

2007

# ERP Systems and Decision Support – An Exploratory Study

Ravi Seethamraju

*The University of Sydney*, [Ravi.Seethamraju@sydney.edu.au](mailto:Ravi.Seethamraju@sydney.edu.au)

Follow this and additional works at: <http://aisel.aisnet.org/icdss2007>

---

## Recommended Citation

Seethamraju, Ravi, "ERP Systems and Decision Support – An Exploratory Study" (2007). *ICDSS 2007 Proceedings*. 3.  
<http://aisel.aisnet.org/icdss2007/3>

This material is brought to you by the International Conference on Decision Support Systems at AIS Electronic Library (AISeL). It has been accepted for inclusion in ICDSS 2007 Proceedings by an authorized administrator of AIS Electronic Library (AISeL). For more information, please contact [elibrary@aisnet.org](mailto:elibrary@aisnet.org).

# ERP Systems and Decision Support – An Exploratory Study

Ravi Seethamraju

Discipline of Business Information Systems, Faculty of Economics & Business,  
The University of Sydney, Sydney, NSW-2006, Australia  
r.seethamraju@econ.usyd.edu.au

**Abstract.** Implementing Enterprise Resource Planning (ERP) systems, the most significant IT development in recent times, affects all aspects of organizational life. While the positive impact of ERP systems on operational efficiencies is well established in the literature, the relationship between ERP systems, decision support capability and decision-making processes has been inadequately investigated in the past. Taking an interpretive case study approach, this paper analyzes the impact of ERP systems on managerial decision-making. Confirming recent studies in the USA, this study observes a positive influence on decision support capability. Though improvement in the quality of information, centralization and the consequent increase in visibility and accessibility have influenced the decision support capability of managers, factors such as information overload and inadequate reporting tools in the ERP software appear to be limiting the benefits of implementing ERP systems.

**Keywords:** ERP systems, decision support, information visibility

## 1 Introduction

Since the early days of data processing, designers of information systems have been striving to satisfy the requirements of both operational and managerial users. Much debate has centered on the ability of integrated information systems to satisfy both the operational requirements for managing basic resources and the managerial requirements for planning and control of these activities. More than 50% of the large enterprises in the US, Europe and Asia-Pacific region already have ERP systems in place, and more medium-sized enterprises are embarking on implementing ERP systems [1] with the market expected to reach US\$ 1 trillion by the year 2010.

In view of the standardization of the processes and the centralization of responsibility in decision-making consequent to the implementation of enterprise systems (ES), it is necessary to understand the longer-term effects of ES on management decision-making [2]. From a review of various ES implementations in the late 20<sup>th</sup> century however, it is not clear whether they really foster decision-making [3]. Even though characteristics of ERP systems such as integrated information and process integration have implications for organizational decision support, this is not explicitly recognized as a major reason for implementing ERP

systems [4]. In the context of ERP implementation, as an implementation team configures the processes and decision models in the organization, several changes could be perceived, including those relating to the roles and responsibilities of the functional or process managers, the decision-making processes in the organization, and the decisions themselves. These changes may result in a perceived as well as a real loss of autonomy and control, and the imposition of additional constraints to the process and decisions. This study, using an interpretative case study method, investigated the impacts of ERP systems on managerial decision-making and control. In particular, it investigated whether there was any improvement in the availability, visibility and use of information in managerial decision-making and control consequent to the implementation of ERP systems and its relationship with the perceived improvement in organizational performance. The paper first provides a review of the literature on ERP systems in the context of decision support and managerial decision-making. It then briefly explains the methodology employed in the study and follows this with the findings of the study.

## **2 Literature Review and Background**

This section reviews the past research on ERP systems in general and analyzes the limited decision support capability of ERP systems.

### **2.1 ERP Systems and Past Research**

ERP systems assist management in all aspects of business transactions, from human resources to production, maintenance, purchasing, sales and distribution, and customer service. ERP systems are expected to offer managers an off-the-shelf-solution to the problem of business integration. These packaged software solutions are configurable information systems that integrate information and information-based processes within and across functional areas in an organization [5]. Considering their standardized and automated processes and their transactional focus, they are also described as systems that show users how to process business transactions and offer a management control system to facilitate planning and communication for managers [2]. ES thus provide solutions to ‘operational’ integration problems as well as meeting the ‘informational’ requirements of managers [6, 7]. They are therefore expected to reduce costs by improving efficiencies through standardization and automation, and to enhance decision-making by providing accurate and timely enterprise-wide information [8].

Early studies on ERP systems predominately focused on issues such as how these systems added organizational value [9, 10, 11]; implementation issues and methodologies [12, 13, 14, 15]; key factors for successful adoption, and potential problems that may arise during ERP implementations such as end user acceptance and participation [16, 17]; software and organizational fit [18]; and measuring ES success [19]. As can be seen, most of the initial research on ES focused predominantly on issues relating to the implementation phase [20]. Even though organizations achieved some operational, managerial or IT infrastructure benefits after implementing ERP

systems [21, 22], their impact on decision-making had not yet been adequately analyzed [2, 4].

Given the increasing presence of ES in a large number of organizations today, it is important to investigate their impact on organizations and particularly on organizational decision-making in different cultural contexts [23]. In an empirical study, Holsapple and Sena noted that there are “substantial connections between enterprise systems and decision support, in terms of both ERP plan objectives and resultant ERP system impacts” (p. 587). Traditional benefits of ERP systems are observed to be significantly different and more prominent than decision support benefits such as shifting responsibility of decision-making, supporting individual decision-makers in their study [4]. In order to leverage the huge investments made in ERP systems, further research into the relationships between various ERP objectives and decision support benefits is necessary [4].

## **2.2 Limited Decision Support Capability of ERP Systems**

ERP systems, because of their transaction-centric nature, have traditionally inadequate or limited capability to support decision-making in organizations. Even though increased transaction processing efficiencies, higher quality information and greater accessibility of information, and greater support for ad hoc reporting were identified as some of the benefits of implementing ES [24, 25], very little impact on the business analysis and decision support areas of management accounting was noticed in the past research. In particular, the use of ERP systems appears to have had only a minor effect on the use of newer management accounting practices, such as Activity Based Costing (ABC) systems, Balanced Scorecard (BSC), value-chain analysis, etc., that emphasize sophisticated manipulation of information rather than simply extracting and reporting transactional data [25]. These authors concluded that ERP systems have simply enhanced mass processing of documents, with very limited true decision support capability.

