

ERP plans and decision-support benefits

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Abstract

Management and implementation of Enterprise Resource Planning (ERP) systems have tended to concentrate on their transactional and record-keeping aspects, rather than on their decision-support capabilities. This paper explores connections between ERP systems and decision support based on the perceptions of 53 ERP system adopters. It offers new insights into the important objectives that are (and should be) considered in ERP plans, including decision-support objectives. It provides insights into the decision-support benefits of ERP systems. The study also examines relationships between the importance of various objectives in ERP planning and the subsequent realization of decision-support benefits from an ERP system.

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1. Introduction

Over the past decade, organizations have spent billions of dollars implementing enterprise resource planning (ERP) systems. Objectives of adopters of ERP systems have focused primarily on improving transaction handling through the standardization of business processes and integration of operations and data [6,8]. However, Davenport [7] suggests the “need to make sound and timely business decisions” as a major reason for ERP. In a field study of six ERP

implementations, Palaniswamy and Frank [22] describe the need for organizations “to digest the vast amount of information from the environment and make fast decisions” and the need to “work together and sometimes with other organizations” to make strategic decisions. In a study focused on the need to link ERP systems with both external and internal data, Li [18] identifies the need for “generating business intelligence that matters” as a primary key to the next generation of ERP systems.

Beyond the need for decision support via ERP, there is evidence that ERP indeed offers features that support decision making. A case study of Earthgrains [8] describes several elements of an ERP system in addition to those used to create, capture, and store transactional data. These elements include tools for data communications, data access, data analysis and presentation, assessing data context, synthesizing data

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from other sources, and assessing completeness of data. A survey [15] of adopters has examined the extent to which 16 decision-support characteristics are exhibited by their ERP systems. Overall, it finds that adopters perceive decision-support characteristics exhibited to a moderate degree by their ERP systems, and those exhibited to the greatest degree are the provision of a repository of knowledge for solving problems and mechanisms to facilitate communication within an organization.

Granted that there is a need for decision support via ERP and that decision-support characteristics can be exhibited by ERP implementations, to what extent do organizations realize decision-support benefits from ERP systems? In addition to answering this question, we seek to learn about the level of importance given to decision support during project planning, and whether there is a connection between objectives of an ERP plan and decision-support benefits of the implemented ERP system. We contend that a better understanding of ERP objectives, decision-support benefits, and their connections can benefit ERP planners, adopters, and vendors, as well as expand the foundation for future ERP and decision-support system (DSS) research.

Sections 2 and 3 review prior literature on ERP objectives and decision-support benefits as a basis for constructing a survey instrument. Section 4 describes the study's methodology along with a profile of respondent demographics. Section 5 reports findings on the importance of various objectives in planning an enterprise system project, including actual importance ascribed to the objectives, perceptions of the importance that should be given to each, and a comparison of the actual versus normative. Section 6 reports the degree to which specific decision-support benefits are perceived to be provided by ERP systems. Section 7 examines the relationship between ERP objectives and decision-support benefits that are realized. We conclude with a discussion of this study's main findings and suggestions for future investigations.

2. ERP objectives

Developing a plan for introducing an ERP system into an organization is a challenging endeavor involving a host of considerations ranging from ERP soft-

ware selection and configuration, to revision of business practices, to securing sufficient ERP development and operating staff, to the process of "going live" with the ERP system. The plan necessarily involves technical, human, organizational, and economic issues. Whatever the nature of the plan, its starting point is an understanding of the ERP project's objectives.

Lonzinsky [19] contends that there are seven general objectives that companies seek to accomplish by installing new enterprise software packages:

1. Drastically reduce the size and cost of the company's informatics sector;
2. Decentralize information processing by making data available in real time without dependence on the MIS department;
3. Provide technology tools that permit simplification of accounting, finance, and administrative functions, as well as the generation of management reports to maintain processes of control and business management;
4. Create a base to support growth with reduced proportional internal support costs;
5. Achieve a better balance between decentralization and control among functions to avoid duplication, ensure synergy, and manage performance indicators;
6. Electronically exchange information and orders with major clients to decrease costs;
7. Employ new technologies to keep pace with or surpass those of competitors.

There is no indication of the relative importance that organizations place on such objectives when planning an enterprise system project.

Cooke and Peterson [6] conducted an empirical study of 162 adopters of SAP's enterprise software. They found that, in order of importance, the top eight reasons why companies implemented enterprise systems were as follows: standardize company processes, integrate operations or data, reengineer business processes, optimize supply chain or inventory, increase business flexibility, increase productivity/reduce number of employees, support globalization strategy, and help solve the year 2000 (Y2K) problem. There is no indication of how much more important any one of these objectives is than those that follow it; nor is

there any indication of the magnitude of importance ascribed to any of the objectives.

Although some of the foregoing ERP objectives (e.g., data and process integration) would seem to have implications for organizational decision support, nowhere is decision support explicitly recognized as a major reason for implementing ERP systems. To explore the importance of decision-support objectives during enterprise system planning, we prepared a survey instrument that augments the top eight objectives reported by Cooke and Peterson with five that explicitly refer to decision support. Using 7-point Likert scales, the instrument asks how important each of the 13 objectives was in planning an enterprise system project. It then asks what degree of importance should have been placed on each of the 13 objectives, given the organization's ERP experiences to date.

Four of the decision-support items concern objectives of supporting various types of decision situations: (1) one person making an individual decision; (2) multiple people jointly contributing to making a decision; (3) multiple people involved in making inter-related decisions; and (4) people both inside and outside of an organization involved in making cooperative or negotiated decisions. A fifth item is concerned with shifts in the locus of decision making.

