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Executive Summary

Organizations have invested in IT to improve their business processes and adapt to rapidly changing conditions in the competitive environment. However, identifying the value obtained from these investments has not been easy. Lack of consistent measures, changes in technology and the environment, and the resulting changes within the organization made it difficult to link investments in information technology with firm performance. Further, many of the benefits obtained from information technology are intangible and hence difficult to define in dollar amounts. However, recent studies have shown positive relationships between investments in information technology and firm performance.

Firms are increasingly investing in Enterprise Resource Planning (ERP) systems. Appropriate use of these systems can result in improved data accessibility and process efficiency. However, implementing these systems have proven to be very expensive and the benefits from implementation are not easily achieved. Lessons from previous research may help realize value from investments in ERP. Customer focus, redesigning of business processes to leverage the technology, empowerment of the workers and management of the risks are some of the recommendations from these articles. A vital message is that management of organizational change needs to be considered an integral part of the systems implementation process.

ERP - Enterprise Resource Planning

ERP has evolved and extended from the Material Requirement Planning (MRP) and Manufacturing Resources Planning (MRP-II) systems of the previous decades to cover the gamut of activities within any business enterprise. ERP is recommended for organizations that require integration of key operations and has been touted as being able to transform the business itself. It can reduce costs associated with information technology by consolidating all systems in a single information system. By providing integration between the different processes within the organization, an ERP system has the potential to quickly provide relevant and comprehensive data to decision-makers; the availability of timely data will aid operational and strategic decision-making.

Organizations that have invested in ERP software to improve internal business processes can extend these systems to provide tighter collaboration with customers and suppliers, allowing participants to conduct business at different locations at different times. By extending ERP applications to the Internet, firms are able to reap the combined benefits of superior supply chain management and pervasive global reach. Firms are also trying to leverage their investment in ERP by turning their ERP packages into platforms for application development and integration. The ERP platform should therefore generate significant performance outcomes for the investors.

However, industry statistics paint a dismal picture of ERP implementations and benefits. Industry surveys have shown that the gap between the promise of an ERP system and the business value actually delivered once the project has been deployed is great. Enormous cost overruns, deadlines missed in some cases by years, and even abandoned implementations make clear that managing ERP projects is a complex task.

If you can't measure it, you can't manage it

It seems obvious that IT assets, large or small, could lead to business value through their support of a firm's IT planning, delivery, and operations and support processes. However, assessing value received from investments in information technology (IT) and proving the obvious has never been easy. In fact, one of the reasons cited for the "productivity paradox" of IT was the inability to measure the impacts of IT. It was also suggested that the lack of explicit measures of the value of IT made it vulnerable to misallocation and mismanagement. Another reason for the difficulty with evaluation is that the issue of IT value is not one question, but three; productivity, business profitability and customer value are different aspects of IT value (Hitt & Brynjolfsson, 1996).

However, a measure of IT impact will not suffice to help management understand the value IT can provide in a firm's business operations. Users and managers of IT agree that most of the benefits from the use of IT are intangible and hence difficult to relate to "profit" results. Justification for investment in IT develops out of a firm's belief that IT grants it the ability to respond in a successful manner to the competition. Using a case study approach, Clemons (1991) has shown that even when firms do not see an IT investment as essential at present, they may have to consider investment in IT as buying an option for the future survival of the firm.

A considerable amount of the research in the area of IT evaluation has focused on associating IT related costs and benefits with financial or accounting-based firm performance measures, based on the reference disciplines of microeconomics and accounting. The focus of these studies has not been the individual stakeholders impacted by the use of IS within the

organization, but the management of a firm or business units within a firm. The information systems studied in these research projects are the traditional systems implemented to serve the needs of one functional area. Results have been mixed, with some studies showing neutral or negative impacts of IT, while other studies show a positive impact.

Investments in ERP

The implementation of an ERP package is an enormously complex task requiring project management skills and knowledge, a lack of which often leads to projects failing to meet deadlines and stay within budget. Firms typically do not have the resources to develop an ERP system in-house and rely on integrated software packages from manufacturers like SAP, Baan, Oracle, and PeopleSoft to meet their needs. Usually, IT staff in firms are not familiar with these packages, and implementing an ERP system requires external expertise. Lucas et al (1988) have stated that implementation of a package differs from that of a custom system in three different ways.