A study by Booth and others in Australia also reported that ERP systems perform better in transaction processing and ad hoc decision support than in sophisticated decision support and reporting [26]. More specifically, they found that ERP users were highly satisfied with reporting and decision support for finance and financial accounting, but were slightly less satisfied with managerial accounting capabilities [26]. Several studies identified possible explanations for this pattern. First, the more time that passed following the implementation of the system, the more likely it was that greater and more sophisticated benefits were obtained. Given the complexity of ERP systems and their conceptually different nature from most stand-alone legacy systems, it is not surprising that ERP users take some time to learn how to extract all potential benefits [27].

An exploratory study of the existence and importance of decision support characteristics embedded within ERP systems observed that the adopters of ERP systems placed high importance on the mechanisms that support communication within an organization [23]. Their study observed that there are differences in the perception of the importance and extent of the characteristics between the adopters (i.e. between SAP or Oracle adopters), users (e.g. functional managers vs. IS/IT staff),

and over time (for example, one year after implementation and two years after implementation). The study also noted differences in the relative importance attached to decision support capability and characteristics of the ERP system between vendors and adopters, with vendors, as expected, noticing a higher level of decision support characteristics in their ERP systems than adopters. By delineating the current state of ERP systems as they pertain to decision support, this study identified areas that vendors and adopters can focus on to improve the level of decision support provided by their ERP systems [23].

It appears that several major ERP software vendors have recognized and acknowledged the weaknesses of their systems in providing decision support. In response to such criticisms, they have started offering extension products such as business intelligence warehousing and business analytics, supply chain management, customer relationship management, product life cycle management etc., that offer decision support capability. Organizations are increasingly 'bolting-on' a decision support system from different vendors on top of the existing ERP system and deriving the benefits of increased automation of processes and powerful decision support capability [28]. For example, SAP, even in their 'mySAP ERP' all-in-one solution, have incorporated new reporting functionality in the form of 'Business Analytics' to their new customers in the mid-market. This new generation of software, developed recently by ERP vendors, is designed to sit on top of the ERP system to provide a more value-adding and strategic information analysis capability [24]. These developments explicitly signal that ERP systems by themselves have limited capacities to meet such needs, and software vendors are offering additional tools and solutions to support decision-making capability. As noted by Holsapple & Sena, the increase in such third party offerings and extensions to ERP systems by the major software vendors reflects the weakness of ERP systems in delivering unstructured decision support benefits [4].

### **2.3 Increased Accessibility and Visibility**

Integration of information across an enterprise is expected to increase the accessibility and visibility of information to various functional and operating staff and to assist them in their activities. Considering that ERP systems are a mechanism of integration that allows automation of routine and predictable activities and transactions, they are expected to enhance the visibility of information across the organization without much communication and/or interaction. Increased information visibility is expected to encourage managers to base their decisions on real-time information and facts rather than on rumors or subjective opinions, and in general to change the information culture. Since the information in an ERP environment is instantaneously visible to all employees and managers at multiple levels, it gives no scope or time for manipulation of the information or a smoothing of its effects. The integrated information and database facilitates enhanced knowledge processing and improves the reliability and speed of decisions [4].

Since most of the claimed benefits of ERP systems over legacy systems and best-of-breed systems arise from the integration of information across functional areas, the ability to extract benefits will be reduced if only a limited set of ERP modules is

implemented. Evidence from the field suggests that the so-called integration is not full and complete even in organizations where full implementation has reportedly taken place [27]. In certain organizations where only two or three modules are implemented for whatever reasons, the level of integration, and therefore the extent of the visibility and accessibility of the information across the organization, is limited. If information integration is not achieved because of limited implementation, then all potential benefits of ERP systems should not be expected, including that of improved managerial decision-making.

#### **2.4 Incomplete Information**

Information provided by ERP systems may be incomplete. ES cannot provide all the information necessary for decision support, even though it is widely reported in the literature that enterprise-wide applications promise seamless integration of all the information flowing through a company [29, 5]. There is a wealth of information outside the ERP systems environment that is at least as crucial and important for decision-making as that available in the ERP systems [30]. Other sources of information such as published statistics, market data, industry reports/news items, experts' opinions etc., though typically outside the traditional ERP boundaries, may provide invaluable support for decision-making. Similarly, legacy systems may contain years of historical data that can be crucial in determining the trends and patterns that could offer intelligent decision support [2]. Even though many organizations have implemented ERP systems, some legacy systems have been left in tact for economic and/or managerial reasons and the historical data contained in them could not be fully transferred into the new ERP system for several organizational reasons. Therefore, it is debatable that ERP systems provide all the information necessary for decision support

#### **2.5 Inadequate Reporting**

Reporting tools available in ERP systems were generally considered inadequate for decision-making by many adopters. Though ERP systems have the capability to generate standard reports that can generally meet average decision-making concerns, many firms feel the need for non-standard reports [25]. Recognising this inherent weakness, a majority of large organizations have invested significant effort in redesigning the reporting tools to suit their internal decision-making styles and processes, though this is relatively expensive and difficult, especially when it involves the transfer of information from legacy systems [31]. Adam & Doyle noted that the reporting capabilities of the ERP packages available in the market were not sufficient for organizations despite vendors' claims that the software includes leading-edge reporting capabilities [32]. In fact, lack of flexibility of reporting tools and excessive time needed to train staff for amending existing reports and/or developing new reports were some of the reasons cited for the inability of ERP systems to support decision-making [28]. Stanek et al. noted that many of the observations made several years ago on the relationship between ERP systems and decision support systems (DSS) remain

fundamentally true and are just as relevant today as they were at the time [28]. Reporting is such a unique management need that many ERP software vendors are not able to cater to the differing needs of their customers, even those in the same industry, with standard reporting tools and solutions, despite their efforts over time to produce various upgrades and versions.

