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A Comprehensive Study on The Differences Between MRP and ERP Implementation

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ABSTRACT

This paper presents a comprehensive study on the fundamental differences between Material Requirements Planning (MRP) and Enterprise Resource Planning (ERP) systems. In order to reduce the complexity in undertaking such a comprehensive study, the study is performed in a number of steps such as 1) Comparative analysis of the differences in Key Critical Success Factors (KCSFs) in MRP implementation with those in ERP implementation in the period prior to the millennium change, 2) Comparative analysis of the differences in KCSFs in MRP implementation with those of ERP implementation in the post millennium-change period, and 3) How the perceptions of the KCSFs and the processes in ERP Implementation change with time.

Keywords: ERP implementation, MRP implementation, Key Critical Success Factors.

INTRODUCTION

This paper presents a comprehensive study on the fundamental differences between Material Requirements Planning (MRP) and Enterprise Resource Planning (ERP) systems. This is done by studying Key Critical Success Factors (KCSFs) in MRP implementation and ERP implementation, and the process of MRP implementation and ERP implementation.

Differences Between MRP and ERP Systems

Since the 1960s, manufacturing systems were focused on traditional inventory control concepts and most of the software packages were based on traditional inventory processes. They were designed to work back from the sales orders to determine the raw material required for production. MRP is one of the earliest computerized information systems and it is one of the available techniques for planning and control of tangible inventory in operations management. MRP was traditionally based on raw material feedstock requirements and maintenance planning requirements. Since 1975, MRP has been extended from a simple MRP tool to become the standard Manufacturing Resource Planning (MRP II), to resolve some of the most obvious operational problems. In the same period, the birth of total quality management, TQM, and its instruments of material requirements planning, MRP, and just-in-time ((JIT) where work-in-progress inventories (WIP) are minimized by having parts made available just as they are needed, fuelled the momentum of IT implementation.

MRP II provided a closed loop system by linking production capacity to resource requirements when developing production schedules and it translated the Master Schedule built for the end-items into time-phased net requirements for the sub-assemblies, components and raw materials planning and procurement (Chung and Snyder, 1999). MRP II as tool for inventory control and bridge between production, inventory control, procurement and supplier was an

early ERP package. MRP II is the underlying principle for most ERP software. ERP covered tangible-related functions as well as intangible-related functions, i.e. service-oriented activities. The key difference between MRP II systems and ERP systems is that ERP includes functionalities such as human resources planning, decision support applications, regulatory control, quality, elements of supply chain management and maintenance support that are beyond the traditional focus of MRP II (Yusuf and Little, 1998). In fact, ERP advocates believe that ERP could combine business processes optimization in the organization and IT solutions into one integrated solution, which MRP and MRP II were not able to provide (Chung and Snyder, 1999).

The Scientific Approach of this Paper

The differences in implementation between MRP and ERP arise from the increase in complexity by the inclusion of more modules for each functional aspect of the business processes and from the integration of various service-related functions and processes in a manufacturing firm. Since more functions have been added to the functionality of MRP moving to ERP, the system became more complex particularly when this functionality incorporated the service activities. ERP specifically addresses the need for integration of application programs in various service related functions and processes in a manufacturing firm.

In order to reduce the complexity in undertaking a comprehensive study on the differences on MRP and ERP implementations, the study is performed in a number of steps. These steps are:

1. Comparative analysis of the differences in KCSFs in MRP implementation with those in ERP implementation in the period prior to the millennium change,
2. Comparative analysis of the differences in KCSFs in MRP implementation with those of ERP implementation in the post millennium-change period, and
3. How the perceptions of the KCSFs in ERP Implementation change with time.

Section-2 presents the differences in MRP and ERP implementations in the pre-millennium era. Section-3 presents the differences in MRP and ERP implementations in the post-millennium era. Section-4 looks into how perceptions of the KCSFs in ERP implementation change with time. Section-5 presents some concluding remarks.

MRP AND ERP IMPLEMENTATION IN PRE-MILLENNIUM ERA

The complexity of implementation of MRP II and MRP related software motivated earlier research efforts to identify KCSFs in MRP implementation in the manufacturing sector. Since MRP implementation was largely limited to manufacturing and ERP implementation extended the items of manufacturing to the service sector, the differences between KCSFs in MRP implementation and ERP implementation also suggested differences in ERP implementation between the two sectors. The findings sketched out above suggest that since organisational infrastructure and processes vary fundamentally from one industry to another, the process of ERP implementation may be different in manufacturing and service sectors.