- The user may have to change or add to the programs in the package to fit business requirements
- The user may have to change business procedures in order to work with the package.
- The user develops dependence on the package vendor for assistance and for updates with the package.

ERP implementations are seldom out of the box; customization is necessary to accommodate the unique business processes of each organization. Competent management of the customization results in an implementation that preserves the uniqueness of the firm and derives proprietary strategic advantage from information systems. Weill (1992) has asserted that some firms are able to obtain better performance effects from IT because of their "conversion effectiveness". Conversion effectiveness is an aspect of the firm's climate and is defined as the

quality of the firm wide management and commitment to IT. Conversion effectiveness contains four factors that will help ensure successful use of IT: top management commitment to IT, previous firm experience with IT, user satisfaction with systems and the absence of turbulence in the political environment within the firm. A number of studies have concluded that top management support as well as user group support is essential for the success of the IT investment. User satisfaction is an indicator of the effectiveness of the system and will contribute to the productivity of the organization and hence the business value of the system.

Research has shown that firms with a customer focus have a greater chance of reaping benefits from IT than firms operating in the cost-savings mode (Brynjolfsson, 1995). Integration of sales force automation application packages with ERP will help provide better service to customers. The ERP platform serves as a storehouse for information from core business processes, which can be used, by several peripheral processes within the organization to great benefit. Communication technology today provides organizations the capability to make information available at any time, at any place and by any method. Thus it makes sense to implement tools that will allow this data to be extracted and provided when and where it can be used.

Studies in outsourcing have shown that it is important for an organization to be able to manage its vendor partnerships. Along similar lines, organizations need to be able to manage their relationships with ERP vendors and consultants. Involvement of IT staff is critical for the development of in-house expertise. If the IT staff are not involved in the implementation, they will not be able to provide the on-going support that is necessary once the system goes into production.

Implementation of any new technology necessitates organizational change; the change is of a greater magnitude in the case of the ERP systems. ERP systems are actually more than integrated transaction processing modules and a new infrastructure; they require a new way of doing business. As in all systems development projects, educating the staff so that they understand the changes in procedures and acquire the skills necessary to use the new system, is important. In other words, a successful ERP implementation must be managed as a program of wide-ranging organizational change rather than as a software installation effort. Purchasing of the package may be the smallest part of the overall cost of implementing a new system; organizational changes will take a much bigger chunk of the resources.

Implementing changes in the business processes by implementing an ERP system can have disastrous results. Fixing a dysfunctional organization by implementing a new system will only make the problem worse. Resistance to the process may be manifested as resistance to the system leading to the failure of the system. Before organizations implement a new system, the goals the organization hopes to attain using the system must be identified. This helps in planning the implementation as well as evaluating the benefits from the implementation.

It is becoming increasingly important for firms to organize in ways that leverage the value of IT. This may not be true across all possible settings, but in the case of ERP systems this is applicable. Firms will have to invest in changing business processes and organizational structure to get the benefits from their investments. Matching complementary assets as infrastructure and human capital with IT assets produces the maximum benefit for the organization and creates lasting value (Brynjolfsson & Hitt, 1998).

Implications for Management

The success of an ERP implementation depends on the organization's commitment to the ERP solution. A clear IT strategy based on corporate objectives will help the firm identify its expectations for the ERP. These identified targets help the firm plan and monitor the ERP implementation as well as evaluate the outcome.

Research on systems implementation has consistently pointed out that organizational change accompanies any implementation. The organization needs to be prepared for the organizational change that results from an ERP implementation; this change will definitely be of greater magnitude and of a different nature than the change resulting from implementation of smaller information systems. The integration that ERP brings about implies that the actions of the individual user will have a greater ripple effect.

The research on IT evaluation offers some guidelines for realizing value from ERP systems:

- Redesign the business processes to leverage the capabilities of the ERP system
- Take advantage of the increased data visibility to enhance management reporting and improve decision-making
- Focus on the customer rather than on cost savings
- Empower the workers; train them in the skills required to use the new system
- Monitor the use of the system to ensure that it is being utilized so as to achieve the targeted goals.
- Manage the risks by identifying the different forms of risk and balancing them.

As Clemons (1991) has noted, evaluation of strategic investments in information technology will never be routine procedures. With the application of guidelines derived from scrutiny of successful and unsuccessful deployment of IT, these crucial decisions can be improved.

