Bailey (1998) studied in depth the type of change characteristics (tangible, conceptual, and personal) that could be expected once a project has been implemented. Tangible characteristics are associated with the production of some physical thing that has a practical purpose. Conceptual characteristics are associated with the production of an object or effect that creates an emotional response or intellectual idea. In contrast, personal characteristics are associated with the change in people's attitudes, the way in which they behave or the things they do.

For effective implementation of an ERP system, particularly SAP R/3, an organization must take a holistic view of the process (Al-Mashari and Zairi, 2000). Various issues at strategic, managerial, and operational levels should be addressed in order to achieve optimum outcomes from an ERP system. Furthermore, for a successful outcome an organization must have established competencies in four
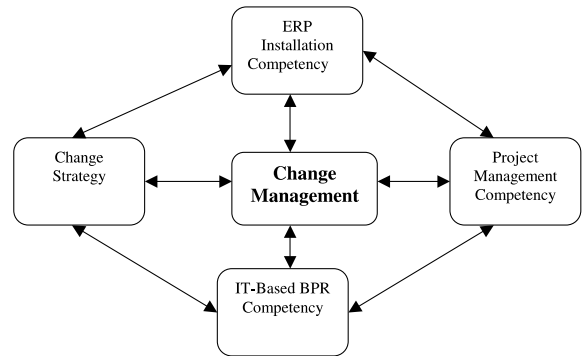

Fig. 1. Core competencies in effective implementation of ERP (adopted from Al-Mashari and Zairi, 2000).

core areas: change strategy development and deployment, enterprise-wide project management, BPR integration with IT, and technical aspects of ERP installation. These competencies will enable managers to effectively manage the changes and, thereby, moving the organization to desired goals (see Fig. 1).

2.1. Change management implementation

Changes are actually brought about through implementation of strategies. Kuruppuarachchi et al. (2002) examined the success (and failure) factors and implementation methodologies that contribute to change management strategy formulation in organizations. Fig. 2 presents a framework of the change management process incorporating change agents and strategic considerations at various stages of ERP implementation, when viewed from an IT project implementation point of view.

Meyers et al. (1999) analyzed about 130 research papers to find out factors influencing the implementation of new technologies for improved operational efficiencies. They classified implementation success factors as buyers' characteristics, seller characteristics, buyer–seller interface, and environment. Factors facilitating (or enhancing) implementation as stated by Meyers et al. (1999) are:

- **Human resources**: greater education and training among personnel; positive motivation,

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3.1. Legacy management systems

Prior to the introduction of SAP, PMB carried out its operations via a number of information systems. The general corporate systems (GCS), though not specifically orientated to project management functions was used by PMB in carrying out its operations. The GCS system consisted of

- general ledger (GL): the overall accounting database for the Corporation;
- corporate costing system, called WORKS, and associated with it the internal recharge system (IRS);
- stores management information system (SMIS), which was used for purchasing and supply;
- capital works planning system (CWP), which tracked costs against estimates and cashflows for specific projects;
- numerous minor systems, such as electronic asset registers, human resource systems (HURMIS) and various paper based systems such as the Water Corporation Policy Library and its supply manual.

PMB had also developed a number of internal branch systems for both its own operating efficiency and as part of its role as the center of expertise for project management within the Water Corporation. It had a full quality system certified to ISO 9001 by Bureau Veritas with associated quality manual; operating procedures; work instructions, standard forms and records. PMB also had its own small electronic project management system called interim project and contract system. This had its own database and reporting system, and was provided with downloaded data from the WORKS system and CWP. It was able to integrate information relating to project and contract schedules and payments, keep track of all PMB projects and generate branch key performance indicators.

3.2. Replacement need

Prior to the introduction of SAP, the Water Corporation relied for its operations upon a host of mainframe based systems, which were basic, inflexible, not user friendly, had very little integration, diminished functionality, and increased maintenance requirements. In late 1996, corporate information management strategy (CIMS) found that there were only two solutions—repair or replace. At about the same time the Corporation adopted Windows NT and MS Office, which allowed for the introduction of a corporate Intranet and e-mail. The adoption of new operating system, installation of new application software, and realization of the unlocked potential benefits that might accrue put pressure on CIMS to abandon the repair option. Replacement of all or most of the corporate mainframe systems was considered most appropriate.

