ENTERPRISE RESOURCE PLANNING RESEARCH: WHERE ARE WE NOW AND WHERE SHOULD WE GO FROM HERE?

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ABSTRACT

The research related to Enterprise Resource Planning (ERP) has grown over the past several years. This growing body of ERP research results in an increased need to review this extant literature with the intent of identifying gaps and thus motivate researchers to close this breach. Therefore, this research was intended to critique, synthesize and analyze both the content (e.g., topics, focus) and processes (i.e., methods) of the ERP literature, and then enumerates and discusses an agenda for future research efforts. To accomplish this, we analyzed 49 ERP articles published (1999-2004) in top Information Systems (IS) and Operations Management (OM) journals. We found an increasing level of activity during the 5-year period and a slightly biased distribution of ERP articles targeted at IS journals compared to OM.   We also found several research methods either underrepresented or absent from the pool of ERP research. We identified several areas of need within the ERP literature, none more prevalent than the need to analyze ERP within the context of the supply chain.

INTRODUCTION

Davenport (1998) described the strengths and weaknesses of using Enterprise Resource Planning (ERP). He called attention to the growth of vendors like SAP, Baan, Oracle, and People-Soft, and defined this software as, "…the seamless integration of all the information flowing through a company-financial and accounting information, human resource information, supply chain information, and customer information." (Davenport, 1998). Since the time of that article, there has been a growing interest among researchers and practitioners in how organization implement and use ERP systems (Amoako-Gyampah and Salam, 2004; Bendoly and Jacobs, 2004; Gattiker and Goodhue, 2004; Lander, Purvis, McCray and Leigh, 2004; Luo and Strong, 2004; Somers and Nelson, 2004; Zoryk-Schalla, Fransoo and de Kok, 2004). This interest is a natural continuation of trends in Information Technology (IT), such as MRP II, (Olson, 2004; Teltumbde, 2000; Toh and Harding, 1999) and in business practice improvement research, such as continuous process improvement and business process reengineering (Markus and Tanis, 2000; Ng, Ip and Lee, 1999; Reijers, Limam and van der Aalst, 2003; Toh and Harding, 1999).

This growing body of ERP research results in an increased need to review this extant literature with the intent of "identifying critical knowledge gaps and thus motivate researchers to close this breach" (Webster and Watson, 2002). Also, as noted by Scandura & Williams (2000), in order for research to advance, the methods used by researchers must periodically be evaluated to provide insights into the methods utilized and thus the areas of need. These two interrelated needs provide the motivation for this paper. In essence, this research critiques, synthesizes and analyzes both the content (e.g., topics, focus) and processes (i.e., methods) of the ERP literature and then enumerates and discusses an agenda for future research efforts.

The remainder of the paper is organized as follows: Section 2 describes the approach to the analysis of the ERP research. Section 3 contains the results and a review of the literature. Section 4 discusses our findings and the needs relative to future ERP research efforts. Finally, section 5 summarizes the research.

RESEARCH STUDY

We captured the trends pertaining to (1) the number and distribution of ERP articles published in the leading journals, (2) methodologies employed in ERP research, and (3) emphasis relative to topic of ERP research. During the analysis of the ERP literature, we identified gaps and needs in the research and therefore enumerate and discuss a research agenda which allows the progression of research (Webster and Watson, 2002). In short, we sought to paint a representative landscape of the current ERP literature base in order to influence the direction of future research efforts relative to ERP.

In order to examine the current state of research on ERP Systems, the authors conducted a literature review and analysis. As shown in Figure 1, the analysis was conducted in 3 phases. Phase 1 involved the accumulation of a representative pool of ERP articles. Phase 2 involved the classification of the articles by research method and phase 3 involved a thorough review and synthesis of

CONTRIBUTION

The growing body of ERP research has resulted in an increased need to review the extant literature with the intent of identifying gaps and thus motivate researchers to close this breach. This need served as the motivation for this study as well as its contribution. Specifically, this paper makes a contribution by (1) Analyzing the ERP research relative to methods employed; (2) Analyzing and synthesizing the ERP research relative to the content (e.g., topics, focus); and (3) Laying the foundation for future ERP research efforts by discussing the current needs in the extant literature and discussing areas "ripe" for future ERP researchers. Further, since we analyzed articles published in top Information Systems as well as Operations Management journals, we feel that this paper represents a broader view of the ERP research than previous ERP literature analysis efforts.

the ERP research. Each of the three phases is briefly discussed in the following paragraphs.

Accumulation of Article Pool

Since ERP research is published in both Operations Management (OM) and Information Systems (IS), the researchers searched through a five year period (1999-2004) of the top ten journals in OM and IS. In order to decide which journals to search, the researchers chose relatively new rankings for OM (Barman, Hanna and LaForge, 2001) and IS journals (Mylonopoulos and Theoharakis, 2001; Peffers and Ya, 2003). Due to the practitioner focus of the Harvard Business Review (on both lists) and the Communications of the ACM, both of these journals were omitted from the search. Also, Decision Sciences and Management Science appeared on both lists and therefore the numbers of journals analyzed was 15—see Table 1 for the listing of these journals. We used the ABI/INFORM database to search for ERP research articles by searching within the titles and abstracts of each of the 15 journals using the phrases "ERP" and "Enterprise Resource Planning." The returned articles were then selected based upon the guidelines set forth by Davenport's (1998) description of ERP systems.