(1 and 2) Much DSS literature has focused on systems that aid individual and group decision makers (e.g., Ref. [16]). It is conceivable that such decision makers could be supported by tapping into an ERP system. Thus, our instrument asks about the extents to which supporting individual decision makers and joint decision makers were considered as objectives in ERP plans. It also asks about the importance that respondents believe should be given to these objectives in ERP planning.

(3) Over the past decade, technological advances have made organizational decision-support systems (ODSSs) increasingly feasible. Although the concept of an ODSS has evolved over many years [1,12,13], no study has examined an ERP system functioning as a type of ODSS. Yet, ERP and related systems perform functions similar to those described for custom-built ODSSs [24]. Support for inter-related decision making is one element that can distinguish an ODSS from other systems. For example, Carter et al. [3] define an ODSS as “a common set of tools used by multiple participants from more than one organi-

zational unit who make interrelated, but autonomous decisions”. ERP systems, by integrating processes and knowledge from distinct units, have the potential to provide substantial support for inter-related decision making. This is evidenced by Palaniswamy and Frank's [22] statement that ERP systems provide “related functions with information they require to work efficiently” and help to fulfill the “need for organizations as a whole to work together”. Hence, the instrument asks about the importance of treating such support as an objective in ERP planning, both descriptively and normatively.

(4) Another type of decision support that has grown in technical feasibility over the past decade is transorganizational, where a decision maker is comprised of representatives from multiple organizations. Because of the proliferation of the Internet and global networks, organizations are increasingly connected to one another, not only for the purpose of transacting and exchanging data but also for making collaborative or negotiated decisions [4]. ERP systems can serve as platforms for transorganizational exchange. As Kumar and van Hillegersberg [17] note, ERP systems are presently considered necessary “for being connected to other enterprises in a networked economy”. Similarly, Palaniswamy and Frank [22] note that ERP systems can fulfill the need “to work with other organizations as a virtual corporation to make strategic decisions and achieve competitive gains”. The instrument examines the extent to which enabling this connectivity translates into an important role for transorganizational decision support in ERP planning.

(5) The fifth decision-support item stems from ERP's integrated databases that furnish a consistent base of real-time knowledge for retrieval. As a result of this integration, any decision maker can be granted access to relevant knowledge, and thus be empowered to make a decision. Zygmunt [32] points out that ERP creates a system whereby “everyone from the chief executive down to the machine operator can get business critical information instantly”. This may allow organizations to shift the responsibility of making particular decisions. While this shift could have negative consequences in some organizations, others are likely to benefit from the ability to decentralize decision-making responsibilities. The instrument therefore asks whether supporting such decisional

shifts has been (or should be) an important objective in ERP planning.

3. Decision-support benefits

ERP objectives are driving forces behind ERP plans, which, in turn, shape the benefits ultimately realized from ERP adoption. According to more than a dozen ERP users and analysts, return on ERP investment depends much more on the plan an organization has for using the system than on the technology itself [26]. Moreover, poor planning has been cited as a major reason why ERP implementations fail [30]. Sponsors of ERP projects need to understand that return on ERP investment can have both quantifiable aspects (e.g., cost savings, revenue gains) and intangible aspects such as improved customer service [27]. Our focus in this paper is on the decision-support benefits, be they quantifiable or qualitative.

Through interviews conducted with 23 ERP managers, Market Data Group found important perceived benefits from ERP adoption to be standardizing or improving business processes, lowering costs, solving Y2K problems of legacy systems, and accommodating corporate growth or market demand [5]. Sources of cash benefits included reduction in people focused on transaction processing, operational efficiencies, reductions in training and technical support staff, better inventory management, and fewer people needed to support sales growth. Sources of intangible benefits included better compliance with customer requirements, improved system reliability, higher data quality, and greater agility in implementing new businesses. With one exception, no mention of decision-support benefits was reported. One manager predicted that the greatest ERP payoff in her organization a year in the future would be “decision-making opportunities that we think we’ll have on real data”.

Heretofore, there has been no detailed examination of the extent to which decision-support benefits accrue to ERP adopters, or the extent to which they relate to various objectives in an ERP plan. Indeed, it has even been claimed that although “organizations have found that ERP packages offer benefits supporting transaction processing, they haven’t been so successful in using them for decision processing” [31]. The empirical results reported in this paper give

ERP adopters a sense of decision-support opportunities that may be applicable in their own organizations, and the linkages of those to their ERP plans’ objectives.

Decision-support benefits have been identified and discussed by several DSS researchers, although not in connection with ERP systems. Udo and Guimares [29] reviewed the literature related to DSS benefits and conducted a subsequent empirical study to gather the views of DSS adopters about such benefits. They concluded by advancing eight ways for gauging DSS benefits: overall cost effectiveness of DSS, overall user satisfaction with the DSS, degree to which a DSS enhances decision-making processes, degree to which a DSS enhances company competitiveness, degree to which a DSS enhances communication within an organization, degree to which a DSS enhances user productivity, degree to which a DSS provides time savings, and degree to which a DSS reduces costs.

From a different vantage point, an examination of DSS abilities suggests potential DSS benefits [16]. These include the capacity of a DSS to enhance a decision maker’s ability to process knowledge, enhance a decision maker’s ability to handle large-scale or complex problems, shorten the time associated with making a decision, improve the reliability of decision processes or outcomes, encourage exploration or discovery by a decision maker, reveal or stimulate new approaches to thinking about a problem space or decision context, furnish evidence in support of a decision or confirmation of existing assumptions, and create a strategic or competitive advantage over competing organizations. Others have subsequently listed similar potential benefits [20,28].

