ORGANIZATIONAL PERFORMANCE, SIZE, AND THE USE OF DATA PROCESSING RESOURCES

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ABSTRACT

This study addresses two issues-whether the size of an organization determines its methods of obtaining, structuring or controlling data processing resources, and whether organizational performance is influenced by how a firm makes use of these resources. Several propositions are tested using data from a sample of 58 mutual savings banks with a 10:1 range in size. The results suggest that, although no difference is found in the proportion of operating expense allocated to data processing, larger banks do tend to develop in-house computing resources while smaller banks obtain these services from other banks or service bureaus. Consequently large and small banks must resolve different kinds of managerial issues if they are to provide high quality data processing service to their organizations.

Unexpectedly, no relationship is found between organizational performance and the relative proportion of resources allocated to data operating cost and the intensity of data processing use. These findings raise questions about the extent of benefits obtained from a data processing intensive strategy as well as questions about the efficiency with which firms convert capital and labor into application systems.

Key Words: Technological Innovation, Organizational Performance, Data Processing Resources, Computer Resources, Organizational Size, Management.

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1. Introduction

One of the key factors affecting organizational performance is the ability to innovate. Firms that recognize opportunities presented by a technological advance and time its adoption properly usually obtain an advantage over competitors (Mans73, Lawr69). Many factors determine a firm's propensity to innovate including its environment, structure, culture, and size, as well as the economic costs, advantages and risks of the innovation. Of these, organization size is the most equivocal.

Large organizations may dominate an industry, effectively controlling pricing and new product introduction. And, large organizations have the financial resources to develop new products, to accept the risks of new product introduction, and even to engage in basic research.

Yet most technological innovation has come from small firms or individuals (Blai72). Small firms, due to fewer organizational levels (i.e., less vertical span of control) and less formalization, may be faster to recognize and respond to technological opportunities than are large firms. That is, small firms have less organizational inertia and, consequently, may be easier to change.

Computing is one of the most pervasive technological advances of the last century. Yet, few studies have considered the relationship between firm performance and the extent of its commitment to computer

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technology.

Two issues are considered in this paper. First, to what extent does organization size influence a firm's propensity to apply computer technology? Does size act as an accelerator or inhibitor of technological innovation? If significant differences exist in the speed with which a new technology is adopted, in the diffusion of that technology within a firm, and in the manner in which technological resources are obtained and managed, then this raises important strategy formulation issues.

Second, to what extent is organizational performance related to a firm's ability to innovate? Do firms that commit heavily to computing technology show bottom line benefits? If they do not, then this raises serious questions as to why this perception is so prevalent. As Stabell (1982) has observed, there is little or no evidence to support or reject the notion that computer technology has improved organizational effectiveness or productivity. Certainly then, this question is worthy of direct investigation.

2. Differences Between Small and Large Firms

Small and large firms face considerably different operating environments. Small firms tend to have financial constraints which increase the significance of cash flow considerations while reducing the importance of investment opportunities (Delo81). Due to limitations in transaction volumes or in market share, small firms may be unable to achieve the benefits of scale economies, consequently

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increasing relative unit costs. Small firms may lack the expertise needed to apply new technologies in product or service innovations, whereas large firms may be able to retain specialized staffs for this purpose. Small firms may not have available the slack resources to risk in technological innovation. However, due to less organizational inertia, small firms may be able to mobilize resources, responding more quickly to opportunities, such as those presented by a change in technology.

High transaction volumes that accompany large organization size permit specialization of function with the corresponding opportunity for operational efficiencies (for example, flow shop work organizations). However, this differentiation of function requires additional coordination and control, frequently referred to as integration to produce final products or services (Lawr69). Differentiation leads to enlargement of the administrative component of an organization, mainly due to the increased communication required by a high degree of coordination and control implicit in integration (Pond69). In a sense firm size and the enlarged administrative component work at cross purposes: increased size presents opportunities for economies of scale, while a proportionately larger administrative component diverts resources from production. Consequently, the overall result of organization size on firm performance is not clear. There is some evidence that, in the public sector, size is positively related to the perceived quality of service provided (Chri80).

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Organization size has been shown to be positively related to such structural factors as the degree of differentiation (vertical span of control), specialization (both in terms of narrow job scope and in the use of specialists), and the delegation of decision making through out the organization (Grin81, Pugh69).