## **2.6 Selective Use of Information**

Selective use of information in managerial decision-making, irrespective of its availability and accessibility, is a typical managerial trait, particularly under conditions of uncertainty. Managers use information selectively in order to rationalize their decision processes and prefer to use data and decision-making processes “with which they are comfortable” [33]. Although ERP systems make information available for managerial decision-making, the application of such information is dependent upon individual managerial preferences and conditions. The choice for using the information is, however, limited by the extent of automation in the decision-making process. In implementing certain modules and by configuring the processes using an ERP system, organizations in a way are eliminating some routine decisions normally made by process users [2]. For example, by setting up certain limits to credits, triggers for stock reorders, availability checks and other order conditions in sales order processing, organizations are eliminating the need for managerial approval, thereby reducing decision-making to a mechanistic level. These conditions configured in the ERP system will improve the efficiency of the processes and ensure consistent execution of the decisions. The danger in such automated decision-making, however, is that it may lead to inattention to the opportunities of improving the process over time. Consequently, managers may learn to accept consequences without questioning them, allowing the decision-making model to mask reality, with assumed uncertainties embedded in the system.

## **2.7 Information Overload**

In providing transactional data, ERP systems tend to increase the volume of information available to managers. While this may reduce the responsibility of decision-making at the operating level, it may actually increase the volume of information required to be handled by management. ERP systems, while providing good transactional engines for operational control, tend to increase the volume of information available to managers [2]. This may contribute to information overload as well as an increase in the complexity of managerial decision-making. According to Eppler and Mengis, research on information overload in the realm of management has mainly been undertaken in the areas of accounting, management information systems (MIS), organization science and marketing [34]. The question of how the performance (in terms of adequate decision-making) of an individual varies with the amount of information the individual is exposed to, is an important issue to be investigated. Even though the amount of information one receives influences positively the quality of decisions or reasoning in general, researchers found that this is true only up to a

certain point [34]. If further information is provided beyond this point, the performance of the individual will rapidly decline [35]. This is because the information provided beyond this point will no longer be integrated into the decision-making process, resulting in information overload [36]. The burden of a heavy information load will confuse the individual, affect their ability to set priorities, or make prior information harder to recall [34, 36].

By contrast, Eppler and Mengis (2003) further contend that a similar way of assessing the information overload phenomenon consists of comparing the individual's information processing capacity (the quantity of information one can integrate into the decision-making process within a specific time period) with the information processing requirements (i.e. the amount of information one has to integrate in order to complete a task) [34]. The requirements refer to a given amount of information that has to be processed within a certain time period. If the capacity of an individual only allows a smaller amount of information to be processed in the available time slot, then information overload is the consequence. Schick et al. (1990) also stress time as the most important factor regarding the information overload problem [36]. Interesting within this discussion is Schroder et al.'s (1967) view that suggests that information load and processing capacity are not independent of one another, but that the first can influence the second, i.e. dealing with a rather high information load increases one's processing capacity up to a certain point [37]. In addition, feelings of stress, confusion, pressure, anxiety or low motivation that may be potentially caused by the introduction of any new information system/IT enabled innovation, and particularly a complex ERP system, may signal information overload [38].

It is not only the amount of information and the available processing time (i.e. the quantitative dimension), but also the characteristics of information (i.e. the qualitative dimension) that are seen as major overload elements [39]. In addition, some of the qualitative characteristics of information such as novelty, intensity, uncertainty, complexity and ambiguity can either contribute to overload or reduce it [40]. This leads us to examine the quality of information generated by ERP systems. Thus, though information overload is a complex issue influenced by the characteristics of information, processing capability of the individual manager and information processing requirements, the literature suggests that information overload caused by ERP systems beyond a certain point may be counter-productive. While increasing the complexity of the decision-making process, it may actually contribute to selective use of information by managers in order to deal with the uncertainty and complexity of the real world.

## **2.8 Improved Quality of Information**

Quality of information is expected to influence managerial decision processes and their outcomes. ERP systems, while disciplining the basic information transactions for efficiency and standardization across the enterprise, empower all levels of employee on information analysis issues and provide flexibility [41]. In an ES environment, it becomes necessary for everyone in the organization to understand not only the process in which they work, but also their own specific task, along with the impact

their work has on other aspects of the business. This involves a culture shift and forces some discipline in the data entry and information management fields.

Some of the key espoused benefits of ERP systems are information integration, elimination of data redundancy and improved quality of information [21]. This ensures that the same data is used throughout the enterprise for better and consistent planning and control. The skills of employees, which vary from one organization to another, may not guarantee input of consistent quality data. The integration of the data across various functions will enhance the critical requirement of the data quality and, unlike in independent legacy systems, may not give opportunities for operating personnel to correct those data quality issues immediately. The risk of incorrect data entry is also relatively high in an ERP context as a data element is entered only once. Thus, ERP systems, while reducing the costs of data entry and improving the overall quality of information, may pose a significant control risk for day-to-day management.

In addition, the ability of ERP systems to push data gathering activity to the point of its origination may have a further effect on the quality of information. Operating personnel such as loading workers, production operators and maintenance personnel may not be motivated to carry out data entry and may have neither the skills to input the data nor the ability to understand its implications [42]. While some features of ERP systems such as validity rules for data entry, restrictions on type of data, display of possible entries and match code selections could minimize the possibility of errors, its implementation is still considered a challenge [42, 21].

Managerial decision processes depend largely on the individual decision-maker, the organization in which the decision-maker operates, and the quality of information provided. In fact, the flow of information within organizations instructs, informs and supports decision-making processes and the decision-maker, and can also act as a constraint on decision [43]. According to Gendron and others, several researchers in the past have proposed a number of approaches to understanding, assessing and improving information quality [44]. Information quality relates not only to the intrinsic quality of information but also to how the information will be used by stakeholders for various purposes and in different contexts. An improvement in the quality of decision support and the decision-making process is expected with the improved quality and quantity of information and data consistency facilitated by ERP systems.

### **3 Research Framework and Methodology**

Based on the above review of the literature, and the need for further research, this study investigated the impact of ERP systems on managerial decision-making. In particular, it investigated whether there was any improvement in the availability, visibility and usage of information in managerial decision-making and control consequent to the implementation of ERP systems and its relationship with the perceived improvement in organisational performance.