Classification of the Articles by Research Method

Once the researchers identified the articles for classification, the research method used for each article was examined and categorized according its research strategies. On account of the subjective nature of method classification, we decided to perform a content analysis thus providing a more rigorous process. Figure 1 shows the content analysis process which was adapted from Neuendorf (2002). First, we defined the research method categories utilizing those presented in Scandura & Williams (2000) that extended the research strategies initially described by McGrath (1982). Specifically, we identified the following nine research strategies: formal theory/literature reviews, sample survey, laboratory experiment, experimental simulation, field study (primary data), field study (secondary data), field experiment, judgment task, and computer simulation. A codebook and coding form was then created.

To guard against the threats to reliability (Neuendorf, 2002), we performed a pilot on unused articles, discussed the results and refined the definitions.

Once the pilot and definition refinement was complete, we then divided into two pairs where each pair was allocated approximately one half of the articles. All of the articles were classified independently. The researchers only coded a few articles at a time to minimize coder fatigue and thus protect intercoder reliability (Neuendorf, 2002). Upon completion of the independent classification, agreements and disagreements were tabulated, intercoder crude agreement (% of agreement), and intercoder reliability using Cohen's *kappa* (Cohen, 1960) was calculated. It should be noted that the reliability measures were calculated *prior* to discussing disagreements as mandated by Weber (1999). If two reviewers did not agree on how a particular article was coded, a third reviewer arbitrated the discussion of how the disputed article was to be coded. This process resolved the disputes in all cases. Once all the articles were coded and agreed upon, the articles were analyzed to discern any findings. The literature analysis then moved to literature analysis and synthesis.

Literature Analysis and Synthesis

This stage involved a thorough analysis of the ERP research. Specifically, we held several brainstorming and discussion sessions where we attempted to identify trends in ERP topics with the intent to identify critical gaps in the literature. Further, the sessions also sought to synthesize the literature and thus provide a better understanding of the current "state" of the ERP research.

RESULTS

The results are presented relative to the three phases of the ERP literature analysis: article accumulation, categorization by research method, and literature analysis and synthesis. Also, within each section, the results are discussed.

Results of Article Accumulation

Using the described search criteria within the selected journals, we initially collected a total of 63 articles. Of these 63 articles, 14 articles were removed bringing the

total to 49 articles. Of the 14 articles that were removed from the analysis, one was a correction to a previous article, three were research commentaries, and the other ten either did not focus on ERP as outlined by Davenport (1998) or focused on teaching the subject of ERP in an IS curriculum.

Publications by Year

Figure 2 shows the number of articles per year in our sample. The year 2002 and 2004 shows the most activity with 11 articles each. Research in ERP was growing steadily from the first article published in our sample in 1999 through 2001. After 2002, research activity remained relatively constant in 2003 and in 2004.
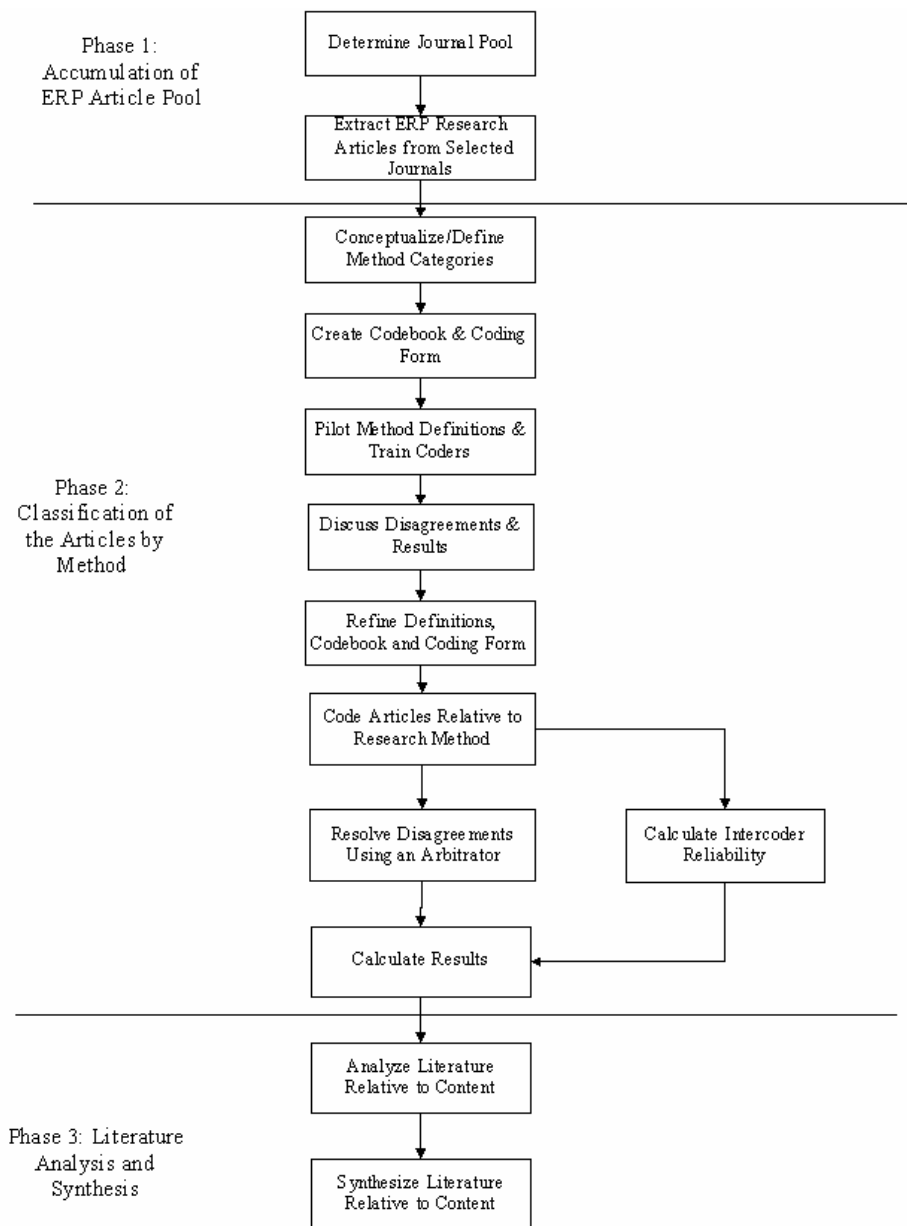
Phase 1: Accumulation of ERP Article Pool
- Determine Journal Pool
- Extract ERP Research Articles from Selected Journals