The foregoing lists refer to benefits that can potentially be achieved by all types of DSSs, regardless of whether the decision maker is an individual or comprised of multiple participants. Additional benefits can be found in the abilities of DSSs that support decision-making efforts of persons working together in a decision process (e.g., working as a group, hierarchic team, or organization). DeSanctis and Galupe [10] have advanced a three-level classification of systems that support group decision makers. Their classification suggests three categories of benefits that can be provided: reducing communication barriers, reducing uncertainty and noise, and regulating decision processes. These potential benefits are applicable

not only to groups, but also to support other kinds of multiparticipant decision makers [16].

Table 1 summarizes the foregoing benefits and shows the corresponding items used in the survey instrument. These items are shown in the order in

Table 1
Decision-support benefits

Benefit	Survey item
Better knowledge processing [16]	Enhances decision makers' ability to process knowledge
Better cope with large/complex problems [16]	Enhances decision makers' ability to tackle large-scale complex problems
Reduced decision time [16,29]	Shortens the time associated with making decisions
Reduced decision costs [16]	Reduces decision-making costs
Greater exploration/discovery [16,29]	Encourages exploration or discovery on the part of decision makers
Stimulates fresh perspective [16]	Stimulates new approaches to thinking about a problem or a decision context
Substantiation [16]	Provides evidence in support of a decision or confirms existing assumptions
Greater reliability [16]	Improves the reliability of decision processes or outcomes
Better communication [10,16,29]	Enhances communication among participants involved in jointly making a decision Enhances communication among participants involved in inter-related decision making Enhances communication among decision-making participants across organizational boundaries
Better coordination [10,16]	Improves coordination of tasks performed by an individual making a decision Improves coordination of tasks performed by participants jointly making a decision Improves coordination of tasks performed by participants involved in inter-related decision making Improves coordination of tasks performed by decision-making participants across organizational boundaries
Greater satisfaction [29]	Improves satisfaction with decision processes Improves satisfaction with decision outcomes
Decisional empowerment	Enables decentralization and employee empowerment in decision making
Competitive advantage [16,29]	Improves or sustains organizational competitiveness

which they appeared in the instrument. Three of the benefits resulted in multiple survey items. ERP systems may improve the coordination of decisional tasks performed by an individual, by multiple persons working together, by multiple persons making inter-related decisions, and by persons involved in trans-organizational decisions. Similarly, communication may be enhanced for each of the multiparticipant situations. For the satisfaction benefit, the instrument distinguishes between satisfaction with decision processes versus decision outcomes. For each survey item in Table 1, a 7-point Likert scale is used to measure the extent to which an organization's enterprise system enables the benefit to be achieved.

4. Methodology and demographics

The instrument for gauging objectives and decision-support benefits was pilot tested by ERP practitioners and scholars, resulting in minor alterations to instructions and item wording. The topic of this study mandates that respondents be familiar with both the objectives and benefits of their organization's enterprise system. Potential respondents were identified from the Web site of an ERP periodical called ERP-World, which summarized specific implementations, and from vendor web sites (e.g., Refs. [23,25]) that list selected customers. The American Big Business Directory was employed to ascertain mailing addresses.

Excluding those returned to the sender as undeliverable, surveys were mailed to 553 organizations. The 53 responses yielded a response rate of about 10%. Respondent demographics, summarized in Table 2, indicate the primary business activity of respondent organizations is spread widely across various industries, none accounting for greater than 25% of responses. The most common industries were high technology, automotive, and consumer products. Most of these organizations are well known, Fortune 1000 companies.

Respondents were sought for four of the leading enterprise software vendors: SAP, Peoplesoft, Oracle Applications, and J.D. Edwards. Table 2 shows the distribution of primary vendors identified by respondents for three major ERP modules: human resources, logistics, and financials.

Table 2

Respondent demographics

Business activity of respondent organizations

- High Technology—23%
- Automotive—9%
- Consumer Products—8%
- Retail—8%
- Education/Research—6%
- Health Care—4%
- Utilities—4%
- Other/Not Specified—38%

Respondent functional area

- Information Systems—44%
- Business Function—29%
- Functional Information System (e.g., Financial Systems)—12%
- Other/Not specified—14%

Enterprise system vendor

- Human Resources
 - Peoplesoft—47%
 - SAP—19%
 - Other—34%
- Logistics/Manufacturing
 - SAP—28%
 - Oracle Applications—9%
 - J.D. Edwards—9%
 - Other—54%
- Financials
 - SAP—37%
 - Peoplesoft—23%
 - Oracle Applications—16%
 - J.D. Edwards—11%
 - Other—13%

ERP project teams typically include members from Information Systems and other business units impacted by the system such as Human Resources, Finance, and Operations. Respondents include high-level managers with such job titles as CIO, information systems director, project leader, CFO, and human resources manager. Respondents have been with their current organizations for a median of 8 years and have a median of 5 years of experience with enterprise systems.

ERP surveys suggest that organizations may need at least several months before they begin to realize expected benefits from their ERP implementations [6]. In the present study, 30% of organizations have “gone live” with (implemented) the majority of their modules more than 3 years ago, 51% had implemented them 1 to 3 years ago, and 13% had implemented them 6 months to 1 year ago.