This study included the carrying out of three parallel searches for KCSFs, looking at (1) KCSFs in MRP (and MRP related packages) implementation in manufacturing; (2) KCSFs in ERP implementation for both manufacturing and services; and (3) KCSFs in ERP implementation in either the manufacturing sector or the service sector in search for the differences between the two. Following the literature review on KCSFs in all industry sectors and upon our recognition of the fundamental differences between the two sectors manufacturing and services, we conclusively reviewed the available literature for differences in KCSFs in ERP implementation between the two sectors. We identified the KCSFs in the process of ERP implementation and we listed these KCSFs in tables (see Tables 1 through 5 below). Then we drew the non-generic KCSFs out of the pool of KCSFs. From the thirty-six KCSFs found by various researchers, we identified only three KCSFs as non-generic factors, which have recently been under review by researchers. From our own findings (i.e. experience, readings and practice) on KCSFs it was possible to identify seven non-generic KCSFs in ERP implementation for the two sectors manufacturing and service

Project related tasks (Trunk, 1996): ERP requires more complex and extensive project management skills and competencies.
Contingency approach to implementation (Wiegerinck, 1997): ERP project route contains a great deal of invisibility thus a careful rational approach to implementation is of vital importance.
Contingency approach to interfaces (Wiegerinck, 1997): The two external interfaces at supplier and client sides must be fully integrated with the client/supplier business processes.
Outsourcing implementation tasks (Trunk, 1996): Involves professionals with implementation of ERP and focuses on the main business activities.
Application of simulation cases (Kylstra et al, 1997): Due to complexity of implementation of ERP modules, test pilots will troubleshoot some of the expected problems in the course of implementation.
Knowledge of ERP within organization (Cramer, 1998): A positive introduction of ERP, its contents and its benefits to personnel and key users will have a positive impact on implementation success.

Table 1: Differences in KCSFs between pre-millennium MRP and ERP implementation

We recognized two periods prior and post the millennium change in our comparative analysis of differences in KCSFs between ERP implementation and MRP implementation. In the period prior to the millennium change, there were other reasons for ERP adoption as dominant factors in ERP implementation, e.g. Y2K, replacement of legacy systems etc. than in the post millennium period.

Project organization (Chen, 1996; Chen and Small, 1994)
Management involvement and commitment (Sohal, 1996; Tranfield and Smith, 1990)
Strategic Approach (Chen, 1996; Chen and Small, 1994;Tranfield and Smith, 1990)
Organizational changes (Chen, 1996; Sohal, 1996; Tranfield and Smith, 1990)
Impact of key factors (Sohal, 1996)
Planning (Chen and Small, 1994; Sohal, 1994; Tranfield and Smith, 1990)
Training (Chen, 1996; Sohal, 1994; Tranfield and Smith, 1990)
Integrated approach (Sohal, 1996; Tranfield and Smith, 1990)
Relation build up with supplier (Chen and Small, 1994; Sohal, 1996)
Technology (Chen and Small, 1994)
Communications (Chen, 1996; Sohal, 1996)
Evaluation (Chen and Small, 1994)
Start with a pilot program (Sohal, 1996)
Project objectives (Tranfield and Smith, 1990)
Client integration (Chen and Small, 1994)
Development of cultures (Sohal, 1996)
Experienced project team members (Voss, 1992)
Financing (Chen, 1996)
Learning curves, i.e. learning from others, benchmarking and experience (Sohal, 1996)
Total system Implementation (Tranfield and Smith, 1990)
Start with modules under own control (Sohal, 1996)
Focus on implementation project (Trunk, 1996)
Identification of key factors (Hill, 1996)
Application of simulation cases (Kylstra et al, 1997)
Avoid reworks (Kylstra et al, 1997)
Avoid measurements (Kylstra et al, 1997)
Performance guarantee by the suppliers (Kylstra et al, 1997)
Avoid change of team members (Kylstra et al, 1997)

Table 2a: KCSFs in implementation of MRP and MRP related packages

ERP stretches itself not only across the internal interfaces from production to items of service but it also goes further to the external interfaces to integration with client(s) by using the applications 'customer relationship management' (CRM), and 'supplier relationship management' (SRM). We derived the initial differences in KCSFs between MRP implementation and ERP implementation from Table 2 and we listed these differences in KCSFs in Table 1.