Phase 2: Classification of the Articles by Method
- Conceptualize/Define Method Categories
- Create Codebook & Coding Form
- Pilot Method Definitions & Train Coders
- Discuss Disagreements & Results
- Refine Definitions, Codebook and Coding Form
- Code Articles Relative to Research Method
- Resolve Disagreements Using an Arbitrator
- Calculate Intercoder Reliability
- Calculate Results

Phase 3: Literature Analysis and Synthesis
- Analyze Literature Relative to Content
- Synthesize Literature Relative to Content

Figure 1. Overview of Literature Analysis

Table 1. Journals Analyzed for ERP Articles Included in Study*

Information Systems Journals	Operations Management Journals
MIS Quarterly	*Journal of Operations Management*
Information Systems Research	*Production and Operations Management*
Journal of Management Information Systems	*Operations Research*
European Journal of Information Systems	*IEEE Transactions*
Information & Management	*International Journal of Production Research*
Communications of the AIS	*Interfaces*
***Decision Sciences*	*International Journal of Operations and Production Management*
***Management Science*	

*   Source: Barman, Hanna and LaForge, 2001; Mylonopoulos and Theoharakis, 2001; and Peffers and Ya, 2003
**   *Decision Sciences* and *Management Science* were noted as a top journal in both fields
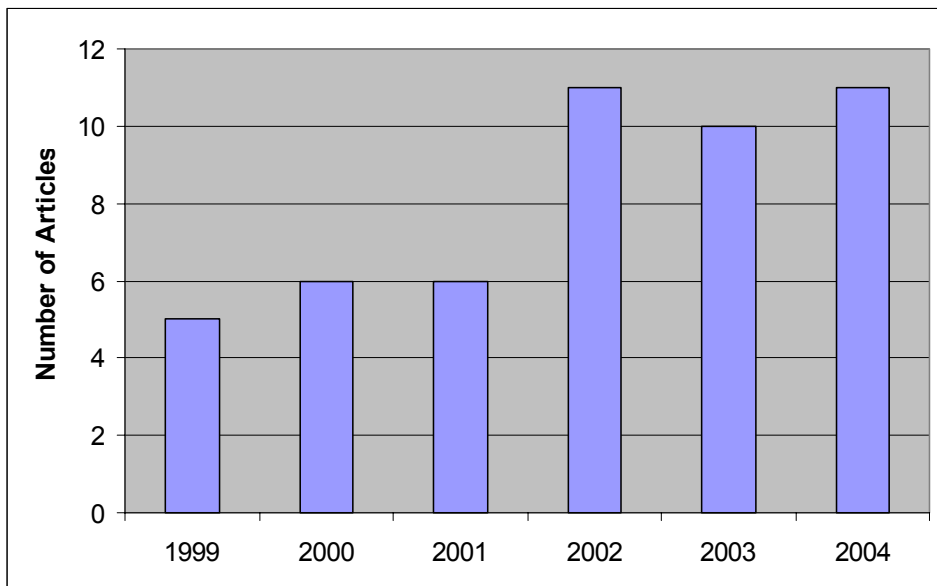
Figure 2. Published ERP Articles Categorized by Year

Publications by Journal

Figure 3 shows the number of articles published in each journal. Recall from Table 1 that we reviewed a total of 15 journals. Information & Management and International Journal of Production Research published the most articles with 10 each. The research efforts appear to be slightly biased towards the IS journals.