After considerable study and with wide internal consultations, it was determined that the vital requirements for this new system were the replacement of the GL, WORKS, and the SMIS. Registrations of interest were sought from the market for a system to meet these needs and address the issues of functionality and integration. The responses were evaluated in detail both internally and externally.

In mid 1997, the choice was made in favor of SAP with Deloitte & Touche—ICS as the implementation partner. One of the features of SAP, which surprised many with its potential for benefit to the Corporation, was its PS or project systems module. While this was not part of the original benchmarked requirements it was an option, which became available with the choice of SAP. With the Water Corporation's capital budget amounting to almost a quarter of its operating expenses, any savings in this area, by improved project management, however slight, would have a considerable impact on the organization as a whole.

There was concern though that while most of the other modules of SAP were relatively mature and had been extensively refined in other organizations, the PS module was the least developed and had never been used to this extent. It was

decided however that the integration benefits of SAP-PS were sufficient to warrant its inclusion in the modules to be implemented.

4. SAP implementation

4.1. The system in general

Table 1 shows how SAP was configured to replace the entirety of the Corporation's operating systems.

4.2. The PS module

While from the above table it appears that the overall system seems to meet the corporate needs, the question was whether the SAP-PS module had the project planning, budgeting, scheduling, monitoring, and reporting functionality, which were vital for PMB.

4.2.1. Project planning

The fundamental tool used by SAP-PS in carrying out its task is the WBS or work breakdown structure. This is a model of the project which breaks it down into a hierarchy of major tasks (WBS elements), which give the overview. This is in turn broken down into individual activity networks for the detail. Project planning can be carried out at either level with costs and dates recorded as estimates, budgets or actuals and an automatic roll up from network to WBS. This is all displayed on the project planning board, a graphical interface that brings together the project elements, structures, and relationships.

Project budgeting: This is achieved by comparing the estimates against actuals or committed costs at either WBS or network level, there being automatic roll up to the required level. In addition, budgetary calculations such as earned value can be carried out at different levels.

Project scheduling: This is carried out on the project planning board and at any desired level with updates from forecast to actual dates being carried out automatically. The standard requirements of earliest start/latest start, earliest finish/latest finish and the various types of float can also be determined at any level.

Project monitoring: At any particular level and at any particular time the status of the project can be monitored—either as a snapshot or for trend analysis. Monitoring can be on a cost basis, time basis, or combinations of both. Milestones can also be assigned to either WBS elements or network activities.

Project reporting and performance monitoring: Both standard reports and customized reports are available. With SAP being a real time system, information that has just been saved is immediately available. Performance monitoring carried out by extracting reports and is enhanced by having the information on hand, in one place, and readily extractable.

4.3. PS module configuration

The fundamental advantage of PS is that it is an integral part of SAP and works off the common database with the entire system being real time. What it also implies is that all the peripheries have to adopt common standards, conventions, and business methodologies. How then did the Water Corporation configure PS to suit its purposes? After all many of PS's features were fully configured for the first time.

Initially work concentrated on the set-up of the package, the links, drafting and naming conventions, and the business rules. Unfortunately, it was soon found that time constraints in implementation program and testing and training

Table 1
List of SAP module replacing legacy systems

Legacy system	Replaced by SAP module
IRS, internal recharge	FI, financials
GL, general ledger	CO, controlling
CWP, capital works planning	PS, project systems
HURMIS, human resources and payroll	HR, human resource management and payroll
WMS, works management system	PM, plant maintenance
SMIS, supply management	MM, logistics/materials management

liabilities meant that no enhancements, which were seen as desirable in the definition stage, were possible prior to going into operation. Any necessary modifications to the module would have to be carried out post-changeover. It was thought, however, that the commonality and integration with the rest of SAP and the features and functionality within the module were sufficient for its use by PMB. Also Release 4 of SAP was due within two years and in this version it was understood that the PS module had been substantially upgraded. In short, the risk was considered acceptable.

5. SAP in operation

An overall implementation timetable was set out, which provided guidance on the tasks required, the preferred order of tasks, and likely durations. Over 1400 people were trained over a six-week period, the training being tailored to a person's specific role and priority. Enormous amounts of data were converted over to SAP, both master data (primarily for reference purposes) and transactional data (day to day operations of the Corporation).

