

**INVESTMENT IN INFORMATION TECHNOLOGY AND
ORGANIZATIONAL PERFORMANCE**

by

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Abstract

Information technology (IT) is essential to many businesses, but there are few guidelines for determining the adequate level of investment in IT. The purpose of this paper is to further understanding of the mechanism of IT investment. Previous studies on IT investment are briefly presented. The authors performed six-mini case studies of large companies in five different industries; these studies addressed the questions of how firms define IT and how they manage their investment in IT. Our goal was to formulate a model of the relationship between IT investment and organizational performance. We present the model and pose questions for investigating this important relationship more closely.

Findings of interest relate to the definition of IT, the importance of political considerations, the concept of an industry-based threshold investment, the conversion effectiveness of IT investment, and the concept of productive capacity. The most important finding relates to the separation of different types of IT investment and their logical matching to particular performance measures.

Key Words: Information technology investment, organizational performance, conversion effectiveness, strategy.

Introduction

PRESIDENT: Recently I have been struggling with how heavily this company should invest in IT.

CONSULTANT: Clearly it all depends on your strategy and associated niche, competitors, environmental turbulence and industry structure, technological profile of your firm, level of differentiation and vertical integration and of course how you feel about it.

PRESIDENT: Really?

Businesses are investing enormous amounts of resources in information technology (IT). A recent study [18] found that the average information technology (IT) expenditure in 1983 was 8% of revenues for high performing companies. The same study found that the average firm allocated approximately 2% of revenues to IT [20]. Another survey [5] found that management information systems (MIS) expenditure on average accounted for 1.44% of revenues. Unfortunately much of this investment is made on the basis of blind faith in real returns. There is little actual evidence that investments in IT are economically advisable. Conversations such as the one reported above illustrate the quandary many managers face. Information technology is essential to their businesses but they have few guidelines for determining the adequate level of investment in IT.

The purpose of this paper is to further understanding of the mechanism of IT investment. Previous studies on IT investment are briefly presented. The authors performed six mini-case studies of large companies in five different industries which addressed the questions of what firms define as IT and how they manage their investment in IT. Our goal was to formulate a model of the relationship between IT investment and organizational performance. We present the model and pose questions for investigating this important relationship more closely.

The Problem

The general research problem is: What is the impact of the level of investment in IT on firm performance? This is a very complex issue, as IT investment is only one of the many variables which affect firm performance [10] [21]. The crux of the problem is whether investment in IT really makes a difference. This problem spawns the following series of related questions:

1. Is there a significant, unique effect of investment in IT on firm performance?
2. What is the nature of the relationship between the level of investment in IT and firm performance? Does increasing investment lead to increased performance? Is there a level of investment that produces an optimum level of firm performance, after which further

investment reduces firm performance [1]? Alternatively is there a diminishing return, where increased investment in IT produces decreasing but still positive effects on firm performance?

3. Is the relationship between levels of IT investment and firm performance dependent on the industry in which the firm operates? Alternatively is the relationship similar across industries?
4. In a particular industry, is there a threshold investment that firms must make to survive?
5. Does the strategic reason for investing in IT make a difference? What effect does the objective for investment have on firm performance?
6. Do the other variables that affect performance dominate the effects of the level of IT investments?
7. Is it possible to predict the effect of a particular level of IT investment on performance for a given firm?
8. What is the appropriate definition of performance?

We do not claim to have answers to these difficult questions. Rather, we propose a model of the relationship between IT investment and firm performance which will be useful in further research. In this paper, we report on the results of six mini-case studies, from which our model is derived. In these case studies of IT investment, we attempted to answer the following specific questions:

1. How do firms define and conceptualize IT?
2. How do firms measure and track or otherwise manage their investments in IT?
3. How do firms infer or calculate return on IT investment?
4. Do firms in different industries approach the investment in IT in different ways?
5. What is the impetus for IT investment? At what level in the organization does the impetus originate? Is it top-down, i.e. driven by corporate strategy at the highest level; or is it bottom-up, i.e. driven by operational requirements?

Previous Studies

A number of researchers have studied various aspects of IT investment and the effects on performance. In this section we summarize the results and discuss the different approaches researchers have adopted to operationalize the variables. Figure 1 identifies important variables that are common to each study.

Table 1 lists the studies included in this review. Under the column headed Topic, studies labeled "IT Investment" reported only on the levels of investment in IT. Studies labeled "IT Investment and Performance" measured both, and presented findings on the effects of IT investment on performance.