In line with the exploratory nature of this research, a case study method that involved an interpretive approach was adopted to capture its corresponding contextual richness

and complexity [45]. Interpretive research offers deep insight into the impact of information systems on various organizational dimensions [46] and attempts to understand the phenomena through the meanings that people assign to them [47, 48]. As the managers in the case study organization experienced the impact of ERP systems, their descriptions were expected to provide a sufficiently rich and contextualized foundation for understanding the phenomenon [49]. Like all interpretive studies, this study sought a subjective understanding of the conditions, practices and consequences of social action as expressed by the managers in their particular social context, and was therefore expected to reveal complexities and details that are commonly omitted in quantitative studies [49].

The case study organization is a manufacturing company that employs about 150 staff. It is part of a large manufacturing group that employs about 2000 people, has several plants, distribution centres and other facilities throughout Australia and the Asia-Pacific region. In 2001-2002, SAP R/3 was implemented in this unit. When the field study was conducted in 2004/2005, the unit had already had some experience of working with the ERP system. The organization was selected because of the access given to the researcher, its implementation of several modules, and therefore its potential as a rich organizational context in which to study the potential impact of ES on decision-making.

The participants included managers who were responsible for implementation of the enterprise system, and functional experts/operations managers who were responsible for managing the processes. A total of eleven people was interviewed to collect the primary data in this study. These people consisted of managers from various functional areas such as sales, production, materials/procurement, accounting, warehouse/distribution and human resources, and one general manager. Permission to conduct the study was negotiated with the Chief Operations Officer who authorized interviews to begin. The personal interviews were recorded and transcribed verbatim for data analysis.

As is typical in any case study research, this study had limitations, including lack of generalizability and subjective bias [45, 49]. The findings of this study were specific to the situation observed and provide anecdotal evidence. Although the organization was accessible for research, the extent of cooperation from different respondents in the organization was not uniform, and the respondents may have either overrated or underrated the impact of ERP systems [50]. Even though this company had had an ERP system in place for more than two years at the time of the study, it was possible that the impact of these systems on certain aspects might not have been seen immediately, and may have only become apparent after a relatively long period of time [50, 9]. Further, the limitations of studying a complex decision-making phenomenon influenced by the emotions, imagination and memories of decision-makers, the difficulty in isolating decision processes, and the difficulty in pinning down decision choices in time or in place, render it a complex subject for empirical research [51].

The limitations discussed above could thus have influenced the process as well as the outcomes of this study. However, these limitations are unlikely to have affected the validity and reliability of the outcomes significantly because the objective of the study was not to generalize, but to provide anecdotal evidence.

## 4 Study Findings and Discussions

Confirming previous research by Holsapple & Sena, implementation of ES in the case study organization supports and enhances the quality of decision-making processes. While some of the consequences were expected, there were also some unexpected and unintended outcomes. As pointed out by one respondent (respondent 8), *“the biggest impact is on people, their skills, knowledge, and in general the way we use information in management decision-making”*. The impact is discussed with reference to various themes examined in the literature review. The following discussion highlights some of those issues and provides anecdotal evidence gathered from the interpretation of the impact by the respondents in the study.

Decision-making is generally expected to be more information-based in an ERP environment. Increased visibility of information and its integrated view is expected to push the decision-making down to the shop floor level [52]. It is, however, observed that the impact on managers and the operating personnel differs according to their specific roles within the organization. For example, in the case of managers, it has resulted in an informed and improved decision-making capability, though it has not really changed the process of decision-making. As noted by one manager (respondent 4), *“a manager is better informed in ERP context, and can access the information from his seat. But the decision-making has not changed much.”* In contrast, another manager (respondent 3) noted that *“decision-making was made easier, because of greater accuracy of the information”*. Respondent 1 observed that *“there is vastly more information now ... but I am still doing things pretty much the way I used to do in the old system, it is just a lot easier and I have got a lot more information at my fingertips”*. Although no significant change to the process of decision-making was observed, the implementation of ERP systems has nevertheless contributed to the improved quality of decision-making for managers. As highlighted by the above three respondents, two key themes have emerged in this study – informed decision-making and the process of decision-making. Informed decision-making is made possible by the increased accessibility of information in real-time, and the improved quality of decision-making is feasible because of increased information and enhanced accuracy of information.

Commenting on the reduction in the number of decisions to be made, another manager (respondent 4) pointed out that *“there is probably less decisions to be made because of the fact that complete information is given to operating personnel”*. Suggesting that managerial decision-making is dependent upon the work of others, respondent 2 observed that *“I can do a lot with this information now ... and I can see a lot of my decisions are based upon things that other people do, like planning, sales, forecasting etc.”*. The way managers make decisions has also changed. Respondent 5 observed that *“we now have facts behind our beliefs ... Practically it reduces the time frame in which you can make a decision, any form of decision; we have to make decisions on the spot.”*

This contrasts with the views of some managers who perceived an improvement in the decision-making capability and improved decision-making process, while others pointed out that the reduction in the number of decisions to be made was interesting. It can be explained by the objective losses or gains in power consequent to the implementation of ES [53]. As Markus argued, the impact of information systems on decision-making and decentralization of controls is dependent upon individual roles

and tasks. It is possible that some units or individuals in the organization would find that they have lost power whereas others will find an increase in power. For example, respondent 3 observed that *“there is a significant change in our accounts payable section, our purchasing function did not have the same sort of weight as it has now and the transfer of accountability between the account payables and purchasing is fairly significant”*.

At the operating level, however, the change with regard to decision-making was not significant, other than some increase in workload. As pointed out by respondent 9, *“now they have to verify the work orders, material documents and log book regularly, and enter the information in the system. In the past, they just go and tell the supervisor/manager ... We don't have supervisors on the floor now, they all are gone.”* While pointing out that decision-making had changed for the better, one respondent noted that several managers who were responsible for making decisions in the past were no longer entrusted with those responsibilities as those decisions were now automated in the ERP systems context.