The changeover itself had its own project plan and schedule of over 1500 separate activities. A full dry run was carried out a month prior to the actual changeover. This was necessary because the changeover process itself was sequential—once started it had to continue to its conclusion. In actual fact the changeover was somewhat of an anticlimax with no real problems and was actually finished ahead of time. On November 2, 1998, SAP (Release 3) was brought on line, replacing all previous corporate mainframe systems.

5.1. Initial operations

PMB's initial operations with SAP-PS was characterized by the effort by all to carry out whatever task was necessary to make the system work and pay contractors on time. This effort included creating all the WBS activities, purchase orders and outline agreements as well as the project structures themselves. It was during this phase

that the first shortcomings in the system became apparent.

Firstly, a considerable amount of the WORKS' project structures were transferred across to SAP-PS. Unfortunately this proved fruitless as no future cashflows information transferred across nor was any contract information brought over. Also the initial configuration of having one network per contract proved to be unworkable. Contracts categorization had to be changed from external activities to general cost activities to reflect multiple payments, which resulted in the loss of many drill down features and negated much of the Project Analyst training. In addition, process guidelines had not been properly thought out for contract variations and retention monies. Despite all this, all commitments and payments were made on time and the system was in place and operational.

5.2. Interim modifications

To fix these faults a number of interim modifications were made. A baseline WBS was created with a number of standard activities and milestones, and enhanced to suit the particular project. Networks were created on the basis of only one network per project. A number of standard reports were also rewritten in order to meet customer requirements.

In short, progress was being made. Unfortunately external requirements then overtook the pace of the improvements. The Corporation required all cashflows, by period, for all projects, for the 1999/00 to be available by the end of July 1999. It was found that this requirement was impossible to achieve in this time frame without excessive effort within the current network based SAP-PS system. The decision was made, therefore, to download the planning data into an offline database, process it there to give the required cashflow information and then input it back into SAP-PS for project execution.

5.3. Present system

This changeover occurred on July 14–16, 1999. The new arrangement was that all project planning would be carried out offline by a variety of means.

The WBS structures were to remain in place as were the networks but these used only for cost accruals. The planning functions of SAP-PS are used minimally at present. The module is currently being mainly utilized as an accounting and financial management package, and as a data collector and presenter for the purposes of project reporting and monitoring.

5.4. Future plans

Currently the Water Corporation is engaging a SAP consultancy team to either find solutions or recommend plans of action to meet the project management and reporting needs of the Corporation. The ultimate plan is dependent upon the findings of the consultancy group but two main options are apparent. The first is to provide a bolt-on fix with a sophisticated seamless interface with SAP. The second, to implement a future user friendly, up to date and flexible release of SAP-PS that meets the requirements of the Corporation and PMB.

While this state of affairs could be seen as an indictment of PS, it must be remembered that it is in operation; it is interfacing with the rest of SAP; project information is available to all users; and all projects have their SAP structures in place. It is only the planning and scheduling aspects, which have been turned off and are being carried out offline.

6. Summary of findings

In summary, as part of the new ERP implementation process a review of the legacy systems were carried out. It was found that repair was not cost effective and replacement was the only option. The SAP package was chosen because it provided the best option to replace the GL, WORKS, and the SMISs. These were the primary legacy systems, which were vital to the operation of the Water Corporation.

SAP's PS module was also adopted, as there appeared to be considerable benefits in doing so, despite concern about its relative immaturity. After all, PS appeared to possess most of the features required of a PMIS, in particular, integration. The

system was tested, business rules promulgated, processes documented, data converted over, staff training organized and run, and it went live on time.

Once the system went live, a number of minor problems arose, mainly to do with data transfer, project structure, contract categorization, and the process guidelines. The primary concerns were PS's project planning functions, and in particular, cashflows. The SAP-PS scheduling package was simply not powerful enough for the work required of it. In the end, the needs forced changes: planning and scheduling functions are now being carried out offline. This situation will change when further improvements are made on SAP-PS package.

There were considerable spin-off benefits as an Intranet and personal e-mail were used to adapt PMB's existing guidelines, processes, and procedures to the new environment. The introduction of SAP forced PMB to upgrade its own procedures and systems, which in turn assisted in the implementation of SAP-PS and improved the PMB's performance overall, especially in its role as the Project Management Center of Expertise for the Water Corporation.