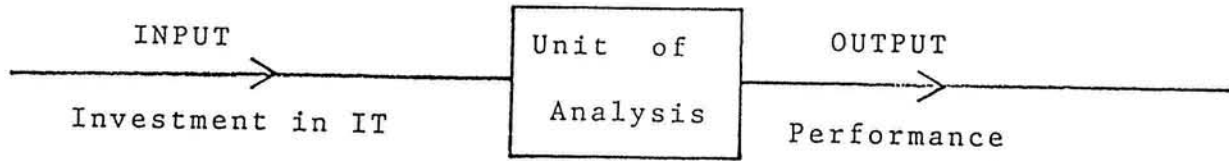


Figure 1: Schematic for Investment in IT

<u>Study</u>	<u>Year</u>	<u>Topic</u>	<u>Industry</u>
Panko	1982	It Investment	Office Automation
Cron&Sobol	1983	IT Investment & Performance	Wholesalers
Diebold	1984	IT Investment	All
Turner	1982	IT Investment & Performance	Banks
Strassmann	1985	It Investment Performance	All
US Government	1985	Investment	Government Sector
Bender	1986	IT Investment & Performance	Insurance
Datamation	1986	IT Investment	All

Table 1: Previous Research on IT Investment

What is IT?

The definition of IT varies between studies, which makes comparison of results difficult. Some studies only included Management Information Systems (MIS) and related personnel, consulting, external services, and personal computing expenditures within the centralized MIS budget [5] [4] [20] [21]. Other studies broadened the definition to include communications devices such as electronic mail, telephones, facsimile, and reproduction machines [17]. Another approach to determining the level of investment in IT was to count the number of standard application areas that were computerized [3] [21].

With the noticeable trend toward decentralized expenditure in IT by functional departments, considering IT Investment as equivalent to the centralized MIS budget is probably inadequate. However, since these expenditures are generally embedded within the functional department's operating budget, they are more difficult for researchers to capture.

Measures of IT investment

Studies have used a variety of measures of the input levels of investment in IT. In their biennial surveys of major corporations over the last ten years, The Diebold Group [5] consistently uses three measures:

- MIS budget as a percentage of revenues
- MIS staff as a percentage of total staff
- Ratio of hardware expenditures to personnel costs

Datamation regularly conducts a survey of the magazine's circulation base and the Fortune 1000 and 400 firms to assess centralized MIS input investment. The measure utilized is MIS budget as a percentage of revenues. Strassmann [18] attempted to refine the input measure to be the fraction of management costs devoted to IT. He felt that the base of management costs was more appropriate than revenues since it was more directly influenced by management decisions. In a study of the banking industry, Turner [21] used a number of measures including 'Relative DP Expenditures' (ratio of DP Expenditures to Total Assets) and the number of standard functional areas with computerized applications. Cron and Sobol [3] used three input measures:

- Computer ownership - owned/leased vs. timeshare,
- Number of standard applications areas computerized,
- Types of application areas computerized - Accounting, Management Control and Environmental Links.

All of these approaches have advantages and disadvantages. It is doubtful that any of them captures all of the input investment in IT, due to increasing decentralization of IT investment and increasing ad hoc expenditures on IT (e.g., personal computers) from non-IT operational budgets.

In the 1986 Datamation survey, the MIS budget as a percentage of revenues for all industry groups combined was 0.57%. This figure is statistically biased [due to the large number of small sites] and underestimates MIS expenditures in large organizations. Adding 0.3 to 0.4% will indicate likely values for large MIS centers¹. Strassmann [18] found that the average IT expenditure in 1983 was 8% of revenues. In the government sector [23], IT is a significant expense which in 1982 was 1.2% of the Federal Budget and increased steadily to 1.6% in 1986. In 1986 50% of this expenditure was on outside commercial IT expenses such as computer service bureaus. The disparity of the results reflect the differences in defining and operationalizing the variables. Differences were also apparent in the homogeneity and randomness of the samples and these are also likely to account for variation.

Comparison of these macro investment levels between companies (particularly across different industries) is useful only as a rough guide. The macro investment percentages are taken out of the context of the of the strategy of the firm. In addition, the ability of a particular management team to efficiently convert the investments into useful outputs is not considered.

Measures of performance

The determination of performance is highly problematic in this type of work. A variety of social and economic measures can be adopted depending on ease of measurement or the concerns of the researcher [26]. Many combinations of measures have been used, often with as much regard to convenience as to construct validity.

