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Enterprise Resource Planning (ERP) Systems: An Empirical Analysis of Benefits

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ABSTRACT: This paper uses a database, derived from a data repository, in order to do an analysis of enterprise resource planning (ERP) system benefits. ERP benefits are important for a number of reasons, including establishing a match between what ERP systems benefits are—as compared to ERP expectations—setting a benchmark for other firms, and measuring those benefits. ERP benefits also are central to the business case for deciding whether a firm will invest in an ERP system. It is found that some benefits vary across industry, while others seem to be important to firms independent of industry. In particular, tangible benefits are largely industry-independent, while intangible benefits vary across industry. In addition, when compared to an earlier study by Deloitte Consulting, the results are statistically consistent with their findings, but find substantial additional intangible benefits.

Keywords: enterprise resource planning system; ERP; benefits.

INTRODUCTION AND PURPOSE

The use of enterprise resource planning (ERP) systems is widespread. For example, SAP, the ERP system with the largest market share, is used by more than 60 percent of the multinational corporations (Bowley 1998). However, large firms are not the only ones impacted by ERP systems. Small- and medium-sized firms also make extensive use of ERP systems (Foley and Stein 1997). With so many firms influenced by ERP systems, it is important to understand the benefits of these systems. As a result, the purpose of this paper is to understand some of the key ERP benefits and how those benefits change based on industry.

Importance of This Topic

Determining and investigating key ERP benefits is important for a number of reasons. First, determining the benefits that some firms have experienced from implementing an ERP system provides other firms with a basis of determining if and how ERP systems will solve their problems. Determining benefits allows firms to investigate the alignment between their needs and what an ERP system can do. Second, establishing ERP benefits provides a basis for setting expectations for other

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ERP implementations. Establishing ERP benefits for one firm provides a benchmark for other firms' ERP implementations. Third, once we understand what ERP benefits are likely to be experienced, then those potential benefits can be used as a basis to set up measurements for those benefits. Then those measures can be used to establish whether a company has attained what they expected they would from an ERP implementation. Fourth, a critical issue is the extent to which different industries experience or should expect different benefits. Should a manufacturing firm expect the same benefits as a software firm?

Outline of This Paper

This paper proceeds as follows. The next section summarizes some of the previous literature discussing ERP benefits. The third section discusses the repository of firms on which this study is based. The fourth section summarizes the methodology used in this paper. The fifth section gives the results, in terms of counts of which categories were found in each industry, and discusses the results. The last section summarizes the paper and discusses some contributions.

PREVIOUS LITERATURE

Researchers have investigated the issue of ERP benefits using a number of approaches, including an experiment, archival financial data analysis, and interviews.

Using archival data, Hayes et al. (2001) investigated the market response to the announcement of an ERP implementation. They found an overall positive reaction to such announcements. In addition, they found a significantly more positive reaction when the ERP vendor was large, rather than small.

Hunton et al. (2002) did an experiment with financial analysts, studying the extent to which investors believed ERP implementation enhanced firm value. Analysts' overall reaction to such announcements was positive, with higher post-implementation earnings forecasts.

Poston and Grabski (2000), using archival financial data, analyzed a group of firms before and after adoption and found no improvement in general financial performance. However, they also found a significant decrease in the ratio of employees to revenues in all three years of their data, and a reduction in the ratio of cost of goods sold to revenues in year three.

Hunton et al. (2003) found a similar result, with an interesting twist. They found that although the financial performance of ERP adopters did not change, the financial performance of non-adopters decreased. It was necessary to implement the ERP system in order to stay a competitor.

Two other papers addressed rationales at different points in the life cycle: selection and upgrading. Everdingen et al. (2000) find primary criteria for ERP selection: support, scalability, user friendliness, cost, flexibility, and fit. Kremers and Dissel (2000) analyze a closely related problem, that of why firms migrated from one BAAN system to a later version. They found that those reasons included Business (added functionality), Technical (keeping the system up-to-date), Organizational (organizational), and Environmental (pressure from the value chain). Unfortunately, little detail is provided to these categories, except for the Technical category, and the issue of upgrading is not quite the same as the issue of determining benefits that is addressed in this paper.

Perhaps the most similar study was that developed by Deloitte Consulting (1998), and discussed in O'Leary (2000), that investigated the rationales and benefits for why firms choose to implement ERP. That study broke benefits into two broad categories: Tangible Benefits (Table 1) and Intangible Benefits (Table 2). Deloitte Consulting's (1998) study was based on interviews with 62 client firms of the *Fortune* 500. As part of a large-scale project, client firms were asked which tangible and intangible benefits had been realized. The results in Tables 1 and 2 present the percentage of the firms that indicated which benefits would be realized, allowing for multiple responses for each firm.