Additional References (not extracted):

- Brynjolfsson, E. and Hitt, L.M. "Beyond the Productivity Paradox," *Communications of the ACM* (41:8), 1998, pp. 49-55.
- Hitt, L.M. and Brynjolfsson, E. "Productivity, Business Profitability and Consumer Surplus: Three Different Measures of IT Value," *MIS Quarterly* (June), 1996, pp. 121-142.
- Lucas, H.C., Walton, E.J. and Ginzberg, M.J. "Implementing Packaged Software," *MIS Quarterly* (December), 1988, pp. 537-549.
- Weill, P. "The Relationship Between Investment in Information Technology and Firm Performance: A Study of the Valve Manufacturing Sector," *Information Systems Research* (3:4), 1992, pp. 307-333.

ARTICLE ABSTRACTS

The following section contains summaries and analyses of articles in the area of evaluation of IT. The references for the articles are provided as sources for further study.

Article Title: What is the Value of Investment in Information Systems?

Summary:
Management has always been concerned with the value of investments in information systems (IS). IS managers thus the challenge of associating dollar value to the investments. There is a need to provide IS managers with techniques for quantifying the value of IS investments that will help them convince management of the value of the investments made.

Value to Managers:
Evaluation methods that associate dollar amounts to intangible benefits will help document IS effectiveness.

Description:
Quantifying the value of IS has long been the dilemma for most IS managers. In order to help the managers make more effective and convincing IS decisions, the author presented four IS report formats and discussed several IS evaluation techniques. These documents will also serve as a tool for communicating information about IS investment.

Four different quarterly reports used to present the investment data on IS were described: evaluation of objectives attained, evaluation of investment value, evaluation of current period investment, and analysis of investments in non-profit categories.
Four techniques for evaluating intangible benefits are: -

1) replacement cost – Calculate the cost of producing the information in another manner
2) cost avoidance – Calculate the costs avoided as a consequence of investing in IS activities
3) related benefits – Some IS investments are made as a part of a larger improvement
4) comparison value – Compare the benefits of IS with other tangible benefits

Two measures of performance that relate IS investment to profitability are, standards of accomplishment which compares the performance to a pre-specified level of accomplishment to actual performance, and standards of return on investment which compares the pre-specified ratio of value to cost to actual ratio of value to cost.

Since creation of these reports require staff from IS and other functional areas to work together, this will also foster understanding and cooperation between the two different groups. It is important that management should facilitate this process of working together and assigning a dollar value for each objective attained.

Key Lessons:
Appropriate techniques as well as positive relationships between IS and other departments are important in establishing and realizing the value of IT investments.

Research Base:
The research is based on the author's personal experience and the experience at Land O'Lakes Inc.

Reference:
Matlin, G. (1979 Sep). *What is the Value of Investment in Information Systems?* MIS Quarterly, (3:3), 5-34.

Article Title: Measuring Gains in Operational Efficiency from Information Technology: A Study of the Positran Deployment at Hardee's Inc.

Summary:
Information technology (IT) can help firms achieve competitive advantages. When senior management wants to see the direct operating-cost savings, it is difficult for IT managers to justify the business value impacts of IT. However, measuring the value of IT at the intermediate production process (instead of at the aggregate firm level) proved to be helpful in justifying high IT investment budgets.

Value to Managers:
The way an operation is managed affects the success of IT investment.

Description:
Competitive efficiency method measures the relationship between technology investments and other major firm-level expenditures and bottom-line impacts. This kind of aggregate measurement method does not explain the contribution of IT since many other factors may confound the impact of IT.

Thus, there is a need for managers to realize that IT performance need to be measure at functional level. This measurement method, which is called operational efficiency measure, allows the evaluation of IT values at the segments of the service value chain most affected by IT.

Key Lessons:
Companies have to be careful in selecting where to deploy IT technology so as to maximize its contribution to the operational performance of the firm.

Cautions:
Different management practices might influence the result of the measurement of IT value.

Research Base:
Hardee's Inc.'s cash register point-of-sale and order-coordination system, Positran, was studied using the case study method.

Reference:
Banker, R. D., Kauffman, R. J., and Morey, R.C. (1990). Measuring Gains in Operational Efficiency from Information Technology: A Study of the Positran Deployment at Hardee's Inc. *MIS Quarterly*, (7:2), 29-54.