One study of the relationship between the process of corporate planning and financial performance of firms [7] used 16 financial measures which assessed firm size, profitability, performance and growth. This study showed statistically that the one measure of return on assets could substitute for all the others. For each firm this measure was compared to its competitors to take account of industry differences, and this relative performance was used as the dependent variable. In a study of the insurance industry Bender used the single measure of the ratio of expenses over premium income [1].

Another view is that one measure of performance will not capture all the factors that contribute to high

¹For a detailed assessment of these results and their validity and usefulness see Weill [25].

performance and consequently the use of any measure is relatively arbitrary [21]. A study of the impact of investment in computerization on financial performance in a group of wholesalers [3] used four measures;

- Pretax Profits
- Return on Assets
- Return on Net Worth
- Five Year Growth Rates.

Unfortunately no data on correlations among these measures were reported.

Other researchers have used user (or department) satisfaction measures of performance rather than financial measures in their studies. Lucas [11] incorporated a series of attitude measures to capture satisfaction.

Relationships between IT investment and performance

A comparison of the results from this research demonstrates some of the difficulties of assessing IT investment and performance.

In his study of 58 savings banks, Turner [21] concluded that "unexpectedly no relationship is found between organizational performance and the relative proportion of resources allocated to data processing."

In a study of insurance companies, Bender [1] concluded that in this industry there is an optimum level of investment in information processing. He divided IT investment into components and found only the expenditures on people, hardware, and environment to be significantly related to performance. Investment in software was not significant. Firms that invested below this optimum had lower performance, and firms that invested above this optimum added to costs unnecessarily. This study provides encouraging results for researchers working with IT investment; however, it is concerning that Bender assumed that all firms convert the investment in IT into measurable performance with the same degree of effectiveness. Some firms are likely to be more effective than others at this conversion and thus an industry-wide optimum level of investment makes little sense.

In a comprehensive study of warehousing companies [3], Cron and Sobol found that firms that made extensive use of computers were either very strong or very weak financial performers. This finding is most interesting as it supports the strategic literature that stresses the importance of strategic position [20]. If the firm has a strong strategic position, investment in IT will enhance performance. If the firm

has a weak strategic position, significant investment in IT will just add to costs.

The findings reported above are sparse and somewhat contradictory. Where a relationship between IT investment and performance was found, the results cannot be generalized beyond a particular industry or firm type. The methods of measuring investment and performance and the units of analysis differ, limiting possible comparison across studies.

A further reason for the disappointing findings of these studies is that all IT investment was treated equally. No distinction was made between different types of IT investment. Investment in transaction IT, such as accounts payable systems, will affect different aspects of firm performance than strategic IT investment, such as an expert system share trading package. These studies are also all cross-sectional in nature and ignore any time lag between IT investment and performance.

We conclude that a general model of the relationship between IT investment and performance is necessary. The model, with appropriate definitions of inputs and outputs, can be used as a guideline for assessing IT investment and performance across industries and firm types. In the next section we describe a series of six case studies we used, with the research studies described above, to derive a general model of IT Investment and performance. The model is presented in Section 8.

Case Study Methodology

We conducted a series of six mini-case studies to help us understand how firms define and manage their IT investments. Five of the companies were large, profit-making firms operating in four different industries. The sixth was a large private university. We conducted one lengthy, semi-structured interview with the appropriate representative of each organization. All interviewees were senior managerial-level, in corporate planning or information systems. All the interviewees had general knowledge of the IT intensity of the entire organization. The interviewees were frank and open; we have made every attempt to conceal the identity of the organizations and any sensitive information that was discussed.

In each interview, we discussed a broad spectrum of topics relating to IT investment. The primary questions related to what firms included in their definition of IT and how their investment in IT was managed. Other questions related to what other factors (e.g., strategy, structure, size, and time) were important determinants of IT investment.

Case Study Results

The results of the cases are presented in two stages. This section concentrates on a brief presentation of the demographics and interesting findings in each company. Since only one person was interviewed in each organization, we do not intend to imply that they are representative of the entire organization. In the next section we present a brief, aggregate analysis of all the cases by the key factors which emerged.

Organization One - Insurance

Organization One is a large insurance company with three major businesses: individual insurance, group insurance, and investment. The interviewee was a manager of Corporate Technology Planning. The company performs an inventory of all IT investment each year. The inventory includes all DP center expenditures, communications (excluding voice-based technology), personal computers, software, education, and consultants. The definition does not include consumables (such as paper, diskettes etc.) and computer operators. The company is decentralizing rapidly and the management of IT investment is also becoming more decentralized. A steering committee oversees major investments. Return on investment analysis is used to justify investment where it is considered appropriate; however, in some cases investment is driven by a need to stay with the competition or by "gut feel". There is a general perception that a certain threshold investment is required to compete in the industry.