TABLE 1
Tangible Benefits Realized[a]

Inventory Reduction	32%
Personnel Reduction	27
Productivity Improvements	26
Order Management Improvements	20
Financial Close Cycle Reduction	19
IT Cost Reduction	14
Procurement Cost Reduction	12
Cash Management Improvement	11
Revenue/Profit Increases	11
Transportation/Logistics Cost Reductions	9
Maintenance Reductions	7
On-Time Delivery	6

Source: Deloitte Consulting (1998).
[a]Percent of firms mentioning.

TABLE 2
Intangible Benefits Realized[a]

Information/Visibility	55%
New Improved Processes	24
Customer Responsiveness	22
Cost Reduction	14
Integration	13
Standardization	12
Flexibility	9
Globalization	9
Y2K	8
Business Performance	7
Supply/Demand Chain	5

Source: Deloitte Consulting (1998).
[a]Percent of firms mentioning.

DATABASE AND DATA REPOSITORY

This research is based on a database of information about changes in organizations due to the implementation of an ERP system—in particular, Oracle applications—gathered from a large data repository of ERP system information. The data repository (titled "Oracle at Work") was located at http://www.oracle.com/corporate/oracle_at_work/html/. The data repository is no longer available at that address or any other that the author could locate at http://www.oracle.com. I have contacted the Webmaster, but have not been able to find the new location, if it still exists. The specific data used in this study was downloaded on March 6, 1999. Since much of the focus of Oracle currently is on e-business, I doubt whether the information is still available on line.

The original data repository from which this data is generated consisted of companies generated from 12 industries, including Alliances, Chemical/Pharmaceutical, Consumer Sector, Energy, Financial Services, Hardware/Software (HW/SW), Health Care, Manufacturing, Media/Entertainment,

Natural Resources, Public Sector/Government, and Telecommunications. The industry divisions were provided by Oracle. I gathered the information listed on each of the companies from Hardware/Software and Manufacturing.

The repository was for four Oracle products, including Oracle's Server, Tools, Applications, and Services. For each firm in the repository the specific Oracle products used by the client were listed. In addition, a two- to four-page write-up was provided, typically giving information about either the implementation or functioning of the system at the specific company. The write-ups were company-dependent and nonuniform. In some cases, implementation issues were discussed, while in others, usage issues were discussed.

There are a number of advantages of using data gathered from such a repository. First, Oracle ERP applications, whose primary competition is SAP® and PeopleSoft®, are generally conceded to have one of the top three ERP systems. According to Herrera (1999), Oracle has roughly 10 percent of the ERP market share. Thus, a substantial number of firms are affected specifically by Oracle. Second, each of the companies in the sample employs common software, minimizing differences arising from software differences. Focusing on a single "brand" of software is consistent with the previous literature. For example, Kremers and Dissel (2000) examined 24 BAAN installations. Similarly, Hayes et al. (2001) found that large ERP systems have a larger effect on ERP adoption announcements than with smaller ERP systems. Third, each of the studies apparently occurred at roughly the same time. These studies were copyrighted in 1995 and 1999, respectively. Thus, the effects of time also would be normalized. Fourth, the company profiles were based on information that is uniquely available to Oracle. There are many quotes from various information systems personnel that would not be generally available. Fifth, as a result, some of the information in the company profiles is quite specific (e.g., as noted in the *In Focus* summary, "For example, it takes only four days to close the quarterly general ledger books, compared with 8 to 11 days under the old system."). Sixth, this approach allows us to make use of actual comments by the Chief Information Officer or equivalent personnel, gathered at a time when benefits were being analyzed, even if only implicitly. Many of these comments, provide insight into the impact of ERP systems. Seventh, the information was placed in a public forum and was not aggregated or disguised. As a result, this suggests that the quality of the data that is given likely would be good, otherwise the companies for which the results were attributed would be in a position to indicate the incorrectness of the data. This is particularly true since specific individuals from within the companies were quoted. Client individuals misquoted would likely ask Oracle to change the quotes. Eighth, although the data functions as marketing data, it is representative of "real-world benefits." Companies that are interested in the feasibility of the benefits can contact the companies and representatives listed in the studies for further information. Ninth, relative to individual case studies on ERP, the repository provides a large group of firms that can be analyzed together to make broader-based inferences that could be made with a single case study. In particular, by using a number of studies, we have the ability to use statistical analysis of the data.