Contrary to past research by Psoinos and others [54], there was no empowerment of operating personnel and no change in the participation level of operating personnel in managerial decision-making in this organization. Whether the removal of direct supervisors is an indication of their increased role in decision-making or not, is not certain from this study. Access to the ES for operating personnel to do data entry is in a way limited by cost factors since the license fees are proportionate to the users.

In summary, anecdotal evidence suggests that improved decision-making capability is mostly the result of accuracy, completeness and instantaneous availability of information derived from the implementation of ES. Consequent to the ES implementation, there was no real ‘pushing down’ of decision-making to the operating personnel in this organization. It is not clear, however, whether this is because of the cost implications for providing access to the operating personnel or as a result of a deliberate move by management to limit diffusion of responsibility and decision-making. In the past, supervisors/managers appeared to possess that information and therefore were making the operating decisions. Now that the information is available to operating personnel, no further instructions are found to be necessary and the day-to-day decisions appear to be obvious. With the general de-layering of middle management positions consequent to changes in technology and management systems in general and enterprise systems in particular, operating personnel appear to be taking those minor operating decisions armed with complete and accurate information. It was observed that operating personnel viewed this as ‘intensification’ of their work rather than increased participation in decision-making.

ERP systems offered increased capability to supervise and have an effect on the control points [25]. It is argued that the recent trends of increased centralization of financial controls by senior management may actually be further accelerated with the help of ERP systems [55, 56]. Tighter controls over data are facilitated by ERP systems allowing management to continuously and accurately monitor and control performance of managers/operating personnel and units of organization. The knowledge that employees’ work is visible to managers in an ERP environment may actually improve self-discipline at the individual level [41]. The degree of managerial control improved in the case study organization primarily because of the increased visibility of information across the organization. As noted by one manager (respondent

3), *“centralization of information and control is the main theme”* in this implementation and every manager in the organization is aware of this and its consequences.

Referring to the transparency of work performed and the ability of senior managers to oversee the work remotely, respondent 8 noted, *“my colleagues and superiors can clearly see what I am doing”*. According to respondent 9, *“my role therefore now has to be faster, a lot cleaner and sharper. I have to maintain the records a lot more accurately and timely now, because I am very visible now.”* The ability of managers to track transactions and data systematically in an ERP environment appears to have facilitated better monitoring by managers. As pointed out by one manager (respondent 2), *“the supervision is more of supervision through the computer, through the system rather than physical means. Two strokes and you know who has done what. In the past, there were lots of ways they could ‘short circuit’ the system, but now, you have to do everything through the system and you can’t be funny about it.”*

Suggesting that the very nature of supervision had changed, respondent 2 observed that *“supervision more or less falls into the role of request for material or some information that don’t show up on the system ... In a way it is self correcting, it won’t let you do anything really stupid, and you can see every time you make a mistake and everybody else also can see that mistake.”* Respondent 1 commented that *“you are aware of these people seeing what you are doing, so therefore you take a lot more care to do what you do, so that in that way you improve your skills and efficiency; you are a little more self-conscious about the fact that you are so visible”*. Even though some individual managers/employees became self-conscious about such ‘surveillance’, this feeling may decrease over time, with the employees becoming used to the new environment. So, the long-term impact of this may be negligible.

Confirming the key benefits of ERP systems, information visibility and accessibility significantly increased in this organization consequent to ERP implementation, helping managers perform their tasks more efficiently and productively. Respondent 2 commented that *“it has become more central and control is a lot better. In the old system we were very decentralized and compartmentalized, nobody knew what anybody else was doing unless you specifically went and asked. Everything overlaps and impacts everything else. Little things like, just putting delivery date and updating delivery date on a weekly basis is vastly and vitally important now.”*

The findings of this study suggest that managerial control improved in the case study organization after the implementation of the ES. This is primarily because of the improved information visibility across the organization and the centralization of information, rather than as a result of any deliberate organizational redesign initiatives.

Past research revealed that ERP systems contribute to the decentralization of responsibilities to shop floor [41] and in the process result in a de-layering of middle management positions and empowerment of shop floor personnel [54]. Similarly, Shang and Seddon (2001) and Staehr and others noted a deskilling of employees and empowerment of operating personnel in ERP environments [22, 21]. Staehr and others observed that older and experienced users of the legacy systems were generally not able to adjust well to the new ERP environment and reportedly lost status in organizations [21]. One senior manager (respondent 1) in the case study organization observed that *“there is a significant change in the role of supervisors/managers. Some showed interest and moved and handled new things, and stayed on in new roles, while some others who did not take interest left the company.”*

In the case study organization, employees coped with the consequent changes of ERP implementation differently. Supporting the past research, this study observed that some long-term employees left the company or took retirement because of their inability or unwillingness to cope with the change when there was a significant loss of power to the individuals in question and/or to the units in which they were working, or when their roles had changed significantly. While some respondents viewed this as a good thing for the company in modern times, others noted the 'loss of knowledge'. *"It is one of the problems we got, people with lots of company knowledge actually left the company; the SAP system can't have everything and there is always some knowledge in people; if you lose a number of such old and experienced people, the company could become knowledge-poor ... It is a serious problem."* (respondent 4) Other managers, however, stayed put. To quote one senior manager (respondent 2), *"they have grinded their teeth and weathered the storm"*. Of course, if there is too much change, employees may choose to go. As mentioned by one respondent (respondent 5), this could be a real loss of 'corporate knowledge' or simply a part of 'corporate history' and depends upon the extent of change required – "if it is too much they will go".

In terms of the nature of work, the study observed that there was some reduction in transactions and paperwork. As noted by respondent 5, *"the most clear impact was the reduction in amount of transaction, the amount of journals we have to do now is much smaller than the past ... that obviously makes our monthly reporting times much easier to achieve"*. Suggesting that there is a considerable reduction of data entry in the new environment, respondent 3 noted that *"we had the ability to centralize our customer credit department now and it has saved us lots of money, and also in terms of [a] consistent approach [now used]"*. However, some respondents held contrasting views within the organization. Respondent 9 commented that *"we have made more paperwork now than I have ever seen in my life; I am not blaming the system, but maybe it is how we decided to do it, but our production orders, my God, are now in pages and pages; it used to be 4 or 5 pages in the past"*. Thus, the impact of ERP systems on paperwork is not uniform and is influenced by previous paperwork/documentation in the unit, extent of information use for decision-making before the implementation of the ES, and the power position of the unit within the organization. Therefore, as shown above, it appears that paperwork has been reduced in accounting and finance functions while there seems to be an increase in paperwork in production/logistics functions consequent to the implementation of the ERP system. Although the implementation of the ERP system has physically made certain tasks quicker to do, management expects the tasks to be performed more frequently and thus in real terms the workload has either increased or, at best, remained the same.