Historically, IT investment decisions were "less political as there were fewer experts" but the interviewee noted a definite increase in the political nature of the process. Approximately 14% of the total budget is devoted to investment in IT. The impetus to invest is both "bottom up and top down" and the intention is that corporate strategy should drive investment in IT. However, the competition also drives IT investment, and IT also impacts corporate strategy; thus there is a complex circular relationship between IT investment and corporate strategy.

The interviewee observed that the MIS function was becoming more complex and sophisticated but he had not observed any attempt to manage this process at the management level. He perceived the issue of converting IT investment into useful output as "just another example of the familiar problem of resource management" and observed that some organizations were more skilled at this management task than others.

Organization Two - Banking

Organization Two is a large, geographically dispersed commercial bank. The interviewee was the Director of Corporate Systems. The bank includes in their working definition of IT "everything related

to IT". According to the interviewee, the bank is "getting carried away" with their investment in IT. Individual projects are assessed using ROI techniques but there is no notion of an overall return on IT investment. The bank tracks IT investment at both the project and corporate levels; multiple measures are used because no simple measure is considered "comfortable" in terms of accuracy. Some divisions were considerably more dependent on intensive information technology than others.

Historically the impetus to invest was bottom up. According to the interviewee, the bank views information as the product of the organization; it makes a distinction between administrative IT (e.g., MIS and office automation) and IT for productive capacity (e.g., transaction processing and general ledger).

The interviewee had not observed an increase in the political nature of IT investment; however, there have been attempts to change organizational power structures by shifting responsibility for the management of the IT resource.

Organization Three - Insurance

Organization Three is a large diversified insurance group. The interviewee was the manager of capacity planning in Corporate Administration. The company defines investment in IT as expenditure which appears in the Corporate Administration information systems budget and includes all data centers and communications. Currently this expenditure is approximately \$270 million. It does not cover divisional expenditures for information systems, including personal computers, programmers, and some minicomputers. The latter expenditure was estimated to be at least as large as the corporate budget expenditure. The company has begun to decentralize its IT management and budgets, in line with perceived trends of its competition.

The interviewee was unaware of any formal tracking of the IT resource; he thought there was a rough estimate at the level of the president. The company justifies IT investment by traditional ROI measures but emphasizes cost containment. There is some "seed money" available for experimenting with the use of new IT but it is very rare. The interviewee had not observed a threshold investment in IT in the industry.

The nature of IT investment decisions is highly political and, according to the interviewee, the "technological aspects are secondary". The decision is usually a function of the "clout of the division based on revenue generation." Divisions with poor performance have a harder time obtaining resources. The impetus for investment is purely bottom-up.

There is a long-term IT strategy but it is not well integrated into overall corporate planning. There are separate departments for IT planning and corporate planning. There is a company-wide attempt to keep "IT investment flat as it is difficult to understand the return on investment phenomenon."

Organization Four - Consumer Products

Organization Four is a large, multi-national conglomerate in the consumer products industry. The interviewee was the Manager of Corporate Information Resources Planning.

According to the interviewee, the company makes no attempt to aggregate or manage IT investment at the corporate level; this process is the responsibility of the individual divisions. Within the context of planning, the definition of IT includes MIS-related expenditures as well as all communications expenditures excluding voice, facsimile and telex. IT also includes expenditures on personal computers and external consultants. All IT investment directly related to manufacturing capacity is excluded.

The interviewee felt that there is an optimal level of IT investment that will maximize return, but the company makes no attempt to estimate it. He sees the impetus for investment to be primarily from "middle down" and not from the top down. Bottom-up push for investment is rare but does occur. The company considers itself "lean and mean"; their drive to extract short-term profitability from products reduces the opportunity for significant speculative IT investment, since all investment is charged against product revenues.

Organization Five - Education

Organization Five is the business school in a large private university in New York City; the interviewee was the Associate Dean for Administration.

According to the interviewee, investment in IT is measured and tracked in an aggregate form. He estimates IT to account for half of the management and administration budget, and thus 10% of the school's total annual budget. IT is defined to include computer centers, departmental equipment budgets, telecommunications (except voice-based), and IT expenditures in administrative departments such as the office of the bursar. Word processors and maintenance are significant expenditures. More capital is invested in non-DP areas on personal computers than the school's total remaining DP investment.