5. Importance of ERP system objectives

Prior studies [6,19] do not identify support for decision making as a reason for adopting ERP systems. Thus, one might expect the decision-support objectives in our survey to be perceived as being unimportant relative to the traditional objectives extracted from the Cooke and Peterson survey. Indeed, the overall mean of the traditional items (4.47) exceeds that of the decision-support items (4.08), with the difference being statistically significant at the 0.05 level. Nevertheless, the results depicted in Table 3 indicate that organizations did, in fact, consider four of the individual decision-support objectives to be fairly important while planning their ERP projects (e.g., at least comparable in importance to two of the top four objectives

Table 3

Importance placed on enterprise system objectives

Objective	Mean ^a	Cooke and Peterson Ranking
Integrating operations or data	5.28	2
Increasing productivity	5.19	6
Standardizing company processes	4.74	1
Increasing business flexibility	4.57	5
Solving the Year 2000 Problem	4.50	8
Shifting responsibility of decision making (by empowering people with knowledge they would not otherwise have)	4.35	^b
Supporting situations where multiple people in organization are involved in making inter-related decisions	4.32	^b
Supporting situations where multiple people in organization jointly contribute to making a decision	4.32	^b
Reengineering business processes	4.23	3
Supporting situations where a person in organization makes an individual decision	4.20	^b
Supporting globalization strategy	3.85	7
Optimizing supply chain	3.37	4
Supporting situations where people both inside and outside of organization are involved in making cooperative or negotiated decisions	3.17	^b
Mean of Cooke and Peterson Items	4.47	
Mean of Decision-Support Items	4.08	

^a On a 7-point scale with end-points labeled “Extremely important” and “Not at all important” and a middle point labeled “moderately important”.

^b Decision-support item (not included in Cooke and Peterson study).

found by Cooke and Peterson—reengineering business processes and optimizing supply chain).

The objectives with the five highest means come from the Cooke and Peterson study. Increasing productivity and integrating operations or data are reported to have been the most important considerations in planning an ERP project. These are followed by standardizing company processes, increasing business flexibility, and solving the Y2K problem. In the same neighborhood as these three items, there is a cluster of four decision-support objectives: shifting responsibility of decision making, supporting inter-related decision making, supporting multiple persons working jointly on a decision, and supporting individual decision makers. The objective of supporting trans-organizational decision making was treated as least important in ERP planning. With this single exception, the mean response for each decision-support objective exceeded the “moderately important” level.

It is interesting that the rankings of traditional objectives in Table 3 do not match the Cooke and

Peterson rankings. For example, in their study, increasing productivity was ranked sixth while it is tied for first in this study. Similarly, they reported supply chain optimization as the fourth most important objective while it is rated as second-to-last in this study. Possible reasons for the ranking differences include the timing and subjects for the two studies. Cooke and Peterson focused only on SAP implementations. Their data set was collected in early 1997 and includes respondents from various countries (58% were from the Americas). 80% of their respondents began their implementations in 1993. This study focuses on U.S. organizations only, includes other ERP vendors (in addition to SAP), and has some respondents with more recent implementations.

While Table 3 shows the importance that respondent organizations actually placed on ERP objectives, additional insight can be gained by examining respondent viewpoints about what importance should (based on their organization’s experiences) be placed on these objectives. Table 4 shows the objectives ranked by

Table 4
Mean normative importance versus mean actual importance for each objective in ERP planning

Objective	Importance that should be given	Importance that was given	Difference	Significance*
Integrating operations or data	6.17	5.28	0.89	0.00
Standardizing company processes	6.08	4.74	1.34	0.00
Supporting situations where multiple people in organization are involved in making inter-related decisions	5.65	4.32	1.33	0.00
Increasing productivity	5.64	5.19	0.45	0.02
Increasing business flexibility	5.62	4.57	1.05	0.00
Reengineering business processes	5.59	4.23	1.36	0.00
Shifting responsibility of decision making (by empowering people with knowledge they would not otherwise have)	5.55	4.35	1.2	0.00
Supporting situations where multiple people in organization jointly contribute to making a decision	5.46	4.32	1.14	0.00
Supporting situations where a person in organization makes an individual decision	5.00	4.20	0.8	0.00
Supporting situations where people both inside and outside of organization are involved in making cooperative or negotiated decisions	4.87	3.17	1.7	0.00
Optimizing supply chain	4.83	3.37	1.46	0.00
Supporting globalization strategy	4.66	3.85	0.81	0.00
Solving the Year 2000 problem	3.56	4.50	−0.94	0.00

* *P*-value for test of hypothesis that difference in means is 0.

normative importance plus the difference between the normative and actual importance placed on each ERP objective. At first glance, it may seem that [Tables 3 and 4](#) contain similar results. Integrating operations or data is the most important ERP objective in both tables. Traditional objectives of standardizing company processes, increasing productivity, and increasing business flexibility also rank highly in both tables. Similarly, the objectives of optimizing supply chain and supporting globalization strategy rank near the bottom.

Nevertheless, there are two striking differences between the tables: decision-support objectives move up in the normative importance ranking and the magnitude of normative means are substantially different from those of actual importance. The importance ranks for decision-support objectives in actual ERP planning ranged from 6 to 13. With the benefit of hindsight, respondents elevate the importance ranks for decision-support objectives to a normative range of 3–10. The objective of supporting inter-related decisions vaults from seventh in importance for actual ERP plans to the third most important normative objective. Transorganizational decision support jumps from the least important objective in actual practice to the tenth position in the normative ranking. The mean importance for each of the decision-support objectives is well above the normative scale's midpoint. Thus, the respondents recommend that each decision-support objective should play an important role in ERP planning, that the importance of decision-support objectives relative to traditional objectives in ERP planning should be elevated, and that ERP planners should give particular attention to support of inter-related decision making.

[Table 4](#) shows the mean difference between the importance organizations actually placed on each objective and the importance that respondents believe should be placed on it. As reflected in the *P*-value column of [Table 4](#), each of the differences is significantly greater than zero except for the Y2K objective which has a difference that is significantly less than zero. The magnitude and significance of the positive differences indicates that objectives are not given sufficient importance during ERP planning. The objectives with largest difference are support for transorganizational decisions and supply chain optimization. Perhaps, many organizations that gave relatively little attention to these objectives during ERP planning (recall [Table 3](#)) are now considering ways

that their ERP systems can be used to link with suppliers, business partners, and other participants outside of the organization.