It is argued that there is an increased risk in a typical ERP environment because of the diffusion of responsibility of data entry to the operating level, delegation of responsibility to generate reports, and through exposure to the Internet and inter-organisational systems [57, 52]. Many ERP systems, however, are minimizing this risk by introducing generic security protocols and standards, and by incorporating appropriate management controls and risk management strategies [52]. Evidence from the analysis reveals that this was not an issue at all in the case study organization. Even though ERP systems typically expect the data entry responsibility to go down to

the operating level, it appears that this data entry responsibility was not given to all operating personnel in the organization. In fact, the number of users with access to data entry and/or changes to the data and records was restricted to managers and supervisory personnel. For example, some of the warehouse personnel on the floor were not given any access. Similarly, some staff on the production floor were also not given access to SAP. Instead, they were required to perform their duties on paper as per the previous system and the data was then entered by production planning staff and the warehouse supervisor. According to management, this limited access is primarily the result of cost implications (software costs are proportional to the number of users) rather than because of any potential risk of data entry errors or accountability issues. Even though this aspect was not explicitly refuted by any of the respondents, it is not possible to attribute limited access to only cost of access. It appears to be a simple issue of cost of access versus benefits of providing such access to operating personnel and the associated risk.

## **5 Summary of Findings and Contribution**

While some past studies have investigated the benefits and potential impact of ES on various organizational dimensions using quantitative methods, interpretive case studies that investigated the consequences of ERP systems after implementation on managerial decision-making are limited. Based on a survey of 53 companies in the USA, Holsapple and Sena noted that “the enterprise systems can indeed support decision making” and suggested further studies investigating the relationship between ERP objectives and decision support benefits [4]. Although largely anecdotal, interpretative in nature and limited to one case study organization, the findings in this paper, because of their rich contextual nature, provide some insights into the interactions and implications of ERP implementation and its effects on managerial decision-making and control. The study findings, though expected, and confirming the past research, in a modest way contribute to the knowledge on the consequences of implementing integrated information systems on decision-making. A brief summary of the findings is presented below:

- The decision-making capability of managers in the case study organization improved, primarily because of the increased accuracy, completeness and real-time availability of information, although the process remained same. Contrary to expectations, decision-making did not appear to be pushed down to the operating level. The limited capability of the ERP systems discussed in the literature and acknowledged by the ERP vendors was not a major issue in this organization. With the decision by management to progressively implement other decision support tools offered by the ERP vendor (for example, supply chain management and business intelligence tools), management indirectly acknowledged the limited decision support capability. Considering that this organization is a subsidiary of a large conglomerate, and that the managers interviewed were responsible for operational and tactical decisions, the findings

can be interpreted as a confirmation of the capability of ERP systems in supporting operational and tactical decisions.

- Centralization of information and the consequent increase in visibility and accessibility of information across the organization facilitated by the ERP system, contributed to improvements in managerial decision-making. In particular, it resulted in improved degree of control, standardization and managerial monitoring of the operational performance and reportedly resulted in improvements in organizational performance. Even though the past research argued that there would be an increased risk because of the diffusion of responsibility to the operating level, there was no evidence in this organization to suggest that such risk had gone up. Limited access influenced by cost factors was, according to senior management, the reason for limiting the access to operating personnel rather than any deliberate move to limit diffusion of responsibility to lower levels.
- Improvement in quality of information can be clearly attributed to the implementation of ERP systems. In general, implementation of ERP systems with adequate upskilling of managers and operating personnel contributes to an improved information culture characterized by the information discipline, centralization of controls and visibility. Though there is no direct evidence to suggest that this is so in the case study organization, this aspect appears to have indirectly contributed to the improvement in the decision-making process. It is believed that the consistency, accuracy and completeness of the information facilitated by the ERP system, improved the decision-making processes and outcomes in terms of consistency and efficiency. It is, however, difficult to isolate the impact of the ERP system on the quality of managerial decisions and to measure their effectiveness in this study; that can only be seen in time.
- Since the implementation of the ERP system covered several major applications, the effect of incomplete information and lack of integration of information across the organization was not noticed in this study. Considering that business intelligence tools are being implemented in the case study organization, it may now be possible to incorporate external information outside the ERP system into the decision-making processes.
- The study observed that the standard reporting tools available in the ERP system were inadequate. The organization has redesigned and reconfigured some tools for internal management control, thus confirming the previous research.
- Selective use of information and its impact on managerial decision-making is a complex factor and this study did not notice any significant issues relating to this aspect in the case study organization. These impacts, however, can only be seen in time and are not immediately discernable. Some anecdotal evidence, however, suggests that this is heavily dependent upon the individual managers and their roles. For example, a manager in accounting reportedly used the information selectively and configured a majority of the reports to suit their specific business requirements, while managers in logistics roles had no such choice and were strictly forced to use the existing reports provided by the ERP system.
- Information overload is an issue in this organization. While managers generally believed that the information is good and accurate, the increase in information management work load was typically felt by almost all the respondents. In time,

this will increase further. Confirming warnings from experts, information overload may become a major issue in time and dispel the myth that increased information will result in better decisions.

- This study observed that managerial desire for information is met by the ERP system and managers generally felt that they have adequate and accurate information at their disposal. Extended visibility and access to information, instead of reducing the need for communication between managers, however, has actually improved. Although it was difficult to evaluate whether the information provided by the ERP system more than meets managerial needs, anecdotal evidence in terms of general managerial satisfaction with the information available suggests that the organization has effectively matched its needs with its desires.