This was achieved firstly with the branch quality system being rewritten to reflect the changes in roles, responsibilities, and relationships, which the implementation of SAP had brought about. All documents were posted on the Intranet and available instantly to any user. Secondly, the branch procedures were enhanced with PMB's home page going on-line only three days after SAP-PS and the procedures similarly disseminated. They now have hypertext links to the relevant documents, built in responsibility matrices, and complete cross-linking into the relevant SAP module.

It is believed that the success of the SAP implementation at the Water Corporation is largely attributed to closely following pre-implementation, implementation, and post-implementation strategies as shown in Fig. 2. The important strategies one must consider in similar situations are summarized below.

Pre-Implementation (planning) strategies:

- Incorporate the risk and quality management plans in the change management plan.

- Breakdown the project into natural phases or subsystems for modular planning and for development of cross-functional communications.
- Consider a phase-based approach for gradual implementation rather than radical approach.
- Use appropriate planning styles for different tasks, detailed task plans for tangible tasks, iterative plans for evolving tasks, and personal communications plans for change management.
- Prepare plans for the recruitment, selection, and training of the necessary personnel for the project team.

Implementation strategies:

- Formulate a network for collecting user requirements and user feedback.
- Set-up monitoring and feedback network for collecting control information at each stage of the implementation process.
- Prepare to handle expected or unexpected crises and deviations from plans.
- Provide a strong leadership with concerns for the welfare of people and resource commitment.
- Provide a professionally stimulating work environment.
- Obtain top management support for the project and plan for an adequately resourced and proficiently executed launch.
- Promote client consultation and user participation and obtain approval from parties for what is being undertaken throughout the project.
- Use pro-active communications to establish more realistic expectations about the technology's capabilities while communicating in tailored way to each division or unit.
- Promote collaborative system development between users and developers.
- Use multi-functional project teams to bring complementary capabilities together during the total life of the project.
- Familiarize the staff about the incoming technology and train the people involve with the system.
- Use intra-project teams and intra- and inter-industry networking for technology transfer.
- Provide stakeholders with a detailed plan of the implementation process, explain how it achieves

business objectives, and keep them informed about the system and progress of its implementation.
- Propose possible ways for restructuring personnel and systems to accommodate the new technology including maximizing of system integration and interfacing.

Post-implementation strategies: Post-implementation activities are critical for the acceptance (adoption) of ERP systems. Requirements of IT systems and structures tend to change continuously even after the completion of a project. Post-project evaluation strategy could be followed in measuring the effectiveness of an ERP system, where questions such as listed below could be used for further improvement:

- whether the objectives of the ERP system were realized fully;
- whether the scheme options were considered adequately;
- whether the estimates and project information were accurate;
- whether or not the agreed practices and techniques were complied with;
- any other factors which are considered appropriate.

Such evaluations could concentrate on, firstly, cost estimates against actuals and reasons for variations. Secondly, the evaluation could suggest any possible improvements to the IT system. Thirdly, the degree of staff consultation could be assessed and improvements suggested. Finally, post-implementation evaluation can suggest improved procedures in avoiding failure in future similar projects in the organization.

7. Conclusions

Introducing a new ERP system poses a great challenge to an organization's leadership. It seems the Water Corporation successfully faced that challenge. The SAP package was implemented with out any major disruption. Particularly, the SAP-PS module, which is the focus in this paper,

was configured and implemented on time. Apart from initial teething problems, modifications were made to increase its effectiveness. All contracts and project details have been loaded onto SAP-PS and to date no project has been held up because of its introduction. Also the SAP-PS module improved the visibility of projects throughout the Corporation.

PMB implemented a fully integrated project planning and management package. It has new on-line procedures and management systems. Project structures, budgets, costs, and expenditures are all working as planned. In the overall, it can be said that project management in the Water Corporation has advanced as a result of the implementation of the SAP package. However, detailed evaluation reveals that the planning and scheduling functions of the SAP-PS module are not up to the demands placed on it by the PMB and the Corporation. Fortunately, this limitation could be overcome with the use of existing scheduling software, namely P3, in the organization.

The experience presented here has global implication. Though this case study pertains to an Australian situation, public utility corporations in other parts of the world face similar circumstances, and the management will face similar kinds of challenges. It is hoped that the experiences described here will make the task of managers a little easier.

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