Project organization (Hill, 1996)
Management involvement (Kylstra et al, 1996)
Strategic Approach (Chen, 1996; Chen and Small, 1994; Tranfield and Smith, 1990)
Process of organizational changes (Trunk, 1996)
Impact of key factors (Sohal, 1996)
Planning (Hill, 1996; Kylstra et al, 1997)
Training (Hill, 1996; Kylstra et al, 1996)
Integrated approach (Sohal, 1996; Tranfield and Smith, 1990)
Relation with the Suppliers (Hill, 1996; Trunk 1996)
Technology (Chen and Small, 1994)
Communication (Hill 1996)
Evaluation (Chen and Small, 1994)
Pilot Test (Hill, 1996; Kylstra et al, 1997)
Project goals (Hill, 1996; Trunk, 1996)
Client integration (Chen and Small, 1994)
Development of cultures (Sohal, 1996)
Project Team Members (Hill, 1996; Kylstra et al, 1997)
Financing (Chen, 1996)
Learning curves, i.e. learning from others, benchmarking and experience (Sohal, 1996)
Total system Implementation (Tranfield and Smith, 1990)
Start with modules under own control (Sohal, 1996)
Focus on implementation project (Trunk, 1996)
Identification of key factors (Hill, 1996)
Application of simulation cases (Kylstra et al, 1997)
Avoid reworks (Kylstra et al, 1997)
Avoid measurements (Kylstra et al, 1997)
Performance guarantee by the suppliers (Kylstra et al, 1997)
Avoid change of team members (Kylstra et al, 1997)
A thorough knowledge of ERP within the organization (Cramer, 1998)
Outsourcing (Use external consultant with the experience on the same branch) (Trunk, 1996)
Contingency approach to interfaces (Trunk, 1996)
Project related tasks (Wiegerinck, 1997)
Right allocation of dedicated personnel on ERP projects (Cramer, 1998; Kylstra et al, 1997)
Contingency plan and (back-up) procedures (Wiegerinck, 1997)
Business processes (Everdingen et al, 2000)

Table 2b: KCSFs in implementation of ERP

MRP AND ERP IMPLEMENTATION IN POST-MILLENNIUM ERA

In our comparative analysis of the KCSFs (table 3), we found the following non-generic KCSFs in ERP implementation: process segmentation, clear implementation strategy, project and change management competency, partnership on ERP software with supplier and client, and a contingency approach to the post implementation period. ERP implementation is a complex project, requiring special change management and project management competencies and leadership competencies in addition to the planning, scheduling, budgeting, control and risk management skills of traditional project management. There is a great deal of invisibility and hidden opportunity costs with ERP (post) implementation.

The importance of finding these differences in KCSFs between MRP implementation and ERP implementation lies in recognizing that they are related to the addition of service elements and the service sector to the ERP implementation portfolio. Additional differences in ERP implementation in comparison to MRP implementation were distinguishable due to: (a) the complexity of the ERP systems, (b) better understanding of the differences between MRP and ERP, (c) ERP implementation demands in preparation of business processes (i.e. organizational fit), (d) the preparation of people (i.e. corporate culture) and of technical systems (i.e. legacy systems), (e) change management competencies (i.e. EQ), and (f) project management (e.g. planning and competencies etc). ERP implementation is a complex project, requiring special change management and project management competencies and leadership competencies in addition to the planning, scheduling, budgeting, control and risk management skills of traditional project management.