Results of Categorization by Research Method

Intercoder Agreement and Reliability

Individual classifications of the ERP research relative to method agreed 95.45% (average crude agreement). Although there are no widely accepted levels of crude agreement necessary, Neuendorf (2002) states that crude agreement of .9 or above is "acceptable to all." Our results relative to crude agreement have clearly surpassed this standard.

Crude agreement does not consider the fact that there is a probability that the coders may agree by chance. We therefore present our results using Cohen's *kappa*, which corrects for the possibility of chance agreement and is, therefore, a conservative estimate of agreement (Neuendorf 2002). The classification resulted in a Cohen's *kappa*

of .94—this measure falls in the "almost perfect" range (Landis and Koch, 1977), and therefore, it appears that our intercoder reliability is acceptable.

Classifications of Research Methods in ERP Research

The results of the categorization of the 49 articles according to the 9 research strategies described by Scandura & Williams (2000) are summarized in Figure 4. Of the articles, 40.82% were classified as Field Study-Primary Data making it the most prevalent research strategy. This was followed by Survey (26.53%) and Formal theory/Literature review (20.41%); Field study-secondary data (6.12%); and Experimental simulation, Field experiment, and Computer simulation (2.04% each). No articles were classified as either Lab experiment or Judgment task.
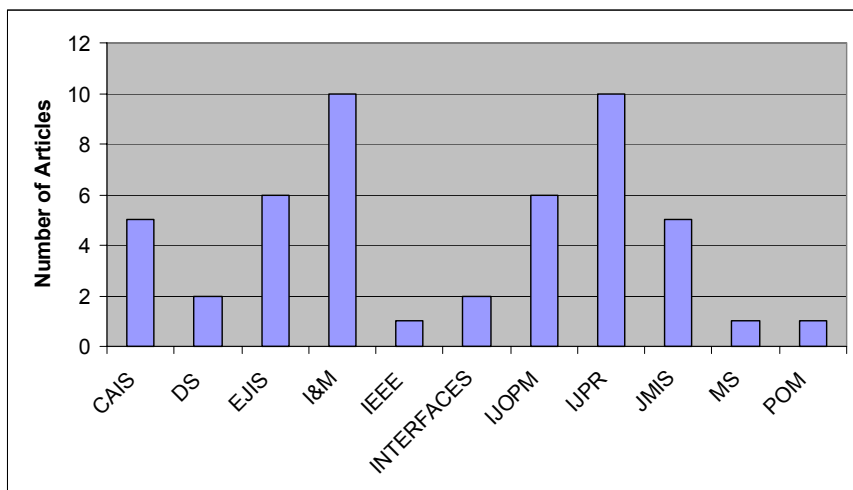

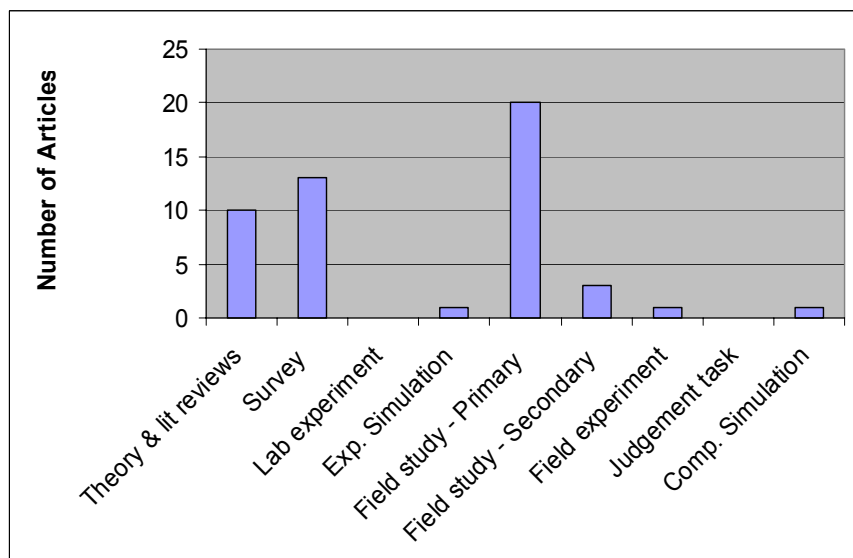**Figure 3. Published ERP Articles Categorized by Journal**

Figure 4. Published ERP Articles Categorized by Research Strategy

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Each research strategy is defined by a specific design approach and each is also associated with certain trade-offs (inherent flaws that limit the conclusions that can be drawn from a particular design method) that researchers must make when designing a study. The trade-offs refer to three aspects of the study that can increase or decrease depending on the research strategy employed. These variable aspects include: generalizability from the sample to the target population which relates to the issue of external validity; precision in measurement and control of behavior variables which relates to internal and construct validity; and the issue of realism of context (Scandura and Williams, 2000). Table 2 contains an overview of the 9 strategies (Scandura and Williams, 2000).