Specialization and standardization of function (along with sufficiently high transaction volumes) are prerequisites for the application of computers to operational functions. As the relative cost of labor increases and the cost of computers decrease it becomes more attractive, both from an economic and operational standpoint (for example, in the reduction of clerical errors), to replace some manual procedures with computer application systems.

For example, since mortgage loan processing involves a considerable amount of routine record keeping, a bank may decide to invest in the purchase or design of an application package (either run internally on the bank's computer or run by a service bureau) to post mortgage payments and provide account information, rather than maintaining manual records and a large clerical staff. In less routine situations, opportunities for labor replacement or cost reduction may not be as evident and therefore the rationale for implementing application systems less clear (Ginz79).

In summary, firms adopt a particular strategy, which may include computer application systems, to contend with an anticipated level of business activity. Structure (or configuration) follows from this strategy. Large firms have certain market and economic advantages, and they also have the opportunity to take advantage of specialization

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and standardisation of function. However, if they do so, they must contend with more complex structures in order to coordinate these functions, and these may lead to inefficiencies.

3. Hypotheses

The forgoing discussion of concepts suggests the following hypotheses:

> H11: Larger firms will allocate a greater proportion of their operating resources to data processing than will smaller firms.
>
> H12: Larger firms will have relatively more routine operational functions automated than will smaller firms.
>
> H13: Larger firms will have more mature data processing applications than will smaller firms.
>
> H14: Larger firms will retain their application system versions longer than will smaller firms.

Due to the opportunities presented by high transaction volumes, specialized and standardized functions, availability of specialists with the necessary technical knowledge, and better access to financial resources, larger firms will tend to replace routine operational procedures with computer applications earlier and more completely than will smaller firms. Consequently, larger firms will allocate proportionately more of their resources to the development and operation of computer application systems. However, because of the relatively high cost of large application systems, the difficulty of changing an operational system in production, and organizational inertia, larger firms will tend to retain their application system versions longer than will smaller firms.

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H2: Larger firms will make relatively more intense use of data processing resources for non-routine functions than will smaller firms.

The situation is less clear for non-routine applications. Although there still may be advantages of scale for large firms to develop non-routine applications, the economic benefits of these computer applications, since they are not directly linked to transaction volumes, are difficult to justify. When firms complete automation of routine operations they are likely to turn attention to non-routine activities in order to find opportunities to improve organizational performance. Thus, if H12 is supported, then this will provide a motive for expecting H2 to be true. Although smaller firms may be able to recognize opportunities more quickly and be more innovative than larger firms, they will probably implement first those applications that have the greatest perceived return and they may not have the resources or specialized staff required for non-routine applications.

H3: Larger firms will be more likely to develop in-house computing resources than will smaller firms.

The availability of capital for investment, the desire to protect themselves from the uncertainty of relying on external suppliers less directly under their control, and a tendency to integrate vertically, both as a control and expansion strategy, encourages large firms to develop in-house computing capabilities. This permits them to exercise more direct control over the delivery of service and provides the potential for reduced transaction costs, as well as for a service to be marketed to other firms.

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H4: Firms that obtain their computing resources externally will be more likely to require users to account for computer related expenses than will firms that make extensive use of in-house computing.

Use of external services represents an out-of-pocket cost proportional to use. Firms desiring to control costs will tend to pass these out-of-pocket costs on to users through some form of charge back scheme in order to more directly control costs. Firms with internal computing resources often treat them as a free good since they consider the cost of these resources as being all ready sunk, and are reluctant to impose additional administrative burdens on their staffs unless they serve a useful purpose.

H5: Firms that obtain their computing resources externally will tend to have fewer operational areas automated than firms that make extensive use of in-house computing.

When computing resources are obtained externally, each new application represents an increase in cost proportional to use. Under these conditions, firms will tend to be cautious about initiating new applications, unless benefits are clear. Once resources are committed to internal data processing and staff, new application development and operation do not proportionally increase costs until current capacity is exceeded. Decreasing equipment costs permit increasing capacity without proportional increases in cost. This situation encourages the building and operation of new application systems. Internal staffs, once established, will tend to perpetuate themselves by finding new applications to develop.

H6: Firms that obtain their computing resources externally will have more decentralized computing services than will firms that make extensive use of internal data

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processing resources.