Excluding the Y2K objective, the average positive difference between normative and actual importance is 1.13, a substantial 26% increase over the 4.30 mean of actual importance given to those objectives. Separating the decision-support and traditional objectives (exclusive of Y2K) yields a marked contrast. On average, the normative importance exceeds the actual for decision-support objectives by 1.23 (30% above the actual 4.08 mean) versus 1.05 (23% above the actual 4.46 mean) for traditional objectives. Thus, while traditional objectives are seen as having been under-emphasized in ERP planning, the shortfall is more pronounced for decision-support objectives. Based on their ERP experiences, the respondents' clear message is that all objectives (except dealing with Y2K) need to play considerably more important roles in shaping ERP plans and that the greatest increase in planning attention should be directed toward decision-support and transorganizational objectives. Specifics about how to increase the importance of various objectives in ERP planning, best practices for doing so, and the results of doing so are topics for future research.

6. Decision-support benefits of ERP systems

Having established that decision-support objectives have been important in ERP planning and that they should be even more important, we now look at the decision-support impacts that enterprise systems have on organizations. The extent to which these systems provide support for decision making has not previously been formally studied. The results of our survey indicate that ERP systems do indeed offer substantial decision-support benefits. Overall, the mean of decision-support benefits is 4.38 (on a 7-point scale). As shown in [Table 5](#), each of the benefits has a mean near or above the mid-point of the survey scale. The top six decision-support benefits have medians of 5; the others have medians of 4. Given that ERP systems offer at least moderate decision-support benefits, it is important for both vendors and adopters to examine which particular benefits are perceived to be furnished more extensively than others.

Table 5

Degree to which enterprise system enables organizations to achieve decision-support benefits

Decision-support benefit	Mean ^a
Enhances decision makers' ability to process knowledge	4.84
Improves the reliability of decision processes or outcomes	4.73
Provides evidence in support of a decision or confirms existing assumptions	4.65
Improves or sustains organizational competitiveness	4.65
Shortens the time associated with making decisions	4.59
Enhances decision makers' ability to tackle large-scale complex problems	4.59
Reduces decision-making costs	4.51
Improves coordination of tasks performed by participants jointly making a decision	4.47
Improves coordination of tasks performed by an individual decision maker	4.39
Enhances communication among participants involved in jointly making a decision	4.35
Improves coordination of tasks performed by participants making inter-related decisions	4.33
Enhances communication among participants involved in making inter-related decisions	4.27
Enhances communication among decision-making participants across organizational boundaries	4.25
Improves coordination of tasks performed by decision-making participants across organizational boundaries	4.16
Enables decentralization and employee empowerment in decision making	4.15
Encourages exploration or discovery on the part of decision makers	4.14
Stimulates new approaches to thinking about a problem or a decision context	4.14
Improves satisfaction with decision processes	4.03
Improves satisfaction with decision outcomes	3.98

^a On a 7-point scale with end-points labeled "to a great extent" and "not at all" and a middle point labeled "moderately".

A major advantage of ERP systems over traditional functional systems is the integrated, centralized database that "dramatically streamlines flow of information throughout a business" [7]. The four greatest decision-support benefits shown in Table 5 appear to be based on this integrated knowledge repository. Such a repository gives decision makers the means for enhancing knowledge processing, making more reliable decisions, making decisions more rapidly, and gathering evidence in support of their decisions. It may also be the basis for an enhanced ability to handle large or complex problems.

The next two most highly rated benefits, improvement of competitiveness and reduction of decision costs, concern overall impact of ERP usage on an organization. Although there have been failures of ERP systems in such organizations as FoxMeyer Drug and Hershey [7,26], our results indicate that, on average, managers perceive that ERP systems have a positive impact on competitiveness. The link between ERP and organizational competitiveness is clearly a promising area for academic research.

Because ERP systems are not typically promoted as supporting multiparticipant decision making, it may seem somewhat surprising that enhanced coordination and communications within multiparticipant decision makers are perceived as substantial ERP benefits. However, selected ERP modules contain functionality that is similar to descriptions of ODSSs [12,24]. ODSS research is not nearly as well developed as research related to individual or group DSSs, but the survey results suggest that ERP and related systems (e.g., supply chain management systems, customer relationship management systems) could usefully be studied from an ODSS perspective.

The benefits viewed as least extensive are those related to transorganizational decision making, to user-satisfaction, and to stimulating new ideas and encouraging exploration. The low ranking of satisfaction items could be regarded as surprising in light of the high rankings of seemingly related items (e.g., processing knowledge, quicker decisions). However, early versions of ERP systems are known for their difficulty of use. For example, Caldwell and Stein [2] report that at Amoco, managers "found SAP to be so unfriendly that the refused to use it". Finally, the relatively low ratings of the more elaborate, relatively unstructured decision-support benefits (i.e., exploration, discovery, and stimulating new ideas) are in line with expectations, as reflected in the emerging market for third party offerings of data warehousing, data mining, and online analytical processing (OLAP) software that "bolt on" to ERP systems [14].

7. Relationship between objectives and benefits

In conventional systems development, one would expect a clear link between system objectives and perceived benefits. This connection has been exten-

sively examined in information systems literature (e.g., Ref. [21]). Systems are typically customized and introduced in ways consistent with desired objectives of the project. Even though desired benefits are not always realized, particularly within the time and budget desired, organizations are generally able to control the functionality of their systems in attempting to achieve project goals. It also sometimes happens that unanticipated benefits can accrue.

With ERP implementations, the relationship between objectives and benefits has yet to be extensively examined in academic literature. Because altering code in order to customize an ERP system can be difficult and problematic, most organizations choose not to do so. Configuration options only offer a limited set of choices. Thus, there are substantial limits on the extent to which ERP systems fit organizational needs [11]. The Deloitte Consulting survey [9] of 62 ERP adopters show that expected benefits do not always match achieved benefits: 48% expected inventory reduction, but 40% achieved it; 42% expected headcount reduction, but 32% achieved it; 24% expected better productivity, but 31% achieved it.