Article Title: Evaluation of Strategic Investments in Information Technology

Summary:
Many factors contribute to the indecision in information technology (IT) investments. This paper provides some principles that can guide organizations through the decision making process and ensure a successful investment.

Value to Managers:
It is possible to improve crucial decisions regarding IT if managers are aware of the costs and benefits as well as the risks of deploying the technology.

Description:
No doubt, IT delivers competitive advantage to organizations. However, organizations still hesitate when it comes to IT investment because of the huge sums of money involved, the uncertainties, and the difficulties in quantifying the value of the investments. By critically evaluating decisions related to IT investments, organizations can ensure a desirable return on investment (ROI). The author presented some guidelines for organizations in structuring their analysis of strategic IT investments.

1. Rank the alternatives associated to the strategic investments.
2. Try to quantify the critical variables in order to reach a sound financial analysis. For those variables whose values are unknown, conducted the analysis with alternative values.
3. Balance all forms of risks. Five components of risks are financial risk, technical risk, project risk, functionality risk (functionality no longer appropriate), and systemic risk (external factors).
4. Manage the risks.
5. Exploit the key assets (competitive advantage) not readily available to competitors.
6. Launch a cooperative venture when a major competitor's size places a form at a competitive disadvantage or when such a venture will help the firm acquire necessary resources.
7. Invest to preserve future opportunities.

Key Lessons:
The process of evaluating strategic investments in IT involves consideration of several factors, which vary depending on the firm and its environment; this is not a routine process.

Cautions:
Finding and evaluating strategic opportunities to use information technology and then justifying the decision to make the necessary investment require a set of skills different from those historically required of IS executives.

Research Base:
The research is based on case studies and discussions with different personnel from different organizations.

Reference:
Clemons, E. K. (1991 Jan). Evaluation of Strategic Investments in Information Technology. *Communications of the ACM*, (34:1), 22-36.

Article Title: Measuring the Organizational Impact of Information Technology Investment: An Exploratory Study

Summary:
This is an exploratory study relating IT investment measures to organizational performance. Although individual IT investment indicators were weakly related to organizational performance, they were significantly related to performance when grouped.

Value to Managers:
The model presented in this paper provides managers some guidelines when making IT investment decisions.

Description:
The authors create a framework based on financial indicators that relates IT investment and organizational strategic and economic performance. Tests of the model indicate that IT investment appears to be related to organizational strategic and economic performance. Based on this conclusion the authors offer some guidelines for corporate management:

1. Consider steady investment in IT for enhancing organizational strategic and economic performance.
2. IT investment must be accompanied by appropriate employee training in order to improved organizational performance.
3. Performance measures such as sales by total assets should be considered when evaluating the impact of IT investment on organization strategic and economic performance.
4. Measures such as IT budget as a percentage of revenue should be considered for use as measures of IT investment.

Cautions:
The model represents only the financial and sales dimensions of the organization. Thus, other organizational aspects are needed to complete the model. Also, no distinction is made in this study between strategic, informational and transactional systems.

Research Base:
Data for IT investment measures were obtained from the Computerworld "Premier 100" list for 1989, and for organizational performance measures from the Compact DISCLOSURE database. Statistical analysis was performed to check for relationships between IT investment measures and organizational performance measures.

Reference:
Mahmood, M. A., and Mann, G. J. (1993). Measuring the Organizational Impact of Information Technology Investment: An Exploratory Study. *Journal of Management Information Systems*, (10:1), 97-122.

Article Title: Information Technologies and Business Value: An Analytic and Empirical Investigation

Summary:
This paper proposes a different approach to assessing the impact of IT investments. Instead of focusing on firm level impact of IT, the authors performed their analysis at the functional level. Results indicate that significant IT impacts occur at lower levels in the organization. Using a two-stage approach, it was shown that investments do have a significant impact on high level economic output variables, like market share.

Value to Managers:
The two-stage approach provides insights for better management of IT resources by highlighting the critical variables.

Description:
Previous IT impacts studies has focused on an aggregate level of analysis. These approaches are based on the microeconomic production function, and tries to relate IT expenditures directly to output variables at the level of the firm while ignoring the intermediate processes through which IT impacts arise. This leads to the conclusion that IT has either negative or neutral impact on the firm's performance.