Operating departments will tend to interact directly with external suppliers of data processing services instead of operating through a central data processing group. The effect of this will be that data processing support will be perceived to be more decentralized than in firms that make extensive use of internal data processing.

> H7: Firms that invest heavily in computer resources for operational functions will perform better than firms that invest less heavily.

The popular notion is that firms would not invest in computer systems for routine data processing applications unless these systems provided a better return than alternate opportunities to use their capital. Yet there are relatively few empirical tests of this tenet. The substitution of machine procedures for manual labor should result in lower per unit transaction costs. Yet, many factors determine whether lower costs are actually achieved, including the implementation process followed. In fact, McKinsey (Mcki63) found that only about 10 percent of the companies they studied actually were able to recover both the cost of the application and reduce operating costs.

4. Research Approach

In comparing patterns of computer resource use it is desirable to study cases that are as similar as possible, idealy differing only in values of independent variables. While such an approach may limit the generality of findings, it greatly improves the certainty to which differences in outcome variables can be attributed to changes in

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independent variables.

As part of another study data were gathered on the use of computer application systems in Mutual Savings Banks (Turn80). Banks make a good industry in which to test hypotheses concerning the use of computer resource use because the individual units are similar (i.e., they provide similar products) promoting comparability and the entities are relatively independent (i.e., are not part of larger corporations which might influence management decisions) although they are constrained in their actions by state and federal banking regulations. Furthermore, data processing is a core technology for banks since their production system is almost completely record keeping and data transfer (Galb73). Consequently, decisions about this production system are central to bank performance (Welf68). Another advantage of studying an industry, such as savings banks, is that state, federal and industry reporting requirements define the meaning of financial report entries permiting comparable data to be gathered from the population.

Mutual Savings Banks differ from Savings and Loan Associations in that they are state chartered and deposit customers are treated as bank share holders. As of the time of the study (early 1979) there were 469 Mutual Savings Banks in the United States, mostly located in the northeast, with some in the midwest, middle atlantic and far west. At the time of the study the industry was relatively stable and profitable, and had been so for the prior six years (in contrast to the present period). The savings and loan industry is often referred to as 'thrifts'.

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The original project was sponsored by the National Association of Mutual Savings Banks. Questionnaires were developed with a team of bank officers, pre-tested, and then distributed under a letter from the President of the Association to the Presidents of the 100 largest banks. While restricting the population to the largest banks prevents investigating what occurs in the smallest cases, the distribution is skewed so that most of the variation in bank size is captured. The population does include a 10:1 range in bank size (as measured by the number of full-time staff - from 1374 to 122) and does represent almost a quarter of the universe. This is considered a large enough and representative population to test hypotheses concerning the management of data processing and bank performance.

Responses were received from 58 banks for a 58 percent response rate. Chi-Square tests of deposit size, number of full time employees and geographic location indicate that the 58 bank sample is not significantly different from the population from which they were obtained.

An index consisting of total bank assets and number of full time equivalent staff was constructed to represent bank size. The product moment correlation coefficient for these variables is 0.93, significant at better than the 0.000 level (N=52), suggesting that they be combined into an index.

The following variables were used in the size study:

BKSIZE - Bank Size. An index of bank size consisting of total bank assets and full time equivalent staff.

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DPEXP - Data Processing Expense. The bank's data processing expense for the year based on a description of expense categories.

TASSET - Total Assets. The total value of the bank's assets at year end. For Mutual Savings Banks, this is just slightly more than the total value of deposits since the asset base is almost completely composed of funds on deposit.

TOPEXP - Total Operating Expense. The bank's total operating expense for the year excluding income and retained earnings.

TINTEXP - Total Interest Expense. The total cost of money for the year. This is the largest component of operating expense.

NETINC - Net Income. The bank's income for the year after taxes.

RDPEXP - Relative DP Expense. The ratio of DPEXP to TASSET. A measure of a bank's investment in computer resources per unit of asset.

RNETINC - Relative Net Income. The ratio of NETINC to TASSET. A measure of a bank's financial performance per unit of asset.

RCOPS - Relative Cost of Operations. The ratio of (TOPEXP - TINTEXP) to TASSET for the year. (TOPEXP - TINTEXP) is the cost of operations not attributable to the cost of money.

NAREA - Number of Functional Areas with Application Systems. Twenty five potential functional application areas were identified for Mutual Savings Banks. The number of areas with active application systems was determined.