## **6 Conclusions**

ERP systems will continue to be consequential phenomena for years to come and nearly affect all aspects of organizational life throughout their operational lives. This paper reports on an interpretive case study analysis that investigated the impact of enterprise resource planning systems on managerial decision-making. With their integrative nature, increased quantity and quality of information, ERP systems and their impact on decision-making appear to be significant. The anecdotal evidence gathered from this case study confirms the previous research and concludes that ERP systems have contributed to the improved decision-making capability of managers. Armed with access to centralized, real-time and accurate information, managers are now under increasing pressure to perform, especially with senior management having the ability to oversee remotely in a real-time basis. This involves a culture shift for managers and operating personnel and forces information discipline (input discipline) across organizations, apart from applying pressure for improved performance. It is necessary to study further the interactions of these various complex variables in a range of organizational contexts that occur following the implementation of ES and to explore the differences and common patterns which occur. Understanding the changes to individuals' tasks, organizational structure and managerial aspects consequent to the implementation of such complex IT innovations (i.e. ERP systems), at a particular time in the history of an organization and/or over a period of time, is necessary. Such understanding will assist managers in the prediction and management of outcomes, and lead to full exploitation of the benefits of such IT-enabled innovations in organizations.

## References

1. Forrester Research (2005) "Market Overview "ERP Applications — The Technology And Industry Battle Heats Up," June 9.
2. Carton F. and Adam F.(2005) "Understanding the Impact of Enterprise Systems on Management Decision Making: An Agenda for Future Research", *The Electronic Journal of Information Systems Evaluation*, 8 (2), pp. 99-106.
3. Wah, L. (2000) "Give ERP a Chance", *Management Review*, Vol. 89, No. 3.
4. Holsapple, C.W. and Sena, M.P. (2005) "ERP plans and decision-support benefits," *Decision Support Systems*, Vol. 48, 575-590.
5. Kumar, K. and Hillergersberg, J., (2000) "ERP Experiences and Evolution", *Communication of the ACM*, 43(4), pp.23-26.
6. Zuboff, S.(1988) *In the Age of the Smart Machine: The Future of Work and Power*, Heinemann Professional Publications.
7. Sammon, D., Adam, F. and Carton, F.(2003) "The Realities of Benefit Realisation in the Monolithic Enterprise Systems Era- Considerations for the Future", in *Proceedings of the 10th European Conference on Information Technology Evaluation*, Madrid, Spain, September 25th-26th.
8. Poston, R. and Grabski, S.(2001) "Financial impacts of enterprise resource planning implementations", *International Journal of Accounting Information Systems*, December, pp 271-294.
9. Markus, M.L. and Tanis, C.(1999) "The enterprise systems experience – from adoption to success." In Zmud, R.W. (Ed) *Framing the Domains of IT Research: Glimpsing the Future Through the Past*, Cincinnati, OH: Pinnaflex Educational Resources Inc, pp. 173-207.
10. Ross, J.W. and Vitale, M.R.(2000) "The ERP revolution: Surviving vs. thriving," *Information Systems Frontiers*, 2, 233-241.
11. Somers, T.M. and Nelson, K.(2001) "The impact of critical success factors across the stages of enterprise resource planning implementations," *Proceedings of the 34<sup>th</sup> Hawaii International Conference on Systems Sciences*.
12. Scott, J.E. and Vessey, I. (2002) "Managing risks in enterprise systems implementations," *Communications of the ACM*, 45(4), pp.74-81.
13. Sheu, C., Chae, B. and Yang, C.(2004) "National differences and ERP implementation: issues and challenges," *Omega*, *The International Journal of Management Science* (32), pp. 361-371.
14. Barker, T. and Frolick, M.N.(2003) "ERP implementation failure: A case study," *Information Systems Management*, (20, 4), pp.43-49.
15. Hong, K.K. and Kim, Y.G.(2002) "Critical success factors for ERP implementation: An organisational fit perspective," *Information and Management*, 40(1), pp. 25-40.
16. Nah, F., Tan, X. and Teh, S.H., (2004) 'An Investigation on End-Users' Acceptance of Enterprise Systems', *Information Resources Management Journal*, Vol. 17, No. 3, July-September 2004, pp. 32-53.
17. Kawalek, P. and Wood-Harper, T.(2002) *The Finding of Thorns: User Participation in Enterprise System Implementation*," *Databases for Advances in Information Systems*, 33(1), pp.13-22.
18. Sia, S.K. and Soh, C.(2002) "Severity Assessment of ERP-Organisation misalignment: Honing on ontological structure and context specificity," in *Proceedings of the Twenty third International Conference on Information Systems*, pp. 723-729.