Management involvement and commitment (Chen, 1996; Chen and Small, 1994)
Impact of key factors (Sohal, 1996)
Strategic Approach (Chen, 1996; Chen and Small, 1994)
Organizational changes (Chen, 1996)
Training (Chen, 1996; Tranfield and Smith, 1990; Voss, 1998)
Planning (Chen and Small, 1994; Sohal, 1994;Tranfield and Smith, 1990)
Communications (Voss, 1998 ; Chen, 1996; Sohal, 1996)
Project organization (Chen, 1996; Chen and Small, 1994)
Relation build up with supplier (Chen and Small 1994, Sohal 1996)
Integrated approach (Sohal, 1996)
Technology (Chen and Small, 1994)
Evaluation (Chen and Small, 1994)
Start with a pilot program (Sohal, 1996)
Project objectives (Hall et al, 1994)
Client integration (Chen and Small, 1994)
Development of cultures (Sohal, 1996)
Experienced project team members (Voss, 1992)
Financing (Chen, 1996)
Learning curves, i.e. learning from others, benchmarking and experience (Sohal, 1996)
Total system Implementation (Treanfield and Smith, 1990)
Start with modules under own control (Sohal, 1996)
Focus on implementation project (Bemelmans, 1991)
Identification of key factors (Hill, 1996)
Application of simulation cases (Kylstra et al, 1997)
Avoid reworks (Kylstra et al, 1997)
Avoid measurements (Kylstra et al, 1997)
Performance guarantee by the suppliers (Kylstra et al, 1997)
Avoid change of team members (Kylstra et al, 1997)

Table 3a: KCSFs in post millennium MRP implementations

Management involvement – Top Management Support (Rosario, 2000)
Leadership and visioning (Al Mashari et al, 2003)
Planning (Al Mashari et al, 2003)
ERP package selection (Al Mashari et al, 2003)
Training and education (Al Mashari et al, 2003)
Systems integration (Al Mashari et al, 2003)
Communication (Holland et al, 1999)
Project management (Rosario, 2000)
Process management (Bingi et al, 1999)
Legacy systems management (Al Mashari et al, 2003)
Cultural and structural changes (Al Mashari et al, 2003)
Performance Evaluation (Al Mashari et al, 2003)
Performance management (Al Mashari et al, 2003)
Clear understanding of strategic goals (Rosario, 2000)
A great implementation team (Bingi et al, 1999)
Data accuracy (Hutchins, 1998)
Focused performance measures (Umble et al, 2003)
Multisite issues (Umble et al, 2003)
Business plan and vision (Wee, 2000)
Change management culture and program (Wee, 2000)
Project champion (Bingi et al, 1999)
Software development, testing, and trouble shooting (Rosario, 2000; Wee, 2000)
Motivation for ERP adoption (Markus et al, 2000)
Organizational fit (Hong, 2002)
Invisibility (Griffith et al, 1999)
A clear implementation plan (Mandal and Gunasekran, 2003)
A constant watch on the budget (Mandal and Gunasekran, 2003)
Employee perceptions of new IT (Knights and Murray, 1992)
Pre implementation attitudes (Abdinnour-Helm and Lengnick-Hall, 2003)
Preparing the people (Davenport, 2000)
Preparing the technical system (Davenport, 2000)
ERP teamwork and composition (Rosario, 2000; Wee, 2000)
Appropriate business and information technology legacy Systems (Holland et al, 1999)
Monitoring and evaluation of performance (Murray and Coffin, 2001)

Table 3b: KCSFs in post millennium ERP implementations

PERCEPTIONS OF THE KCSFS IN ERP IMPLEMENTATION

Due to the complexity and invisibility of the process of ERP implementation in comparison to that of MRP implementation, a pilot simulation of ERP modules prior to actual implementation is a must. The most important KCSFs based on their impact are listed in order of importance in Table 4. This degree of importance and/or the impact factor is not necessarily valid for all ERP projects. We developed this ranking from the available literature and from our own practical knowledge on ERP implementation. The available insights on KCSFs in ERP implementation were adopted from Nah et al (2003), Markus et al (2000), Al-Mashari et al (2003), Umble et al (2003), and Hong (2001).

Project (management) ownership (generic)
Organizational culture (generic)
Organizational fit (generic)
Process segmentation (non generic)
Step-by-step implementation (generic)
Clear implementation strategy (non generic)
Clear project management route (generic)
The project owner change management competency (non generic)
Training (generic)
Partnership on supplier and client sides with ERP software (non generic)
Contingency approach to (post) implementation (non generic)

Table 4: The most important KCSFs in ERP implementation

Clearly in the period after the millennium change, there was more visibility in the KCSFs in ERP implementation than in the period before (also see table 1-5). The KCSFs we identified in this period were more detailed and more distinguishable than in the period prior to millennium change.