Due to the prevalence of articles in the formal theory/literature review, sample survey and field study: primary data, in general, the ERP research methods are perhaps excelling along the degree of realism context and generalizability dimensions (Scandura & Williams 2000). On the other hand, in general, the ERP research methods are lacking relative to the precision of measurement dimension. According to Scandura & Williams (2000), the Laboratory experiment is the only research strategy that maximizes the degree of precision of measurement. Both Judgment Task and Field Experiment are the only research strategies that rate a moderately high degree of precision of measurement.

3.3 Results of Literature Analysis and Synthesis

3.3.1 ERP Definitions

During this review, we found the definitions of ERP to be remarkably consistent among the authors and with our initial one from Davenport (1998). Generally, the definitions of an ERP system included two distinct terms, *integrated* and *multiple corporate functions*. Integrated refers to the ability of the information systems from one department to be able to communicate with information systems in other departments, both internal and external to the organization. Multiple corporate functions include the specific functions that vary across the organization and are dependent on the specific structure of the organization (i.e. operations, accounting, human resources, etc.).

Integration is the key to ERP. For the system to be truly enterprise wide, internal systems must be integrated to work together. Integrated software (Amoako-Gyampah and Salam, 2004), integrated into a best of breed solution (Gattiker and Goodhue, 2002), integrated enterprise computing system for planning (Kumar, Maheshwari and Kumar, 2002), integrated systems for corporate planning (Teltumbde, 2000) are a few example of the inclusion of integration.

Many authors' definitions addressed multiple corporate functions. In the thirteen specific definitions of ERP found in this review, finance was included in three of the definitions (Amoako-Gyampah and Salam, 2004; Ng, Ip and Lee, 1999; Robey, Ross and Boudreau, 2002), human resources was included in five of the definitions (Amoako-Gyampah and Salam, 2004; Hitt, Wu and Zhou, 2002; Koh and Saad, 2002a; Ng, Ip and Lee, 1999; Robey, Ross and Boudreau, 2002), manufacturing was included in four of the definitions (Amoako-Gyampah and Salam, 2004; Hitt, Wu and Zhou, 2002; Koh and Saad, 2002a; Ng, Ip and Lee, 1999), materials management was included in two of the definitions (Amoako-Gyampah and Salam, 2004; Robey, Ross and Boudreau, 2002), and sales was mentioned in five of the definitions (Amoako-Gyampah and Salam, 2004; Hitt, Wu and Zhou, 2002; Koh and Saad, 2002a; Kumar, Maheshwari and Kumar, 2002; Robey, Ross and Boudreau, 2002). Other corporate functions such as distribution, customer relationship management, purchasing, distribution, and marketing were included in at least one of the definitions. While these definitions do not provide complete consistency, they do provide a moderately constant view of ERP as an enterprise wide software solution for integrating data from many functions within the organization operating from a central database to support planning and the flow of information within the organization.

Table 2. Research Strategies*

Research Strategy	Description	Strategy Tradeoffs		
		Degree of Precision of Measurement	Degree of Realism of Context	Generalizability to Target Population
Formal theory/literature reviews	Summarization of the literature in an area of research in order to conceptualize models for empirical testing.	Low	Low	Maximizes
Sample survey	The investigator tries to neutralize context by asking for behaviors that are unrelated to the context in which they are elicited.	Low	Low	Maximizes
Laboratory experiment	Participants are brought into an artificial setting, usually one that will not significantly impact the results.	Maximizes	Low	Low
Experimental simulation	A situation contrived by a researcher in which there is an attempt to retain some realism of context through use of simulated situations or scenarios.	Moderate	Moderate	Low
Field study: Primary data	Investigates behavior in its natural setting. Involves collection of data by researchers.	Low	Maximizes	Low
Field study: Secondary data	Involves studies that use secondary data (data collected by a person, agency, or organization other than the researchers.	Low	Maximizes	Low
Field experiment	Collecting data in a field setting but manipulating behavior variables.	Moderately high	Moderately high	Low
Judgment task	Participants judge or rate behaviors. Sampling is systematic vs. representative, and the setting is contrived.	Moderately high	Low	Moderately high
Computer simulation	Involves artificial data creation or simulation of a process.	Low	Moderately high	Moderately high

*Source: Scandura and Williams, 2000

3.3.2 Synthesis of ERP Research

During the literature analysis, three general areas of research focus emerged from the process: ERP Implementation, ERP Operations, and ERP Benefits. For this particular study: Implementation is defined as the process of integrating an ERP system into an organization in which no previous ERP system existed; ERP Operations is defined as extending or optimizing the functionality of an ERP system already in place; and ERP Benefits is defined as the impact of implementing and operating an ERP system.

With the emergence of these focus areas of the ERP research, we individually coded the articles as ERP Implementation, ERP Operations, or ERP Benefits and then met to reach agreement on the categorization. It

should be noted that the three focus areas are not without overlap (e.g., benefits may be discussed in the context of implementation), yet we categorized each article based on its main focus. Once all the articles were coded and agreed upon, the results were analyzed to discern any findings.