IT is tracked and managed at the school level although there is no attempt to include the "relatively small expenses." Some departmental expenditure of PC's is not captured in this tracking. No measure of ROI for IT investment is used although each department is assessed on an input versus output basis.

Inputs include expenditures on people, space, and equipment; output is contribution to revenues via tuition, research output, and student course ratings.

A threshold investment in IT is "required to survive" and remain competitive among business schools. Strategic IT investment is linked to the overall "strategy of quality to maintain and add competitive advantage." One performance measure of quality is GPA and SAT scores of incoming students; this is a relative measure commonly used to rank business schools. As a result of this strategy, the impetus for IT investment is top down, to either cut costs or improve quality. Some cuts in administrative staff have been achieved with IT investment.

Organization Six - Telecommunications

Organization Six is a very large communications company that is currently restructuring its operations. The interviewee was a Manager of Communications.

According to the interviewee, the definition of IT is "moving to include everything". This change has not yet been achieved and many managers "would not know their departmental IT investment."

According to the interviewee, in the opinion of top management there is no evidence of a return from IT investment encompassing the "thousands of systems" currently installed. The organization "spends more on IT than our size would suggest."

The company has recently created a new position of Director of Information Management, whose responsibilities are primarily the "stewardship and quality of data." The management of IT resources is a very political issue and some of the recent changes have been "politically unpalatable".

A major initiative is under way for overall planning for information systems. The scope of the plan includes hardware, software, development projects, databases, telecommunications staff and organizational design. This plan is driven by the organizational strategy and two of the primary objectives are "to cope with rapidly changing technology and to understand data as a corporate resource."

Analysis of Key Factors

This section presents an analysis of the key factors that emerged from the six cases. Tables 2a to 2c show the findings in summary form.

The definition and tracking of IT - Table 2a

Table 2a shows the industry of each organization, the level of the interviewee in the organization, and its definition of IT. Each organization used a different definition of IT investment. All included hardware, software, related personnel, overhead, and some communications expenditure. The majority did not include voice, telex, facsimile, or postal services. IT dedicated to productive capacity (e.g., computers used for process control) was included or not, in different industries. There appears to be an overall trend to broaden the definition of IT to include many more aspects of the technology.

IT investment management - Table 2b

Table 2b summarizes the methods of tracking and calculating return on IT investment. The companies perform the tracking of IT technology expenditure with varying degrees of rigor. One of the difficulties they face is that IT investment made by departments or divisions in their own discretionary budgets is generally not captured in corporate IT budgets. As a consequence, corporate IT investment in MIS or DP centers is adequately tracked but decentralized expenditure is not. The general trend toward decentralization of responsibility for IT investment compounds this problem.

There was complete agreement that integrated coordination of IT investment is necessary. Different methods for calculating returns are used, but no organization is completely comfortable with their approach. Major investments are often subjected to traditional ROI methods. However, a threshold investment is often necessary to compete in the industry and is often not subject to ROI or any other type of return calculation. Most interviewees felt there is an optimal level of IT investment but no interviewee felt it was possible to achieve or even be sure of the optimal investment.

Political and organizational influences - Table 2c

Political considerations were important in most of the organizations and significantly impacted investment decisions. These considerations sometimes eclipsed the technical and economic considerations and were perceived as increasing in importance.

The impetus for investment came from different levels within the organization. In some cases where lower-level management was unable to complete the required transactions with the available resources (e.g., process the required number of invoices) the impetus for investment was bottom-up. Top-down impetus for IT investment occurred where the business strategy included the objective to incorporate more IT into the organization. These initiatives usually originated at the CEO level. In one organization the impetus for change originated middle-down and not from top management. This company was divisionalized and IT investment decisions were left to the discretion of each division.

The link between IT and corporate strategy varied. In two organizations there was no explicit link. In one organization the link was purely for cost containment; i.e., IT played a role in the explicit strategy of cost reduction. In the university, IT was included in the strategy of improving the quality of the program. In the communications company there was an explicit link from corporate strategy to IT support for it. In one of the insurance companies a circular link was identified, where IT was input to strategy formulation, and then the IT required to implement that strategy was identified.

Conversion effectiveness of IT investment

All interviewees agreed that the effectiveness with which investment was converted to useful output was important and could vary from one organization to another. We have called this phenomenon conversion effectiveness. The majority of interviewees felt that this conversion was just another resource management task and that organizations that were good at general resource management would be effective converters of IT investment. They considered the implementation process, culture of the organization, and skill of the managers to be major determinants of conversion effectiveness.