In trying to prove the notion otherwise, the authors proposed a model to measure the IT impacts. It is found that IT impacts do exist and they can be detected when the analysis is executed at a lower level in the firm. The lower level impacts, in turn, are expected to affect higher-level performance measures (i.e., return on investment, etc.). Also, IT inputs were found to have a significant positive effect on the intermediate level output variables.

Key Lessons:
IT benefits at the aggregate level are difficult to quantify. Thus, the measurement of IT impacts need to be traced back to the level where it actually being implemented.

Cautions:
The absence of information on the type of IT, manufacturing processes and managerial strategies reduces the predictive power of the model.

Research Base:
Data from different source were used in this study. The first source of data was from the Strategic Planning Institute, Cambridge, MA. These data were collected through a well-structured survey instrument on approximately 60 business units operating in the U.S. and Western Europe from about 20 large corporations. This was supplemented by publicly available data.

Reference:
Barua, A., Kriebel, C. H., and Mukhopadhyay, T. (1995). Information Technologies and Business Value: An Analytic and Empirical Investigation. *Information Systems Research*, (6:1), 3-23.

Article Title: The Productive Keep Producing

Summary:
Customer-focused strategy, delegation of decision making and reengineering were the keys to IT productivity, in organizations that successfully deployed technology.

Value to Managers:
Comparison of successful and unsuccessful uses of IT in organizations on three aspects – strategy, organizational structure and IS tactics, reveals how IT can be used to bolster organizational performance. . Managers need to recognize the current strategies employed by their companies and constantly work toward refining the strategies in order to gain the benefits from IT investments.

Description:
Firms were ranked on their evidenced capability to combine technology and management to generate more wealth than their competitors. Companies that focus more on their customers tend to gain more benefits in IT investment compared to companies that focus on reducing costs. Empowerment, which gives more decision-making power to line workers, also helps companies to take advantage of IT. Companies in the midst of reengineering or business process redesign (BPR) and devoting more of their IT budget to BPR tend to have high success in their IT projects

Key Lessons:
Get close to the customer, empower your workers, redesign business processes to take advantage of IT and create a partnership among the IS, line and management.

Cautions:
Companies still need to work hard in ensuring a good execution of the policies. For instance, if IT is utilized to empower the line staff, ensure that they have been trained in these skills.

Research Base:
Data were collected from chief information officers (CIO) and human resources directors of companies identified as leading computer users on issues related to IT.

Reference:
Brynjolfsson, E., and Hitt, L. (1995 Sept 18). The Productive Keep Producing. *InformationWeek*, 38-43.

Article Title: Added Value and Pricing with Information Technology

Summary:
Information technology (IT) can add value for the customers. This can be reflected in market prices customers are willing to pay for an IT-enhanced good. This quality differentiation can be used as a strategy to partition the market, thereby reducing the intensity of price competition by serving different market segments.

Value to Managers:
Managers need to determine what value IT can add to help trade off against existing customers' costs, and work towards the goal.

Description:
For industrial customers, IT can add value to the traded good, thus lowering production costs through economies of scale and by productivity improvements. Most of the added value is due to convenience and control the IT provided to customers. However, high adoption costs (the cost of integrating the new IT into firm's existing operations) may at times prevent customers from adopting a new IT. Suppliers can overcome the adoption costs by providing implicit subsidies (eg: training or customer service).

Key Lessons:
IT can provide a competitive advantage to the companies by providing the added value to customers. In this case, IT let a sales and distribution firm to charge a higher price because it provides convenience and control for customers, did not negatively impact any services (like utilization of credit and provides a service that customer cannot attain themselves.

Cautions:
While the research indicates that the business can charge a premium for an IT enhanced good, it has not shown whether the firm is able to obtain a positive return on investment. The paper does not address the issue of optimal supplier behavior. A more complete analysis is needed to integrate the findings from customer's viewpoint to supplier decision making.

Research Base:
Structured interviews were conducted with two Pacific Pride senior executives. Each of the interviews was audio taped for further re-examination. Also, statistical analysis was conducted on the data provided by Pacific Pride. The data included time series of Pacific Pride retail prices, its competitors' retail price and a time series of Cardlock prices.

Reference:
Nault, B. R., and Dexter, A. S. (1995 Dec). Added Value and Pricing with Information Technology. *MIS Quarterly*, 449-464.