The results of the categorization of the 49 articles relative to the three focus areas are summarized in Figure 5. The majority of articles reviewed (57.14%) were classified as ERP Implementation making it the dominant area of focus within the ERP research. This was followed by ERP Operations (28.57%) and ERP Benefits (14.29%). Each of these three areas is discussed in the following sections.

3.3.3 ERP Implementation

Implementation has been studied in conjunction with information systems in many contexts. It is no surprise that many of the articles we reviewed also investigated specific ERP implementation issues. One of the major themes in IS implementation is individual acceptance. Innovation diffusion has also been used frequently as a lens through which to examine IS implementation. Organization change and business process change are closely linked to IS implementation. This change, in conjunction with ERP

implementation, will have significant effects on the organization. It is difficult to study ERP or organizational change in a vacuum as they are often closely linked. There are many technical and business reasons for adopting an ERP system. As an organization is at the beginning of the implementation stage, it must ensure the reasons for adopting the system are in alignment with what the system can really provide.

Several theories from social psychology have emerged to facilitate the understanding of the individual perspective of IS implementation. The Theory of Reasoned Action (TRA) examined individual behaviors. By modifying TRA, Davis (1989) developed the Technology Acceptance Model (TAM) that was used to predict individual use of new systems. Social Cognitive Theory (SCT) (Bandura, 1977) was used to provide even more insights into user acceptance of IS. Compeau and Higgins (1995) expanded this research through their development and refinement of the computer self-efficacy construct. Finally, there has been extensive work based on Innovation Diffusion Theory (Rogers, 1995). Cooper and Zmud (1990) examined the implementation of productionand inventory control information
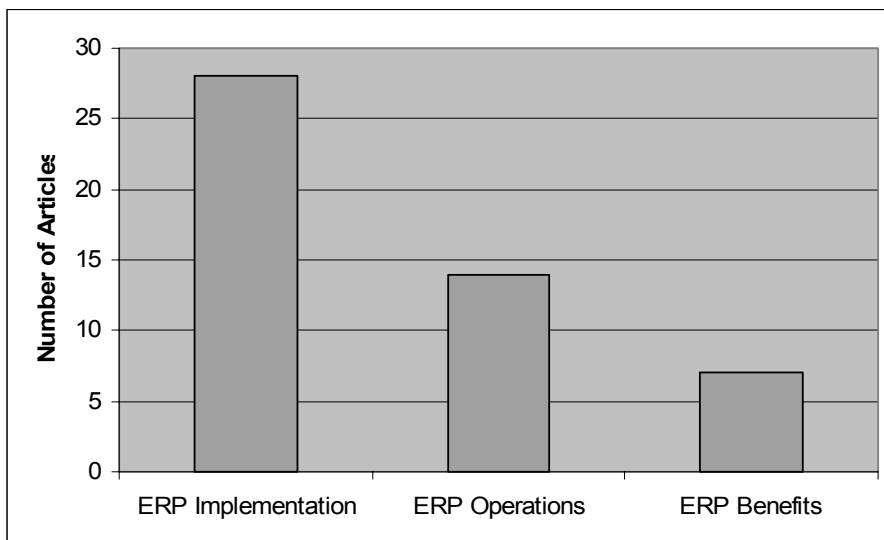

Figure 5. Distribution of Articles' Focus

systems, the predecessors of ERP. Amoako-Gyampah and Salam (2004) presented an extension of the TAM in the ERP implementation context. Lander, Purvis, McCray and Leigh (2004) examined trust building between management, project team members, users, and vendors during an ERP implementation. Sarker and Lee (2003) found that three key social enablers, strong and committed leadership, open and honest communication, and a balanced and empowered implementation team are necessary conditions for successful ERP implementation. Gefen and Ridings (2002) studied the effects of responsiveness on user's assessments and approval of new systems. Robey, Ross and Boudreau (2002) found that user training and a phased implementation approach helped users overcome assimilation knowledge barriers.

ERP implementation requires an organization to integrate many of its internal processes and functions. Given that ERP was gaining popularity at the same time that many organizations were undergoing reengineering or another form of organizational change in the middle to late 1990s, it is critical to understand the effects of organizational change in the context of implementing ERP. Rajagopal (2002) used the Kwon and Zmud (1987) model to study the contextual factors that influenced firms to implement ERP. Luo & Strong (2004) advanced a framework for management decision making with respect to ERP customization choices and the capabilities required to accomplish them. Ng, Ip and Lee (1999) proposed a model to facilitate implementing ERP in a business process reengineering environment.

The decision to implement an ERP system could be based on a wide variety of factors depending on the organization. Often an ERP implementation will be used to replace or upgrade an outdated legacy system within the organization. Many organizations will implement an ERP system to solve technical problems resulting from a variety of incompatible systems used by different functions throughout the organization. An effective ERP system may reduce IS costs in the long term by reducing the costs of maintaining separate legacy systems. Business reasons are another driving factor for an ERP

implementation. In a large organization, an ERP system should be able to improve operations between different locations. Hong and Kim (2002) examined the effect of organizational fit on ERP implementation. Hitt, Wu and Zhou (2002) evaluated the financial performance of firms that implemented ERP and found that firms that invest in ERP tend to show better financial performance across a wide variety of measures. Kumar, Maheshwari and Kumar (2002) found many similarities in motivations, concerns, and strategies across firms that implement ERP.