METHODOLOGY

In order to focus on Oracle's ERP applications, companies that did not implement ERP applications were dropped from the analysis. In addition, companies that reported on the development-specific applications were also omitted. Further, some company discussions focused only on implementation issues, probably because of where they were in the ERP life cycle. As result, those companies also were omitted. In the case of manufacturing and hardware/software, this meant 14 and 11 cases, respectively, were available for analysis, for a total of 25 firms.

Content analysis was used as a basis to summarize the information in the data repository. That analysis focused on quotes and client company statements of the impact of the ERP system on the

company. I did not include text focusing on which modules of the ERP system were implemented, unless it was in a quote from the client company. If a concept (e.g., "globalization") occurred more than once in a single company, then it was only counted once.

Changes in organizational outputs, resulting from the ERP system, were the primary focus of the analysis. For example, if implementing an ERP led to a reduction in the number of people and that information was reported, then it would be gathered as part of the database. In addition, specific changes were sought. For example, "IS headcount (now) stands at 16" and, as noted by one company, "The Financial Department took several weeks to close the books each quarter … It now takes … four days to close the books each quarter." The content analysis was limited to quotes made by client personnel and client statements.

Using the company discussions as input, we read the discussions and captured each discussion of apparent benefits. The original categories used by Deloitte Consulting (1998) (hereafter Deloitte Consulting Study) were used as the basis of categorization. By placing data in those same categories, we can compare the results to determine the extent of similarity. *A priori*, we might expect the results to be somewhat similar, since the data occurred at the same time. Whenever benefits were found that were not in one of the Deloitte Consulting Study categories, a new category was added. Those categories form the basis of an additional set of benefits.

After the benefits were categorized by company, then industry and then total, a "test of proportions" was used to test the statistical significance of the differences in percentages of occurrences of benefits between the two industries in the study. A test of proportions (e.g., Dixon and Massey 1969) is used to test the hypothesis that two proportions from different populations are different. Tables were generated for "tangible benefits," "intangible benefits," and additional benefits (which were intangible).

RESULTS

The results of the study are summarized in Tables 3–8. This section compares:

- Deloitte Consulting Study and the Current Study
- Deloitte Consulting Study, Current Study, and Previous Research
- Comparison across Industries

Comparison of Deloitte Consulting Study and Current Study

There were a total of 43 tangible benefits and 70 intangible benefits mentioned in the case discussions of the current study. A comparison of the results from the Deloitte Consulting Study and the current study is provided in Table 3 and Table 4. A regression was used to compare the two sets of results statistically, using the HW/SW counts to predict the manufacturing counts. In Tables 3 and 4, the F-test resulted in a statistical significance of the regression of 0.10 and .016 for tangible and intangible benefits, respectively. As a result, the two sets of studies appear to be linearly related to each other.

However, although the Deloitte Consulting Study sample and the current sample have similar percentages for 11 intangible categories used in the original study, the current study found a broader base of intangible benefits. In particular, an additional 32 references to benefits were found in those additional 11 categories as seen in Table 5.

Part of the reason for finding additional benefits is likely to be that Deloitte Consulting Study chose to disclose only the more frequently occurring benefits. However, of the additional 12 benefits in Table 5, six occurred in 12–20 percent of respondents. Further, some might be aggregated, e.g., growth and acquisitions, to form very frequently occurring benefit categories. As a result, it appears that the current sample has additional benefits that need to be accounted for.

TABLE 3
Tangible Benefits Realized[a]

	Deloitte %	Current %
Inventory Reduction	32	16
Personnel Reduction	27	12
Productivity Improvements	26	20
Order Management Improvements	20	36
Financial Close Cycle Reduction	19	44
IT Cost Reduction	14	8
Procurement Cost Reduction	12	12
Cash Management Improvement	11	4
Revenue/Profit Increases	11	8
Transportation/Logistics Cost Reductions	9	4
Maintenance Reductions	7	4
On-Time Delivery	6	4
F-test 3.190 (.100)		

[a]Percent of firms mentioning.

TABLE 4
Intangible Benefits Realized[a]

	Deloitte %	Current %
Information/Visibility	55	64
New Improved Processes	24	16
Customer Responsiveness	22	40
Cost Reduction	14	8
Integration	13	44
Standardization	12	28
Flexibility	9	40
Globalization	9	24
Y2K	8	8
Business Performance	7	4
Supply/Demand Chain	5	4
F-test 8.722 (.016)		

[a]Percent of firms mentioning.