Article Title: An Empirical Investigation of the Contribution of IS to Manufacturing Productivity

Summary:
This study shows that even though large manufacturing firms have the potential of investing more in IT than small or medium firms, company size does not affect firms success in IT investments.

Value to Managers:
Organizational goals are achieved by appropriate utilization of IT; company size and amount of investment are not major decisive factors.

Description:
Management requires convincing evidence of contribution of IT to productivity. Due to the lack of such evidence, management is concerned about the returns and under-utilization of existing technology. This paper investigates the effect of firm size on the success of IT investments. It is found that large firms do invest more in IT than small firms, especially in technologies like CAM, EDI, and robots. However, it is also found that there is no difference between large and small to medium enterprises, on average, in the contribution of IS toward achieving specific organizational goals, and the extent to which the MIS department supports functional tasks in a firm. Also, the characteristics of MIS personnel are found to be similar in these firms.

Key Lessons:
It is not the size of the firm or the total amount of investments in IT that ensures achievement of organizational goals.

Cautions:
While it is interesting to note that size does not have a significant effect on utilization of technology, the study does not reveal what does. The results of the study are based only on data from manufacturing firms.

Research Base:
A total of 220 questionnaires were mailed out to manufacturing firms. Of 117 questionnaires returned, 91 were usable. 42% of the firms were large firms (with annual gross sales of $250 million or higher) while the remaining 58% were medium to small firms.

Reference:
Gupta, U. G., and Capen, M. (1996 Dec). An Empirical Investigation of the Contribution of IS to Manufacturing Productivity. *Information & Management*, (31:4), 227-233.

Article Title: Development of Measures to Assess the Extent to Which an Information Technology Application Provides Competitive Advantage

Summary:
Measurement problems have often been cited as the reason for not being able to identify the contributions of IT to competitive advantage. The goal of this paper is to identifies dimensions for competitive advantage provided by an IT application.

Value to Managers:
An established measurement that supports the competitive advantage of IT helps IT managers in justifying IT investments made.

Description:
The authors tried to measure the competitive advantage provided by an information technology application (CAPITA) using the trait approach. Trait approach identifies key attributes that characterize competitive advantage. It provides insights into how and why IT affects competitive advantage. The different dimensions identified to measure CAPITA are efficiency in primary and support activities, functionality in resource management and acquisition, threat to the bargaining power of customers and suppliers, market preemptiveness and synergy due to integration with business goals and strategies. Besides using the measure within their own organization, management could use it to assess competitor's use of IT.

Cautions:
The nature of the IT application determines the degree and strength of the relationships among the dimensions. The model in this study was developed and tested using the same data set. Thus, another data set is required to validate the model.

Research Base:
A field survey gathered data from 185 top information systems executives regarding information technology application that had been developed to gain competitive advantage.

Reference:
Sethi, V., and King, W. R. (1994 Dec). Development of Measures to Assess the Extent to Which an Information Technology Application Provides Competitive Advantage. *Management Science*, 1601-1627.

Article Title: The Impact of Information Technology Investments on Firm Performance and Evaluation: Evidence from Newly Industrialized Economies

Summary:
The goal of this paper is to find out if the results from studies on IT investment impact on firm performance conducted in the United States can be applied to other nations as well. It is found that the results are mostly applicable to other countries though some discrepancies exist due to difference in the level of IT deployment and policy.

Value to Managers:
This research creates an awareness of the impact of government policy on IT investment. Managers need to carefully investigate and study the policies of the countries they are interested to invest in to ensure a successful and profitable investment.

Description:
Prior IS research has focused mainly on one nation (United States) while studying the impact of IT investment on firm performance. However, with the rapid increase in the number of firms operating globally, the author sees the need for an effort to extend these studies to other nations and find out whether the results still hold true.
Surprisingly, the results in this study are mostly consistent with work done in the United States. It is found that IT investment is not correlated with return on stock values when the market is efficient. Also, IT investment does not have a direct impact on firm performance. However, it does have an indirect impact, which is moderated by different management orientation and financing decisions unique to a national setting. There is little evidence that the level of computerization is valued by the market in developed and newly developed countries. Also, the absent of consistent measurement of IT investment is once again indicated by the mixed results across different performance ratios.

Cautions:
This is an initial attempt at considering the impact of IT in a cross-national context; the empirical testing was done using data from various secondary data sources. The definition of IT capital used here includes only computer and peripherals and does not include software and IT labor.