To explore the relationship (if any) between ERP plan objectives and decision-support impacts, we compute Pearson's correlation coefficient (r) between the mean importance of each of the 13 objectives and the overall mean of the 19 decision-support benefits. As an exploratory study, there is no attempt to investigate the causality in these relationships. The results depicted in Table 6 show significant positive correlation between the overall (i.e., mean) decision-support benefit realized and six of the ERP objectives: integrating data or operations, optimizing supply chain, increasing productivity, supporting inter-related decision making, enabling decentralization of decision making, and supporting joint decision making. Observe that these six include three of the eight traditional ERP objective: namely the two given the highest importance in ERP planning (recall Table 3) and one given minimal importance. They also include the three decision-support objectives that were given the highest importance in ERP planning.

The message for ERP adopters is that attributing greater importance to any of these six objectives in an ERP plan can be expected to be accompanied by greater manifestation of decision-support benefits. Although causality is not proven, the fact that objec-

Table 6

Correlation between importance of ERP project objectives and overall decision-support benefits mean

Objective	R	Significance*
Integrating operations or data	0.49	0.00
Optimizing supply chain	0.41	0.00
Increasing productivity	0.35	0.01
Supporting situations where multiple people in organization are involved in making inter-related decisions	0.34	0.01
Shifting responsibility of decision making (by empowering people with knowledge they would not otherwise have)	0.29	0.04
Supporting situations where multiple people in organization jointly contribute to making a decision	0.27	0.05
Reengineering business processes	0.25	0.08
Supporting globalization strategy	0.21	0.13
Increasing business flexibility	0.21	0.14
Supporting situations where a person in organization makes an individual decision	0.20	0.15
Supporting situations where people both inside and outside of organization are involved in making cooperative or negotiated decisions	0.13	0.37
Standardizing company processes	0.10	0.47
Solving the Year 2000 problem	0.08	0.58

*Significance indicates P -value of Pearson's correlation coefficient.

tives ordinarily precede (and can influence) results suggests that either greater attention to these objectives leads to greater overall decision-support benefits or there is some other factor that tends to synchronize the importance of these objectives with the extent to which overall decision-support benefits manifest.

At a more detailed level, Table 7 shows correlations of the six significant objectives with each of the nineteen decision-support benefits. There is significant ($p \leq 0.02$) correlation between the objective of integrating operations/data and 17 of the 19 individual decision-support benefits. This suggests that the relatively unified, consistent, common, real-time knowledge repository resulting from ERP implementation is a foundation for realizing practically all specific decision-support benefits. The exceptions are the two affective benefits of greater satisfaction with decision processes and outcomes.

In the case of the supply chain optimization objective, there are significant ($p \leq 0.05$) correlations with 14 of the decision-support benefits. Enhanced knowl-

Table 7

Correlation between importance of ERP plan objectives and decision-support benefits

Objective	Integrate data/ operations		Optimize supply chain		Increase productivity		Inter-related decisions		Shift resp./ empower		Joint decisions	
	R	Significance	R	Significance	R	Significance	R	Significance	R	Significance	R	Significance*
<i>Benefit</i>												
Knowledge processing	0.45	0.00	0.21	0.14	0.38	0.01	0.26	0.06	0.24	0.09	0.29	0.04
Large, complex problems	0.51	0.00	0.36	0.01	0.37	0.01	0.43	0.00	0.38	0.01	0.31	0.03
Reduced decision time	0.36	0.01	0.31	0.03	0.32	0.02	0.34	0.01	0.19	0.20	0.30	0.03
Reduced decision cost	0.35	0.01	0.21	0.15	0.29	0.04	0.26	0.06	0.15	0.29	0.24	0.09
Exploration, discovery	0.32	0.02	0.28	0.05	0.38	0.01	0.41	0.00	0.35	0.01	0.28	0.05
Stimulate fresh perspective	0.42	0.00	0.49	0.00	0.38	0.01	0.25	0.07	0.44	0.00	0.20	0.16
Substantiation	0.40	0.00	0.35	0.01	0.14	0.31	0.28	0.04	0.21	0.15	0.23	0.11
Greater reliability	0.38	0.01	0.30	0.03	0.26	0.06	0.27	0.05	0.18	0.22	0.30	0.03
Communication-joint decisions	0.36	0.01	0.31	0.03	0.20	0.16	0.30	0.03	0.17	0.23	0.22	0.12
Communication-inter-related	0.46	0.00	0.36	0.01	0.26	0.06	0.37	0.01	0.23	0.10	0.25	0.07
Communication-across org.	0.41	0.00	0.41	0.00	0.34	0.01	0.22	0.11	0.22	0.12	0.17	0.23
Coordination-individual	0.46	0.00	0.36	0.01	0.17	0.23	0.27	0.06	0.13	0.37	0.21	0.14
Coordination-joint decisions	0.50	0.00	0.45	0.00	0.30	0.03	0.30	0.03	0.14	0.32	0.23	0.10
Coordination-inter-related	0.55	0.00	0.46	0.00	0.36	0.01	0.34	0.01	0.18	0.20	0.25	0.08
Coordination-across org	0.53	0.00	0.53	0.00	0.37	0.01	0.28	0.04	0.27	0.06	0.16	0.26
Satisfaction-dec. processes	0.24	0.09	0.20	0.17	0.28	0.05	0.25	0.08	0.17	0.24	0.19	0.19
Satisfaction-dec. outcomes	0.25	0.07	0.21	0.14	0.28	0.05	0.27	0.05	0.32	0.02	0.19	0.18
Decisional empowerment	0.41	0.00	0.25	0.09	0.26	0.07	0.20	0.16	0.41	0.00	0.21	0.14
Competitive advantage	0.41	0.00	0.36	0.01	0.28	0.05	0.15	0.28	0.20	0.17	0.13	0.38

*Includes only objectives with significant correlation with overall mean of decision-support benefits. Significance indicates p -value of Pearson's correlation coefficient.

edge processing, reduced decision costs, satisfaction with decision processes or outcomes, and enabling decentralization of decision making are not significantly correlated with this objective. The strong correlations suggest that optimizing a supply chain involves not only streamlining transactions with external entities, but also improving the effectiveness of the individual and combined decisions that underlie those transactions.