Findings and Implications

A number of findings from these cases have significant implications for the model of investment we will propose. The following points summarize the findings:

- Organizations have different working definitions of IT; however there is a trend to broaden the definition to include all aspects of IT. The only exception was IT which was clearly dedicated to productive capacity; this is considered a direct product cost. This approach is appealing for manufacturing industries but may create problems for service industries.
- The concept of a threshold IT investment required to compete in a certain industry emerged. Returns on threshold investments are likely to be smaller and of a different nature than other IT investment, since this threshold investment is mandatory to compete in the industry and may not be directly associated with real, short-term returns. This threshold investment can be considered a sunk cost required to participate in the industry.
- A trend of increasing decentralization of the management, tracking, and authority for IT investment was identified. A model of IT investment must include decentralized expenditures.

- The political and power processes in organizations play a major role in IT investment decisions, often eclipsing technical and economic considerations.
- There are differences in IT investment needs and profiles between different industries, making comparisons across industries difficult.
- The impetus for IT investment is a function of the importance of IT investment in the strategy of the organization. In the cases, if IT investment was an integral part of strategy, the impetus was top down. If not, the impetus tended to be bottom up. Different levels and timeframes for returns were expected from the different types. Thus the impetus for investment is an interesting variable to include in the model, as it appears to be linked to the objective for IT investment. The objective for which IT is embedded in the business strategy (i.e., transaction, information and strategic)² [22] and the impetus (i.e., top down or bottom up) for IT investment are likely to be highly correlated. We will refer to whether IT is transactional, informational, or strategic as the type of IT investment.
- The performance measures used in the model must be chosen to reflect the type of IT investment. A combination of different measures must be used to capture the diverse impact of IT investment on an organization. For transactional IT investment, performance measures should include variable and fixed cost data to reflect short-term cost savings. Strategic and informational investment IT are likely to have medium and long term effects, and thus require organization performance measures such as growth rates and return on assets. Attention to matching the type of IT investment to performance measures is crucial to the model.
- The effectiveness with which IT investment is converted to useful output is a resource allocation problem for management. Thus firms that are good resource managers should be effective converters of IT investment. The elements that make up conversion effectiveness

²Strategic, informational and transactional IT are defined in section "It Investment" on page 17.

include: size, power and politics, experience with computers, user satisfaction, implementation methodology, and management skill.

- Some industries appear to have a clear threshold investment requirement in IT. This investment is necessary to compete in the industry and is often not subject to traditional ROI hurdles.

A General Model of IT Investment and Performance

We propose a model to assist in understanding the relationship between IT investment and firm performance. Figure 2 presents the model; we discuss each element in turn below. The model is primarily a product of the review of the literature and the findings of the case studies.