Comparison of Deloitte Consulting Study and Current Study to Previous Research

The content findings of the Deloitte Consulting Study and the current study support the findings of previous empirical researchers. Poston and Grabski (2000) found that number of people/revenue would decrease. The Deloitte Study and the current study find a decrease in personnel of 27 percent and 12 percent, respectively. In addition, Poston and Grabski (2000) and Hunton et al. (2003) found that financial performance did not change. In the Deloitte Consulting Study only 11 percent mentioned revenue and profit increases, while 14 percent mentioned expected cost reduction. In the current study, 8 percent mentioned revenue increases and 8 percent mentioned cost reduction.

TABLE 5
Additional Benefits

New Benefit	Total	Percent
Acquisitions	3	12
New Reports/Reporting Capability	2	8
Sales Automation	1	4
Change Business Model/Competitive Advantage	4	16
Growth	5	20
Financial Controls	2	8
Better Decisions	3	12
Leverage Size	1	4
Increased time for analysis	1	4
No Redundant Data Entry	5	20
Reduce Training with Transfer	1	4
Speed	4	16
	32	

Comparison across Industries

Tables 6 and 7 present the tangible and intangible benefits by industry. These tables allow us to see if there are any differences in benefits by industries and to see which benefits are most frequently mentioned by particular industries. As seen in Table 6 the most frequently mentioned tangible benefits for manufacturing firms were "Order Management Improvements," "Financial Close Reduction," and "Inventory Reduction." In contrast, for the HW/SW industry, the most frequently mentioned tangible benefits were "Financial Close Reduction," "Order Management Improvements," and "Productivity Improvements." In Table 7, the most frequently mentioned benefits for manufacturing were "Information Access/Visibility," "Integration," and "Customer Responsiveness." On the other hand, the most frequently mentioned benefits for HW/SW were "Flexibility," "Information Access/Visibility," "Standardization," and "Globalization."

TABLE 6
Tangible Benefits by Industry

	Manufacture	HW/SW	Total	Z-Score
Inventory Reduction	4	0	4	1.93*
Personnel Reduction	1	2	3	0.84
Productivity Improvements	2	3	5	0.81
Order Management Improvements	6	3	9	0.81
Financial Close Cycle Reduction	6	5	11	0.13
IT Cost Reduction	1	1	2	0.18
Procurement Cost Reduction	1	2	3	0.84
Cash Management Improvement	1	0	1	0.90
Revenue/Profit Increases	1	1	2	0.17
Transportation/Logistics Cost Reductions	1	0	1	0.90
Maintenance Reductions	1	0	1	0.90
On-Time Delivery	0	1	1	1.15

* Significant at the 0.03 level.

TABLE 7
Intangible Benefits by Industry

	Manufacture	HW/SW	Total	Z-Score
Information Access/Visibility	10	6	16	0.87
New Improved Processes	4	0	4	1.93**
Customer Responsiveness	7	3	10	1.15
Cost Reduction	2	0	2	1.31*
Integration	8	3	11	1.49*
Standardization	3	4	7	0.83
Flexibility	2	8	10	2.96*
Globalization	2	4	6	1.28*
Y2K	2	0	2	1.31*
Business Performance	0	1	1	1.15
Supply/Demand Chain	1	0	1	0.90

*, ** Significant at the 0.1 and 0.03 levels, respectively.

Using regression analysis of the data based on the two industries in Table 6, with HW/SW firm comments as the independent variable and Manufacturer firm comments as the dependent variable yielded an F-statistic of 6.656 (.027) suggesting the two sets of tangible benefits are linearly related. However, one of the tangible benefits was statistically significantly different between the two industries (Table 6). "Inventory reduction" was mentioned by 4 out of 14 manufacturing firms, but none of the HW/SW firms mentioned that concept. Using a test of proportions (e.g., Dixon and Massey 1969), the difference in the proportions for that single tangible benefit is significant at better than 0.03 level. This is likely to be reflective of the greater importance of inventory to manufacturing firms.

Although only one of the tangible benefits (Table 7) differed across industries, 6 of the 11 categories of intangible benefits had statistically significant differences of proportion by industry. As a result, it was not surprising for the regression of the two industry sets of data to have a regression F-statistic of 1.49 (.253), suggesting that they are not linearly related. The manufacturing firms had a greater emphasis on getting "New Processes," "Cost Reduction," "Integration" and "Y2K." Those concerns are all consistent with a story about firms with long-established, computer-based systems that are not integrated, not Y2K compliant, with old processes that need to reduce costs (e.g., O'Leary 2000). On the other hand, the HW/SW industry sample had greater emphasis on "Flexibility" and "Globalization," consistent with a story of young firms responding to a growth in computerization.