A review of successful ERP implementations pointed to leadership and management commitment as the most important KCSFs (Bingi et al, 1999). Microsoft's top management was instrumental in overseeing its ERP project, and the entire board reviewed and approved the implementation plans. Umble et al (2003) identifies the software selection steps and the implementation procedures as KCSFs in ERP implementation. Furthermore, he linked ERP success and benefits to fulfilment of fifteen KCSFs during the three ERP implementation phases of (a) setting up; (b) implementation; and (c) evaluation. The major KCSF and at the same time benefit of ERP implementation is the required level of Business Process Re-engineering (BPR). In theory all the processes within a firm must conform to the ERP model (Al-Mashari et al, 2003).

In a survey of Chief Information Officers (CIOs) from 1000 companies on their perception of KCSFs in ERP implementation, Nah et al (2003) identified eleven KCSFs in ERP implementation from which the CIOs selected the top five KCSFs. She broke the eleven KCSFs down into many sub-KCSFs covering a wide range of ingredients. These top five KCSFs were top management support, the presence of a project champion, ERP team work including the composition of the team, project management including a change management program, and culture (also see table 5). Various literature reviews suggested organisational fit, internal restructuring, project management, pre-implementation attitude, as more important than the others. Since it has become increasingly common for large IT projects to be managed by multifunctional teams, the management of the process of implementation has become very complex (Rosario, 2000; Wee, 2000; Holland, 1999; Al Mashari et al, 2003).

There is ample evidence to demonstrate that perceptions of employees who are expected to use new IT can have a critical impact on the degree to which an implementation effort succeeds or fails. Extensive organisational investments in shaping pre-implementation attitudes do not always achieve the desired effects. Despite extensive investments of time, money and effort, the length of time people worked with the firm and in their position had a greater impact on their attitudes towards ERP (capabilities, value, acceptance and timing) than high levels of pre-implementation involvement (Abdinnour-Helm and Lengnick-Hall, 2003). The KCSFs in strategic IT alignment were the top management attitudes in IT alignment towards the business objectives and integration of internal systems with the external market (Burn and Szeto, 2000).

Project organization (Hill, 1996)
Management involvement (Hill, 1996)
Strategic approach (Chen, 1996; Chen and Small, 1994)
Process of organisational changes (Trunk, 1996; Wiegerinck, 1997)
Impact of key factors (Hall et al, 1994)
Planning (Cramer, 1998)
Training (Cramer, 1998)
Integrated approach (Sohal, 1996)
Relation with the suppliers (Hill, 1996; Trunk, 1996)

Start with modules under own control (Sohal, 1996)
Focus on implementation project (Bemelmans, 1991)
Identification of key factors (Hill, 1996)
Application of simulation cases (Kylstra et al, 1997)
Avoid reworks (Kylstra et al, 1997)
Avoid measurements (Kylstra et al, 1997)
Performance guarantee by the suppliers (Kylstra et al, 1997)
Avoid change of team members (Kylstra et al, 1997)
A thorough knowledge of ERP within the organization (Cramer, 1998)
Outsourcing (Use external consultant with the experience on the same branch) (Trunk, 1996)
Contingency approach to interfaces (Trunk, 1996)
Project related tasks (Wiegerinck, 1997)
Right allocation of dedicated personnel on ERP projects (Cramer, 1998; Kylstra et al, 1997)
Contingency plan and (back-up) procedures (Wiegerinck, 1997)