The importance of increasing productivity is significantly ($p \leq 0.05$) correlated with 13 of the specific decision-support benefits. Although the conventional view is that ERP systems can improve the efficiency with which transactions are processed, this result suggests that ERP plans giving greater emphasis to increasing productivity are also accompanied by more efficient decision making: reduced decision time and cost, enhanced knowledge processing, better large-

scale problem solving, improved multiparticipant coordination, and enhanced competitiveness (which can stem from greater decisional productivity). Greater satisfaction with decision processes and outcomes, encouraging exploration, and stimulating new viewpoints are also benefits strongly correlated with the objective of increasing productivity.

Giving importance to the objective of supporting situations where multiple organizational participants make inter-related decisions correlates significantly ($p \leq 0.05$) with an ERP system yielding benefits of enhancing both communication and coordination for participants in inter-related decision making. It may be that emphasizing this objective in an ERP plan produces greater task decomposition and distribution of problem finding and problem solving across multiple participants. This division of labor and specialization would help explain the significant correlations between the importance of the inter-related decision objective and such benefits as better problem solving ability, improved exploration/discovery, reduced decision-making time, provision of supporting evidence, and improved decisional reliability. Other benefits realized from ERP systems and having significant positive correlations to the objective of supporting inter-related decisions include enhanced communication and coordination for joint decision making, enhanced coordination for individuals and transorganizational decision makers, and greater satisfaction with decision process outcomes.

Giving more importance to the decision-support objective of more decentralized decision making correlates significantly ($p \leq 0.02$) with achieving greater decisional empowerment and greater satisfaction with outcomes of decision making. This unleashing of previously untapped talents is consistent with the other significantly correlated benefits: stimulating new approaches to dealing with problems, encouraging exploration/discovery and enhancing the ability to handle large-scale/complex problems.

As shown in the last column of Table 7, giving greater importance to the objective of supporting joint decision making has a significant ($p \leq 0.05$) positive correlation with five decision-support benefits. Interestingly, these do not include either the improved communication or coordination among participants in joint decision making tasks, two of the three multiparticipant categories implied by DeSanctis and

Gallupe [10]. However, the third category of reducing uncertainty and noise is consistent with the strongly correlated benefits of improved decisional reliability, enhanced ability to process knowledge, better ability to cope with large-scale/complex problems, encouragement of discovery, and reduced time needed for decision making.

While the importance of the remaining seven ERP objectives did not correlate significantly with the overall decision-support benefit mean, several correlated significantly ($p \leq 0.04$) with individual decision-support benefits. These are indicated in Table 8. For example, importance of the ERP objective of reengineering business processes correlates significantly with each of the benefits related to decisional coordination. Perhaps greater attention to the reengineering objective in an ERP plan tends to yield improved processes that include mechanisms for coordination of decisional tasks. As another example, giving more importance to the objective of increasing business flexibility correlates significantly ($p \leq 0.03$) with the benefit of stimulating new perspectives. This indicates that organizations emphasizing the ERP objective of fos-

Table 8

Other significant correlations between importance of ERP plan objectives and decision-support benefits

Objective	Benefit	<i>R</i>	Significance*
Reengineering business processes	Communication—Inter-related	0.32	0.02
	Coordination—individuals	0.28	0.04
	Coordination—joint	0.33	0.02
	Coordination—inter-related	0.34	0.01
	Coordination—across organizations	0.37	0.01
Increasing business flexibility	Stimulate fresh perspective	0.31	0.03
Supporting globalization strategy	Cope with large, complex problems	0.28	0.04
Supporting individual decision makers	Cope with large, complex problems	0.29	0.04
	Substantiation	0.32	0.02

*Significance indicates *P*-value of Pearson's correlation coefficient.

tering flexibility tend to experience stimulation of new perspectives as one manifestation of greater flexibility. For three of the ERP objectives, there are no strong correlations with any of the decision-support benefits: standardizing processing, handling the Y2K problem, and supporting transorganizational decisions.

The relationships detailed in [Tables 7 and 8](#) can also be viewed from another perspective. That is, in addition to examining what benefits relate to the importance of any particular ERP planning objective, we can consider what objectives tend to be related to a particular benefit. At one extreme, the benefit of enhanced ability to tackle large-scale/complex problems is significantly ($p \leq 0.04$) correlated with the importance of 8 out of the 13 ERP objectives. At the other extreme, improved satisfaction with decision processes is strongly correlated with the importance given to only one of the ERP objectives. Consider, for example, the benefit of reduced decision time. It is significantly correlated with importance for the objectives of integrating operations or data, optimizing supply chain, increasing productivity, supporting joint decision makers, and supporting inter-related decision making. Thus, ERP planners that desire such a benefit might be well advised to emphasize these objectives when devising project plans. However, future research is necessary to substantiate the benefits that would be expected to follow from each objective. The data in this exploratory study are not sufficient to definitively answer this question.

8. Concluding discussion

This exploratory study has established empirically that there are substantial connections between enterprise systems and decision support, in terms of both ERP plan objectives and resultant ERP system impacts. Such connections have heretofore received little attention in academic literature. Thus, the findings of this study represent a fresh impetus for both the ERP and DSS fields.