The implementation research examined in this study covered a wide range of issues ranging from the social aspects of ERP implementation, integration issues, and factors that affect the decision to implement. The research in this study is widely varied in both its approach and topic. Given that ERP is still a relatively new concept, we would expect little duplication and found a substantial breadth of coverage.

3.3.4 ERP Operations

ERP implementation is of utmost importance due to its high risk (Kumar, Maheshwari and Kumar, 2002) and accompanying process and organizational changes (Luo and Strong, 2004). Nevertheless, some organizations have met with success and moved beyond the implementation stage of ERP. For organizations with ERP in place, implementation research may not address their immediate concern. The next category of ERP focus moves beyond implementation to discuss process and module optimization within an ERP environment.

ERP Operations literature can be characterized by extending or optimizing the functionality of an ERP system already in place. Typically set in manufacturing environments, optimizing the operation of ERP usually manifests itself in narrow (process or modular) focused studies or even technical demonstrations. Areas of ERP operational focus include production scheduling (Homem-de-Mello, Shapiro and Spearman, 1999), accounting systems (Lea and Min, 2003), manufacturing control systems (Lea and Min, 2003), production planning (Pechoucek, Riha, Vokrinek, Marik

and Prazma, 2002), product and facility prototyping (Ratchev, Shiau and Valtchanov, 2000), and workflow process design (Reijers, Limam and van der Aalst, 2003). Exceptions to optimizing manufacturing functionality in a narrow focus include (Koh and Saad, 2002a) comprehensive look at uncertainty in an ERP manufacturing environment that ultimately lead to more parts delivered late, Reijers, Limam and van der Aalst (2003) focus on service industries rather than manufacturing, Bendoly's (2003) discussion of extending ERP functionality to fuel data mining, and (Lin et al., 2000) presentation of an extended-enterprise operation throughout an organization.

3.3.5 ERP Benefits

When arguing a new concept or model in ERP optimization, justification by way of demonstrating real world benefits is important. In fact, most discussions of ERP Implementation and ERP Operations include discussions of ERP's potential and real benefits (Koh and Saad, 2002a; Lin et al., 2000; Pechoucek, Riha, Vokrinek, Marik and Prazma, 2002; Reijers, Limam and van der Aalst, 2003); for without explaining or demonstrating benefits, the associated risks would preclude ever having ERP in an organization. These studies, however, are not focused on how to determine ERP Benefits. This prompts the third category of ERP focus, ERP Benefits. Literature focusing on ERP Benefits seeks to measure the impact of implementing and operating an ERP system.

ERP Benefits would best be represented by a bottom line dollars and cents; however, performance is often times both financial and non-financial (Lea and Min, 2003). Teltumbde (2000) discusses the difficulties of quantifying ERP Benefits and suggests that evaluation is multi-dimensional. Given that ERP Benefits are nebulous, research in this area ranges from micro (Gattiker and Goodhue, 2002; Gattiker and Goodhue, 2004) to macro focused (Stratman and Roth, 2002).

3.3.6 Research Strategy versus ERP Research Focus

As a final part of the literature analysis we viewed the research relative to its method and focus. The results of this analysis are shown in Table 3. This table shows several areas where much research has been accomplished. However, this table also shows several areas that need to be explored further. For example, many field studies using primary data have been conducted on ERP Implementation, and relatively few field studies using primary data have been conducted on the ERP Operations or ERP Benefits.

DISCUSSION

The results of our study of the state of ERP academic research revealed four apparent trends. It appears that past publications (1) tend to use exploratory research methods over confirmatory ones, (2) became more frequent in 2002, (3) are found more often in IS over OM journals, and (4) prevalently focused on ERP Implementation.

The dominance of exploratory research methods is not surprising. In a literature review on management, even mature topics such as organizational behavior, organization theory, and human resources showed similar emphases on exploratory methods (Scandura & Williams, 2000). McGrath (1982) described a research spiral in which new theories and exploratory research eventually matured into a state where further precision was desired. However, not all theories and exploratory research findings ever make it to this state. In one respect, this is almost a self-fulfilling prophecy and you would expect that a relatively new topic would be dominated by exploratory methods. Methods that add precision to research such as laboratory experiments and experimental simulations would be challenging at best to use when studying a system that could affect an enterprise. Finally, we must accept that research methods adjust over time to what is currently in vogue. Survey research and field studies have increased in popularity in recent years possibly adding to the number of exploratory research methods.