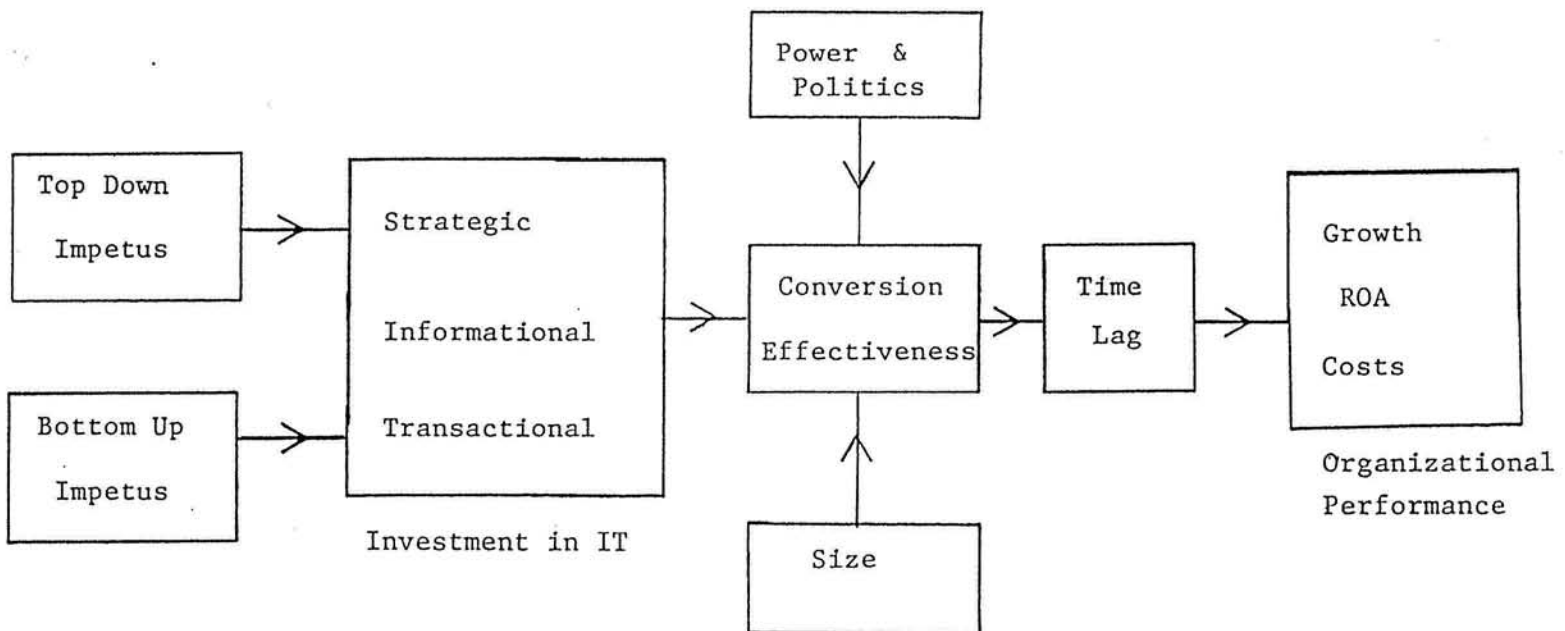


Figure 2: General Model of IT Investment and Performance

Information technology

We adopt a broad definition of IT including all IT used to gather, prepare, and analyze information for operational and management purposes. We include all centralized MIS or DP functions and associated

investment as well as all IT investment within functional departments. We also include all personnel that spend the majority of their time using or managing IT. The definition also includes all communications expenditures (e.g., telephone, electronic mail, facsimile, telex, satellites, and computer networks). It excludes computer systems dedicated to productive capacity, such as process control systems in manufacturing plants.

IT Investment

The investment measure should capture IT intensity, defined as the relative amount of available resources spent on IT compared to other expenditures. The measure recommended is the percentage of total expenses dedicated to IT. The total IT investment can be broken down into components (e.g., hardware, personnel, software etc.) to determine which of these have a significant effect on performance.

IT investment is categorized into three types: strategic, informational and transactional. Strategic IT is defined as IT that "changes a firm's product or the way a firm competes in the industry" [8] and can be identified as IT not currently used by competitors. An example of strategic IT is the establishment of a communications network to deliver information-based products to customers. Strategic IT is generally associated with long-term considerations.

Informational IT is usually concerned with a medium-term time horizon. Informational IT supports management control and tactical planning such as acquisition of resources, structuring of work and personnel management. Transactional IT supports operations-level management, with short time horizons and significant repetition, and is associated with short-term ROI. Operational management usually involves repetitive transactions such as accounts payable, order entry, and inventory control.

Unit of analysis

Many contemporary business organizations contain a number of distinct businesses. To analyze IT investment at the organizational level will not provide a boundary that logically connects IT investment to performance. We choose to analyze each business as a separate unit; to achieve this we adopt the definition of Strategic Business Unit (SBU)³. A SBU has a distinct set of products or services and serves a distinct group of customers. The SBU also has a well-defined set of competitors. Analysis at this level removes many of the aggregation problems of assessing firms.

³The SBU was developed by The Strategic Planning Institute in Cambridge, Massachusetts and was used in the PIMS study [18].

Firm performance

A series of financial and social measures of firm (SBU) performance are available. We choose a combination of measures in order to capture the different aspects of performance. These include five-year growth rates, accounting measures and financial indicators. The objective is to choose measures that can be logically linked to the type of IT investment. We suggest following matchings, inspired by the reasons cited for investing in various types of IT:

<u>Type of IT Investment</u>	<u>Performance Measure</u>
Strategic	Revenue Growth Rates
Informational	Return on Assets
Transactional	Indirect Labour ⁴

Time lag and organizational size

A number of mediating factors affect the relationship between IT investment and firm (SBU) performance. Time is a major factor both in terms of continuity of investment and lags between investment and associated performance. We suggest investment and performance be measured for five years to allow for lag effects. It is expected that the lag between investment and performance will vary from short-term (one year) for transactional IT to long-term (three to five years) for strategic IT.