We have examined the importance of various objectives in ERP planning, including both traditional objectives and previously unstudied objectives concerned with decision support. ERP adopters rated the importance of each objective in their own organizations' enterprise system planning efforts; the means of

these ratings yield the importance of ERP objectives shown in [Table 3](#). The relative importance of traditional objectives has substantial differences from a previously reported ranking: the objective of increasing productivity is found to be among the two most important instead of being among the least important. In addition, the objectives of business process reengineering and supply chain optimization are found to be among the least important, whereas they were previously highly ranked. The findings indicate that decision-support objectives have been at least moderately important in ERP planning. The lone exception is the objective of supporting transorganizational decision making. While, overall, the mean of decision-support objectives did not exceed that of traditional objectives, the relatively high ranking of particular decision-support objectives is an interesting finding.

Beyond actual ERP planning practices, we have examined adopters' views about the normative importance of objectives. Having gone through the process of planning, implementing, and operating enterprise systems (>80% have been live for at least 1 year), the respondents are in a good position to offer advice about how important the various objectives should be in ERP planning. Two major points are evident in the results displayed in [Table 4](#). First, with the benefit of hindsight, adopters recommend ascribing greater importance in ERP planning to almost all objectives. The lone exception of solving the Y2K problem is quite understandable. All other objectives significantly exceeded the "moderate importance" level. Second, the adopters' retrospective recommendation is that importance of decision-support objectives relative to traditional objectives should be more pronounced than it has been in actual ERP planning practice. Most notable in the normative ranking are objectives of supporting inter-related decisions, joint decision making, and shifting the locus of decision making.

We have examined the decision-support impacts that enterprise systems have had on organizations. This has not been previously studied in either the ERP or DSS fields. A ranked list of decision-support benefits perceived to have been realized by ERP adopters is shown in [Table 5](#). Practically all of the benefits were judged to have been achieved to at least a moderate degree. The six highest rated benefits had medians of 5 on a 7-point scale: better knowledge

processing, decision reliability, decisional substantiation, competitiveness, decision-making speed, and treatment of large-scale/complex problems. Aside from the major overall finding that enterprise systems can indeed support decision making, the ranking offers several other messages.

First, it tells prospective ERP adopters what decision-support benefits they are most (and least) prone to experience. Appreciating these tendencies may be useful in the course of ERP system development (e.g., helping to secure project commitment, identifying the most achievable benefits, highlighting issues for special attention). A second message is for organizations that have gone live. If their own ratings of specific decision-support benefits differ greatly from those reported here, it may be useful to investigate why this is so. Recognizing and studying a large shortfall in a particular benefit gives a basis for devising and implementing a remedy. Conversely, a large excess for a particular benefit may reflect an innovative ERP application or a special organizational circumstance, perhaps translating into a competitive advantage.

Third, the ranking speaks to ERP vendors and consultants, indicating potential targets for improving their offerings. For instance, we have found that a top normative objective is improved support for making inter-related decisions (Table 4), but advanced communication and coordination in inter-related decision situations are in the lower half of the realized benefits (Table 5). This suggests a specific opportunity for vendors and consultants to improve their offerings.

Fourth, there are opportunities for researchers to discover why the decision-support benefits rank the way they do, what ranking variations exist across different classes of ERP adopters, what specific ERP traits underlie the realization of decision-support benefits, and what ERP objectives relate to the achievement of decision-support benefits.

We have made a start at examining the last of these research questions by analyzing correlations between the importance given to various objectives in an ERP plan and the degree to which decision-support benefits are realized for the resultant ERP systems. The correlations summarized in Tables 6–8 reveal several major points. First, the overall decision-support benefit realized correlates strongly not only with the importance given to some decision-support objectives, but also with the importance of some traditional objectives. Second,

the three traditional objectives with which there is significant positive correlation are the two most highly ranked (integration and increased productivity) objectives and the one with the lowest rank (supply chain optimization). Practitioners should note that these correlations may reflect a causal relationship between objective importance and benefit realized or an unknown factor that affects them both.

Third, the three decision-support objectives with which there is significant positive correlation are those that have the greatest importance for ERP plans, both descriptively and normatively: supporting inter-related decisions, joint decisions, and shifts in decision responsibility. Here, again, the strong correlations may indicate causal or synchronous mechanisms at work. In either case, the evidence suggests that in order to realize higher overall decision-support benefits, a practitioner should pay careful attention to these three objectives in the course of planning an enterprise system.

Fourth, at a more detailed level, achieving a specific decision-support objective correlates strongly with giving importance to anywhere from one to eight ERP objectives. When focusing on achieving a particular benefit, a practitioner can treat its strongly correlated objectives as candidates for greater attention in enterprise system planning.

Record keeping and transaction handling are crucial organizational activities. To date, the ERP impetus has been on computer-based means for accomplishing these activities. However, the decision making that underlies transactions and uses records is also crucial. This exploratory study establishes some decision-support markers in the territory of enterprise systems. Concerned with ERP plan objectives and ERP decision-support impacts, these markers furnish benchmarks and guidance for ERP adopters, vendors, educators, and researchers. Future research could build on the instruments used in this study by examining whether individual objectives or benefits are subsumed by other survey items. This study provides the foundation for future investigations that could further investigate the relationship between important ERP objectives and achieved decision-support benefits, identify what decision-support characteristics are strongly exhibited by ERP systems and which are candidates for improvement, best decision-support practices for an ERP platform, how to leverage ERP investment into better decision-support capabilities,

emerging decision-support trends at the enterprise level, and the nature of relationships between decision-support objectives, characteristics, and benefits on the one hand, and overall ERP success on the other.

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