The rise in ERP publications in leading journals in 2002 coincides with the rise in ERP sales on and around Y2K. Given the time lag between publication and when the idea was conceived, a study conducted, and a manuscript being approved, it is reasonable to

assume the increased publications in 2002 reflect a rise in research efforts that occurred up to several years prior. The IT scare leading up to Y2K caused many businesses to either correct or replace legacy systems. Increased IT expenditure created a larger market for ERP systems which increased awareness and opened doors to research. ERP academic publication in this instance followed the rise in practitioner interest. If this holds true, academic publication should continue to increase in frequency as the ERP market continues to grow. As more companies that either are implementing ERP or have implemented ERP in years passed, more opportunities for research ought to arise especially in the ERP Implementation but notably in the ERP Operations divisions of ERP research. Furthermore, with recent mergers of major industry players, ERP Implementation may include research on ERP-scale integration.

Between the two fields under study, OM journals appeared to have less ERP-related publications than the IS counterparts. Perhaps this may coincide with the bulk of publications focusing on implementation over operations. Additionally, ERP is a software initiative in the organization. The successful implementation of an enterprise wide software initiative seems more likely to be studied by IS researchers. Conversely, operations and benefits of the system, that require a longer time to develop, may be of more interest to OM researchers.

As reported the majority of ERP publications under study fell into the emergent category of ERP Implementation. As discussed above, the relative immaturity of ERP studies coupled with the increased number of ERP sales may contribute to research being in the preliminary stages. Implementation is chronologically prior to operations and benefits because operations cannot be measured and benefits, while most likely postulated, cannot be determined until a system has been implemented and given time to mature and affect the organization in some manner.

The use of a variety of methods to examine a research topic might result in a more robust and generalizable, yet precise, set of findings (Scandura and Williams, 2000). Clearly, future ERP studies should consider the identified gaps and consider the future research role relative to generalizability, precision of measure, and realism of context. Ideally, future studies would use multiple methods or triangulation as previously called for (McGrath, 1981, Lee, 1991, Mingers, 2001) with the overall strategy of matching methods to offset weaknesses or enhance strengths of the three dimensions.

Future efforts should also consider the three focus areas of implementation, operation, and benefits with respect to the method. For example, many field studies using primary data have been conducted on ERP Implementation while relatively few field studies using primary data have been

Table 3. Research Strategies vs. Article Focus

	ERP Implementation	ERP Operations	ERP Benefits	Totals
Theory/Literature reviews	4	5	1	10
Sample survey	7	2	4	13
Lab experiment	0	0	0	0
Exp. Simulation	0	1	0	1
Field study - Primary	14	5	1	20
Field study - Secondary	2	0	1	3
Field experiment	1	0	0	1
Judgement task	0	0	0	0
Comp. Simulation	0	1	0	1
Totals	28	14	7	49

conducted on ERP Operations or ERP Benefits. Also, the ERP literature was heavily based in the manufacturing environment and therefore would benefit from research in service environments. It would be interesting to compare and contrast each of the 3 areas (e.g., Implementation) relative to manufacturing and service environments.

In our discussions thus far, ERP has predominately been considered within the context of a single organization; however there are some mentions of enterprise activities having an effect beyond the boundaries of the enterprise itself. In their discussions of future research, Hitt, Wu and Zhou (2002) recognized that ERP systems can alter relationships beyond the firm. This notion is demonstrated by IBM's successful employment of an extended-enterprise asset management tool (Lin et al., 2000), an action that altered relationships in a positive manner. Notably in the case of IBM, the extended-enterprise effort came only after an internal reengineering effort (Lin et al., 2000) which is inline with the findings of (Kim and Narasimhan, 2002) who presented internal integration as a precursor to external integration in the stages of supply chain management development. Frohlich and Westbrook (2001) presented a model, called arcs of integration, depicting the magnitude of which an organization is integrated with suppliers and customers. Their model suggests that the greater the magnitude of integration (i.e. the wider the arc) the greater the performance of the organization. With the challenges, organizational changes, and potential benefits that come with an ERP Implementation, certainly the dynamics of relationships within the supply chain would be affected in some manner. While ERP may strengthen an organization internally, it may also create sub-optimized organizational silos

across the supply chain. The role of ERP in supply chain integration and the effects of ERP on supply chains is perhaps the biggest area of need for future research efforts.

Finally, the current analysis of the ERP literature is not without limitations and therefore should be offset with future efforts. Future literature reviews could expand online article searches to full article text searches, widen the time frame, and include other ERP related technologies. We did not intend the literature analysis to be comprehensive, but rather be representative. Leading journals in the fields of IS and OM were chosen since major contributions are likely to be published in referred journals (Webster & Watson, 2002). We hope that this research analysis has laid the foundation for future research efforts which may enhance the ERP body of knowledge and theoretical progression relative to ERP.

CONCLUSION

The importance of periodic literature reviews has been noted by several researchers (Webster & Watson, 2002; Scandura & Williams, 2000). This study reviewed 49 ERP-focused research articles and categorized them according to research strategy, year of publication, publications by journal and the focus of topic within ERP. The trends recognized in publication patterns seem to suggest that ERP research is in the exploratory stages, coinciding with trends in the market. To advance the field of ERP, researchers need to continue to explore creative, multi-method research to overcome the inherent complexities when studying an enterprise. The classification of ERP areas of study may serve as a map as to where more research is needed, namely with emerging topics such as Inter-organizational Information Systems and ERP vendor mergers.

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