Research Base:
Secondary data were obtained from annual issues of the Asia Computer Directory (ACD) on four newly industrialized countries: Hong Kong, Singapore, Malaysia and Taiwan. ACD publishes description of hardware installations of major firms in Asia.

Reference:
Tam, K. Y. (1998 Mar). The Impact of Information Technology Investments on Firm Performance and Evaluation: Evidence from Newly Industrialized Economies. *Information Systems Research*, (9:1), 85-98.

Article Title: Information Technology and the Nature of Managerial Work: From the Productivity Paradox to the Icarus Paradox?

Summary:
Managers in organizations that focus on reorienting of strategy concentrated on only a few activities with increased dependence on IT. This leads to unnecessary over-specialization and may affect the organizational development, since the role of middle management has traditionally been defined as the integration of a wide range of managerial functions.

Value to Managers:
There is the need for managers to understand the level of IT usage and the nature of management work and to strike a balance among all managerial activities.

Description:
Prior empirical research claimed that IT failed to yield significant gains (thus, the productivity paradox). The authors believed that a solution to the paradox could be found by understanding the relationships between the level of IT usage and the nature of middle management work in different organizational contexts. When strategic changes are underway at the organization level (reorientation context), IT is used mainly to reinforce and support the specific roles perceived as critical by managers. This tendency to focus more intensively on one or two activities while neglecting other equally important activities can be disastrous to organizational development. In organizations in a reorientation context, there is a stronger relationship between the level of IT usage and the nature of managerial work, than in organizations where the focus is on improving existing operations (convergence context)

Key Lessons:
A better understanding of how IT usage is related to the nature of managerial work will help untangle the paradox that IT failed to yield significant gains. When managers are conscious of the nature of their IT usage, they can avoid undue dependence on IT and can pay equal attention to all their roles in the organization.

Cautions:
Small sample size used in this research raised the question of generalization of the result to other industries and to managers other than middle managers. Also, the data for the research were gathered on one single day with the assumption that the day was the typical day of work for the respondents. Furthermore, the research only studied the relationships between the level of IT usage and the time spent on various roles by managers, but excluded the comparison on how managers allocated their work time before and after IT implementation.

Research Base:
A total of 59 middle mangers from three firms (a bank, a telecommunications company and a utility company) were asked to log their daily activities and IT usage on one particular day. After that, follow-up interviews were conducted with them.

Reference:
Pinsonneault, A., and Rivard, S. (1998 Sept). Information Technology and the Nature of Managerial Work: From the Productivity Paradox to the Icarus Paradox? *MIS Quarterly*, 287-311.

Article Title: Information Technology Effects on Firm Performance as Measured by Tobin's q

Summary:
A market based valuation measure of firm performance that provides a complete picture of the performance association of IT investments is proposed. Research indicates that there is a positive relationship between this measure and IT investments.

Value to Managers:
A market based valuation measure of firm performance controls for risk and provides a more holistic view of the IT-performance relationship.

Description:
Previous studies have relied exclusively on using accounting-based measure of firm performance. However, this method of measurement leads to several problems. The accounting-based measures only reflect past information, are not adjusted for risk and are distorted by temporary disequilibrium effects. It is also insensitive to the time lags necessary for realizing the potential capital investments. In order to avoid these problems, Tobin's q, a financial market-based measure of firm performance was used, after controlling for a variety of industry factors and firm-specific variables. Tobin's q ratio is defined as the capital market value of the firm divided by the replacement value of its assets and incorporates a market measure of firm value which is forward looking, self adjusted and less susceptible to changes in accounting practices. Based on data for a period of five years, IT investments had a significantly positive association with Tobin's q, indicating that IT contributes to a firm's performance potential.

Cautions:
This study does not make any distinction among the different types of IT investments.

Research Base:
The research used the data related to IT budgets and computer capital from InformationWeek magazine and from ComputerWorld magazine for the year of 1989 to the year 1993. The data from InformationWeek is the annual survey of chief information systems executives conducted by InformationWeek and published in their annual special issue (IW-500). The data in ComputerWorld was the annual survey conducted by International Data Group (IDG).

Reference:
Bharadwaj, A. S., Bharadwaj, S. G., and Konsynski, B. R. (1999 Jun). Information Technology Effects on Firm Performance as Measured by Tobin's q. *Management Science*, 1008-1024.