Of the nine additional categories of intangible benefits (Table 8) with more than one item, five had statistically significantly different proportions between industries. The regression of the two sets of industry data yielded an F-statistic of 2.145 (.174). For those categories where the manufacturing firms had statistically significant greater proportions ("Better Decisions," "No Redundant Data Entry," and "Speed") the story is consistent with a nonintegrated infrastructure where there is redundant data entry, resulting in slow processing of information. As a result, ERP would provide, nonredundant data entry, faster processing of data, and, thus, better decisions. For those categories where the HW/SW firms had statistically significantly different proportions ("Acquisitions," "New Reports/Reporting Capability"), one story is of firms trying to grow through acquisition and trying to get the reporting they need to control those acquisitions.

TABLE 8
Additional Intangible Benefits

	Manufacture	HW/SW	Total	Z-Score
Acquisitions	0	3	3	2.08***
New Reports/Reporting Capability	0	2	2	1.66*
Sales Automation	0	1	1	1.15
Change Business Model/Competitive Advantage	2	2	4	0.26
Growth	2	3	5	0.81
Financial Controls	1	1	2	0.17
Better Decisions	3	0	3	1.64*
Leverage Size	1	0	1	0.90
Increased Time for Analysis	1	0	1	0.90
No Redundant Data Entry	5	0	5	2.22***
Reduce Training with Transfer	1	0	1	0.90
Speed	4	0	4	1.93**

*, **, *** Significant at the 0.05, 0.03, 0.02 levels, respectively.

SUMMARY, CONTRIBUTIONS, AND EXTENSIONS

This paper investigated the benefits deriving from ERP systems. A database was generated using 25 case studies from two different industries: manufacturing and hardware/software. Using content analysis, the frequency of appearance of different concepts was developed using categories from an extensive study of benefits by Deloitte Consulting (1998).

The results were consistent with the original Deloitte Consulting Study. However, the current study also extended the original Deloitte Consulting Study, by studying industries' differences in benefits and additional intangible benefits. It was found that generally so-called "tangible benefits" are similar between the manufacturing and HW/SW industries, with only one of 12 items being statistically significantly different (inventory reduction). On the other hand, there were substantial intangible industry differences.

Contributions

This paper has a number of contributions. First, this paper provides an approach to gathering data and a way of analyzing that qualitative data to provide insights into ERP benefits. Second, the findings provide empirical insight into the most important benefits deriving from ERP systems, in general and on an industry basis. Third, the findings in this paper provide a basis from which to argue that the benefits are often industry-based. In particular, we find that tangible benefits are consistent across industries, with few exceptions. On the other hand, we also find that intangible benefits differ across industry. As a result, any analysis of ERP benefits that does not allow differentiation by industry could be seen as inherently limited. Benefits are not be seen as universally equivalent across industry.

Extensions

Using the approach outlined in this research, other researchers could analyze data from other ERP systems, such as SAP or PeopleSoft. Those analyzes could then be compared to the Deloitte Consulting (1998) study or the current study.

REFERENCES

Bowley, G. 1998. Silicon Valley's transplanted sapling. *Financial Times* (March 27).

Deloitte Consulting. 1998. *ERP's Second Wave*. New York, NY: Deloitte Consulting.

Dixon, W., and F. Massey. 1969. *Introduction to Statistical Analysis*. New York, NY: McGraw-Hill.

Everdingen, Y., J. Hillegersberg, and E. Waarts. 2000. ERP adoption by European midsize companies. *Communications of the ACM* 43 (4): 27–31.

Foley, J., and T. Stein. 1997. Oracle aims at applications midmarket. *Information Week* (July 7): 30.

Hayes, D., J. Hunton, and J. Reck. 2001. Market reaction to ERP implementation announcements. *Journal of Information Systems* (Spring): 3–18.

Herrera, S. 1999. Paradise lost. *Forbes Global* (February 8). Available at: http://www.forbes.com /forbes/1999/0208/6303096a.html.

Hunton, J., A. McEwen, and B. Wier. 2002. The reaction of financial analysts to enterprise resource planning implementation plans. *Journal of Information Systems* (Spring): 31–40.

———, B. Lippincott, and J. Reck. 2003. Enterprise resource planning (ERP) systems: Comparing firm performance of adopters and non-adopters. *International Journal of Accounting Information Systems*: 165–184.

Kremers, M., and H. Dissel. 2000. ERP system migrations. *Communications of the ACM* 43 (4): 53–56.

O'Leary, D. 2000. *Enterprise Resource Planning Systems*. Cambridge, U.K.: Cambridge University Press.

Poston, R., and S. Grabski. 2000. The impact of enterprise resource planning systems on firm performance. In *Proceedings of International Conference on Information Systems*, 479–493. Brisbane, Australia, December 10–13.