We also include organizational size as a moderating variable. Carter [2] found that organizational size moderated the relationship between IT and the structure of newspaper organizations. Larger firms are expected to be more able to provide any expertise and support necessary to make the investments in IT contribute to firm performance.

The mediating effects of the industry and the economy are acknowledged as influences on organizational performance. It is not our intention in this model to include effects from outside the organization. However, if comparisons are to be made across companies at different times or in different industries, the effects of different industry or economic climates must be included.

Conversion effectiveness

We propose that the relationship between investment in IT and organizational performance is moderated by the conversion effectiveness of the firm. Firms that convert investments effectively will have stronger associations between investment and performance than those firms with low conversion

⁴Or fixed and variable product cost in service environments.

effectiveness. Four components of conversion effectiveness emerged as vital from the the IT literature and the six mini-case studies. The components are:

- Top management commitment to IT
- Previous firm experience with IT
- User satisfaction with systems
- Power and politics of the organization.

Top management commitment has long been recognized as important for conversion of IT investment and implementation success [12] [13] [6] [24]. Commitment is required (beyond the signing of the check) as a demonstration of the belief that the systems will be successful and productive tools. This is particularly true in small firms where top management is more visible to all employees.

Previous experience with systems is a vital factor in conversion effectiveness. Firms with more experience with systems will tend to be aware of the potential pitfalls and have realistic expectations of what IT can and cannot achieve.

User satisfaction [9] with systems is a vital component of conversion effectiveness; if users are very unsatisfied with the systems provided it will be more difficult to convert the IT investment into productive outputs.

Power and politics have been recognized as significant determinants of MIS design and implementation [14] [15]. Markus demonstrated that as a result of political negotiations during system design and development, rational management objectives for systems are not always translated into system design features [16]. Shrivastava posited and tested a political expediency model of decision making for computer purchases [19]. Firms with politically turbulent internal environments are expected to experience less conversion effectiveness than more stable firms. Individuals or groups will act in their own interests, and if the firm is perceived as a politically charged environment this will reduce the likelihood of a uniform commitment to the use of the IT. This reduction is posited to lead to less productive outputs from the investment in IT.

Conclusion

Previous studies of IT investment and its relationship to organizational performance have had conflicting findings. The objective of this study was to gain sufficient insight into the IT investment

process so that a model could be defined for further research. The findings of these case studies suggest a way to include and operationalize previously unconsidered variables in a model. Findings of interest relate to the definition of IT, the importance of political considerations, the concept of an industry-based threshold investment, the conversion effectiveness of IT investment, and the concept of productive capacity. The most important finding, however, relates to the separation of the different types of IT investment and the logical linking of these types to particular performance measures.

The importance of the problem to firms investing heavily in IT is paramount. Currently, firms are regularly investing and hoping that real returns will occur. In the unlikely event that an optimum IT investment level exists, knowledge of it would greatly assist managers with these difficult investment decisions. Any optimum investment level is likely to be industry-specific and unstable over time.

The authors are currently empirically testing this model with a sample of firms in the manufacturing sector. Measures for investment, conversion effectiveness and performance have been developed.

Organizations Analyzed by Key Factors - Table 2a

Key Factors				
Company	Industry	Level of Interviewee	IT Definition	Productive Capacity?
1	Insurance	VP	All except voice, operators consumables	No
2	Bank	Director	All	Yes
3	Insurance	Corporate Manager	All	No
4	Consumer Products	Corporate Manager	All except facsimile, voice	Yes
5	Education	Dean	All except Voice	No
6	Communications	Manager	Moving to all	No

Organizations Analysed by Key Factors - Table 2b

Company	Key Factors			
	Centralized Tracking	Decentralized Tracking	Return Calculations	Threshold Investment
1	All	All	Some projects	Yes
2	All major items	All major items	All projects	Yes
3	All MIS centers	Not PC's or minis	ROI	No
4	No attempt	Divisional responsibility	Divisional basis	No but cost driven
5	All except voice	Equipment budgets	No	Yes
6	Moving to	Moving to	No	No

Organizations Analysed by Key Factors - Table 2c

Company	Key Factors			
	Political Climate	Decentralized Management of IT	Impetus for Investment	Link to Strategy
1	Increasing	Yes	Bottom Up and top down	Circular link
2	As any Resource	Yes	Bottom up	Not explicit
3	Highly	Begun	Bottom up	Cost containment
4	Highly	Yes	Middle down	Not explicit
5	Moderately	No	Top Down in admin	Yes to increase quality
6	Highly	?	Top down	Yes

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