19. Sedara, V. and Gable, G. (2004) "A factor and structural equation analysis of the enterprise systems success measurement model," proceedings of the 25<sup>th</sup> International Conference on Information Systems, December, Washington D.C., pp.449-463.
20. Esteves, J. and Pastor, J. (2001), "Enterprise Resource Planning Systems Research: An Annotated Bibliography, Communications of AIS, 7(8).
21. Staehr, L., Shanks, G., and Seddon, P.(2002) "Understanding the Business Benefits of Enterprise Resource Planning Systems," in Proceedings of the Eighth Americas Conference on Information Systems, pp. 899-906.
22. Shang, S. and Seddon, P.(2001) "A Comprehensive Framework for Classifying the Benefits of ERP Systems," in proceedings of the Sixth Americas Conference on Information Systems, Long Beach, California, August, pp. 286-290.
23. Holsapple, C. W. and Sena, M. P.(2003) "The Decision-Support Characteristics of ERP Systems", International Journal of Human-Computer Interaction, 16(1), pp.101-123.
24. Fahy, M.J., and R. Lynch, (1999) "Enterprise Resource Planning (ERP) Systems and Strategic Management Accounting", paper presented at the 22<sup>nd</sup> annual conference of the European Accounting Association, Bordeaux, 5-7 May
25. Granlund, M. and Malmi, T.(2002) "Moderate impact of ERPs on management accounting: a lag or permanent outcome?" Management Accounting Research, 13(3), pp.299-321.\
26. Booth, P, Matolcsy, Z. and Weider, B., (2000) "The impacts of Enterprise Resource Planning systems on Accounting Practice – The Australian Experience," Australian Accounting Review, vol.10, no.3, pp.4-18.
27. Davenport, T.H., Harris, J.G. and Cantrell (2004) S. "Enterprise systems and ongoing process change," Business Process Management Journal, 10(1), pp.16-26.
28. Stanek, S., Sroka, H., & Twardowski, Z.(2004) "Directions for an ERP-based DSS", Decision Support in an Uncertain and Complex World: The IFIP TC8/WG8.3 International Conference 2004
29. Davenport, T.H. (2000) Mission Critical: Realizing the Promise of Enterprise resource planning systems, Harvard Business School Press, Boston.
30. Stefanou, C.J.(2001) "Organisational Key Success Factors for Implementing SCM / ERP Systems to Support Decision Making", Journal of Decision Systems, Vol. 10, No. 1, pp.49-64.
31. Fahy, M.J. (2000) "Strategic Enterprise Management: The Implications for Management Accounting and Control," Paper presented at the 23<sup>rd</sup> Annual conference of the European Accounting Association, Munich, 29-31 March.
32. Adam, F. and Doyle, E. (2001) Enterprise Resource Planning at Topps International Ltd, a case study in Exploring Corporate Strategy, John & Scholes, 6<sup>th</sup> edition, Prentice Hall.
33. Pfeffer, J. (1992) "Managing with Power, Politics and Influence in Organisations, Harvard Business School Press, Boston, MA.
34. Eppler, M.J. & Mengis, J, (2003) "A Framework for Information Overload Research in Organizations. Insights from Organization Science, Accounting, Marketing, MIS, and Related Disciplines", #1/2003 ICA Working Paper, University of Lugano, Lugano.
35. Chewning, E. C., Jr., & Harrell, A. M. (1990) The effect of information load on decision makers' cue utilization levels and decision quality in a financial distress decision task. Accounting, Organizations and Society, 15: 527-542.
36. Schick, A. G., Gorden, L. A., & Haka, S. (1990) Information overload: A temporal approach. Accounting Organizations and Society, 15: 199-220.
37. Schroder, H. M., Driver, M. J., & Streufert, S. (1967) Human information processing – Individuals and groups functioning in complex social situations. New York: Holt, Rinehart, & Winston.
38. Haksever, A. M. & Fisher, N. (1996) A Method Of Measuring Information Overload In Construction Project Management. Proceedings CIB W89 Beijing International Conference, 310-323.

39. Iselin, E. R. (1993) The effects of the information and data properties of financial ratios and statements on managerial decision quality. *Journal of Business Finance & Accounting*, 20: 249-267.
40. Schneider, S. C. (1987) Information overload: Causes and consequences. *Human Systems Management*, 7: 143-153.
41. Sia, S.K., Tang, M., Soh, C. and Boh, W.(2002) "Enterprise Resource Planning (ERP) Systems as a Technology of Power: Empowerment or Panoptic Control?" *The Database for Advances in Information Systems*, 33(1), pp. 23-37.
42. Xu, H., J.H. Nord, N. Brown and G.D. Nord, 2002, "Data quality issues in implementing an ERP," *Industrial Management & Data Systems*, 102, 1: 47-58.
43. Pomeroy, J., & Adam, F.(2004) "Practical Decision Making – From the Legacy of Herbert Simon to Decision Support Systems", *Decision Support in an Uncertain and Complex World: The IFIP TC8/WG8.3 International Conference 2004*
44. Gendron, M., Shanks, G., & Alampi, J.(2004) "Next Steps in Understanding Information Quality and Its Effect on Decision Making and Organizational Effectiveness", *Decision Support in an Uncertain and Complex World: The IFIP TC8/WG8.3 International Conference 2004*.
45. Yin, R.(2003) *Case Study Research: Design and Methods*, third edition, Thousand Oaks, CA: Sage Publications.
46. Klein, H.K. and Myers, M.D.(1999) "A Set of Principles for Conducting an Evaluating Interpretive Field Studies in Information Systems," *MIS Quarterly*, 23(1), pp. 67-93.
47. Deetz, S.(1996) "Describing Differences in Approaches to Organization Science: Rethinking Burrell and Morgan and their Legacy," *Organization Science*, 7(2), pp.191-207.
48. Orlikowski, W.J. and Baroudi, J.J. (1991) "Studying Information Technology in Organizations: Research Approaches and Assumptions," *Information Systems Research*, 2,(1), pp.1-28.
49. Mason, J. (2002) *Qualitative Researching* (2<sup>nd</sup> edition), Sage Publications, London.
50. Willcocks, L. and Lester, S.(2002) "In Search of Information Technology Productivity: Assessment Issues," in L. Willcocks, L. and S. Lester (Eds), *Beyond the IT Paradox*, John Wiley & Sons, Chichester: 2002, pp. 60-97.
51. Langley, A., Mintzberg, H., Pitcher, P., Posada, El and Saint-Macary, J. (1995) "Opening up Decision Making: The View from the Black Stool," *Organization Science*, Vol. 6, No.3, pp.260-279.
52. Hanseth, O., Ciborra, C. and Braa, K.(2001) "The Control Devolution: ERP and the Side Effects of Globalization," *Database for Advances in Information Systems*, 32,(4), pp. 34-46.
53. Markus, L.(1983) "Power, Politics, and MIS Implementation," *Communications of the ACM*, 26(6), pp.430-444.
54. Psounos, A., Kern, T. and Smithson, S.(2000) "An exploratory study of information systems in support of employee empowerment," *Journal of Information Technology*, 15, pp.211-230.
55. Caglio, A.(2003) "Enterprise Resource Planning systems and accountants: towards hybridization?" *European Accounting Review*, 12 (1), pp. 123-153.
56. Seethamraju, R. (2005) "Enterprise Resource Planning Systems – Implications for Managers and Management," *Australian Accounting Review*, Vol. 15, No.3, pp.90-96.
57. O'Leary, Daniel E.(2000) *Enterprise Resource Planning Systems: Systems, Life Cycle, Electronic Commerce, and Risk*, Cambridge University Press, Cambridge.