Table 5a: KCSFs in pre-millennium ERP implementation

Management involvement -Top Management Support (Umble et al, 2003)
Leadership and visioning (Mandal and Gunasekran, 2003; Al Mashari et al, 2003)
Planning (Al-Mashari, 2003)
ERP package selection (Al-Mashari, 2003)
Training and education (Al-Mashari, 2003)
Systems integration (Al-Mashari 2003)
Communication (Rosario, 2000; Wee, 2000; Al Mashari, 2003)
Project management (Al Mashari et al, 2003)
Process management (Murray and Coffin, 2001; Al-Mashari et al, 2003)
Legacy systems management (Al Mashari et al, 2003; Markus et al, 2000)
Cultural and structural changes (Al Mashari et al, 2003)
Performance evaluation (Al Mashari et al, 2003)
Performance management (Al Mashari et al, 2003)
Clear understanding of strategic goals (Rosario, 2000; Wee, 2000; Umble et al, 2003)
A great implementation team (Bingi et al, 1999; Wee, 2000)
Data accuracy (Hutchins, 1998; Umble et al, 2003)
Focused performance measures (Murray and Coffin, 2001; Umble et al, 2003)
Multisite issues (Markus, 2000; Umble et al, 2003)
Business plan and vision (Wee, 2000)
Change management culture and program (Rosario, 2000; Wee, 2000)
Project champion (Murray and Coffin, 2001)
Software development, testing, and trouble shooting (Rosario, 2000; Wee, 2000)
Motivation for ERP adoption (Markus, 2000)
Organizational fit (Hong, 2002)
Invisibility (Griffith, 1999)
A clear implementation plan (Mandal and Gunasekran, 2003)
A constant watch on the budget (Mandal and Gunasekran, 2003)
Monitoring and evaluation of performance (Murray and Coffin, 2001)
Pre implementation attitudes (Abdinnour-Helm and Lengnick-Hall, 2003)
Preparing the people (Davenport, 2000)
Preparing the technical system (Davenport, 2000)
Business processes (Everdingen, 2000)
ERP teamwork and composition of team (Rosario, 2000; Wee, 2000)

Table 5b: KCSFs in post-millennium ERP implementation

CONCLUDING REMARKS

In the literature review for the period prior to the millennium change, the characteristics of a number of the differences in KCSFs in ERP and MRP suggested the immaturity of project routes due to (a) incorporation of service sections, (b) lack of experience in working with a new package (ERP) or (c) the fear for the unknown in the process of ERP implementation. Since the MRP focus was on manufacturing sector and ERP implementation extended the items of manufacturing to the service sector, the differences in KCSFs in MRP implementation and ERP implementation were evidence for differences in KCSFs in ERP implementation between manufacturing and services. The initial differences in KCSFs between MRP and ERP are the additional KCSFs that are only related to ERP implementation: (a) project related tasks, (b) a contingency approach to implementation, (c) a contingency

approach to interfaces, (d) outsourcing of implementation tasks, (e) application of simulation cases, and (f) importance of continuity of team members on ERP projects. For the post millennium-change period, we generated a larger set and other important differences in implementation from the latest findings on KCSFs in ERP implementation. We suggest that these additional findings on differences in ERP implementation are due to the complexity of ERP system and to better understanding of the differences between MRP implementation and ERP implementation. The process of ERP implementation demands the preparation of business processes (i.e. organisational fit), preparation of people (i.e. corporate culture) and preparation of technical systems (i.e. legacy systems), change management competencies, and project management (i.e. planning and competencies etc) all of which are much less needed in MRP implementation.

From the literature, it appears that project related KCSFs (e.g. project management and change management (competencies), planning, budgeting, contingency approach and etc) are identical in ERP implementation for manufacturing and services. However, there are differences between ERP implementation and MRP implementation, so there must be important differences in KCSFs in the process of ERP implementation between manufacturing and services. Therefore, the KCSFs related to the content of the project in ERP implementation will be different between manufacturing and services. In our literature review on KCSFs, we uncovered differences in KCSFs and differences in project routes in ERP implementation between manufacturing and services. For the period prior to the millennium change, there are clear project related differences in KCSFs between MRP implementation and ERP implementation. There are differences in the degree of impact of KCSFs in ERP implementation between manufacturing and services. There are differences in KCSFs in ERP implementation between manufacturing and services. For the period of post millennium, we found more differences in KCSFs, i.e. in addition to the project related ones, than for the period prior to the millennium change. These additional differences were either due to the complexity of ERP system or to the better understanding of differences between MRP implementation and ERP implementation. ERP implementation asks for preparation of business processes (i.e. organizational fit), preparation of people (i.e. corporate culture) and preparation of technical systems (i.e. legacy systems), change management competencies, and project management (e.g. planning and competencies etc) in comparison to MRP implementation. These differences also suggest the differences in process of ERP implementation for the two sectors. These differences conclusively led us to recognition of the differences in project management and change management of ERP implementation between manufacturing and services.

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