NROUT - Number of Routine Functional Areas with Application Systems. Eighteen of the twenty five functional application areas were identified as consisting mostly of routine data processing. The number of routine areas with active applications was determined.

ANVER - Average Number of Application Versions. The average number of versions of application systems, from inception to the time of the study. This is the average number of major system updates or changes.

ANYR - Average Age of Last Application Version. The average amount of time the last application has been in operation.

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EXTERN - DP Resource Supplied Externally. The proportion of a bank's data processing expense provided by sources external to the firm (i.e., by service bureaus or other banks, etc.).

DECENT - DP Decentralized. The proportion of the bank's data processing expense used by decentralized data processing groups (i.e., those in user groups) or for equipment belonging to user areas.

INCHARG - Charged for Internal DP Service. A measure of the extent to which users are charged for internal data processing service.

EXCHARG - Charged for External DP Service. A measure of the extent to which users are charged for data processing services provided externally to the bank.

The statistics for these variables are provided in Table 1.

Place Table 1 about here.

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5. Results

Since most of the variables were measured on interval or ratio scales product moment correlation coefficients are used to investigate the strength of associations between the bank size index and various dependent variables. When a variable was measured on an ordinal level scale the distribution was checked to insure it was symmetrical. Where intervening variables are suspected, partial correlation analysis is used to test the effect.

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Table 2 presents the association of BKSIZE with the dependent

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variables. No association is found between the relative proportion of resources allocated to data processing and bank size. This is in contrast to DeLone's (Delo81) finding of a positive association between relative EDP expenditure and firm size. However, DeLone removed five small firms from the sample that were doing most of their programming in-house in the process of obtaining a significant association. Removing outlying cases is a tempting, but potentially misleading procedure. It is the conclusion of this study that no significant association exists between relative EDP expenditure and organization size, consequently, H11 is not supported.

However, significant positive associations were found between the number of functional areas of a bank with application systems and bank size as well as the number of routine functional areas with applications and bank size. This suggests that larger banks have both more functional areas and routine functional areas automated than do smaller banks. These findings support hypothesis H12 and is consistent with the notion of high transaction volumes creating opportunities to use new technology.

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Having developed an application system, a bank will tend to keep this application in operation for some period of time, assuming the application works reasonably well, until (at least) the cost of the development is recovered. If the further assumption is made that the amount of time an application system remains in operation is independent of bank size, then the number of application system versions is a rough measure of the length of time an application area has been automated. No association is found between the average number of application system versions and bank size. Thus, hypothesis H13 is rejected.

One explanation for the above finding could be that the assumption that the amount of time an application system remains in operation is independent of bank size is incorrect. Large banks may keep applications longer than smaller banks because greater organizational inertia and higher transaction volumes make it more difficult to change these systems. A positive association is found between the average age of the last application version and bank size suggesting that larger banks do keep application systems longer than smaller banks. On this basis, hypothesis H14 is accepted.

A strong negative association is found between external use of data processing services and bank size. This supports the notion that large banks tend to develop in-house data processing resources while smaller banks tend to obtain these services externally - from service bureaus or other banks - supporting hypothesis H3. This finding is consistent with DeLone's (Delo81) conclusion that smaller manufacturing firms are more dependent on external software support than are large firms.

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A significant negative association is found between decentralized data processing and bank size. This result is consistent with the finding that smaller banks tend to use externally provided data processing services since external service represents an extreme of decentralization - the equipment isn't even located on premises.

The finding that smaller banks tend to obtain data processing services from external sources while larger banks develop in-house services is important because it suggests that different managerial issues must be resolved in order to provide customers with high quality service. To investigate this notion more fully, table 3 presents the associations between source of data processing service and the other variables.

Place Table 3 about here.

No association is found between relative data processing expense and service source suggesting that banks obtaining their data processing resources externally do not spend proportionally more than banks with in-house systems. However, negative associations were found between the number of functional areas and the number of routine functional areas with applications and the use of external data processing service. This suggests that external data processing use acts as an inhibitor to the diffusion of application systems in a firm, supporting hypothesis H5.

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A positive association is found between decentralized data processing and external service use, which is consistent with the previous found association with bank size, supporting hypothesis H6.

It was reasoned that banks obtaining services externally would tend, for control purposes, to pass these costs on to users by some form of charging scheme, since these costs represent out-of-pocket expenses proportional to use. Surprisingly, no association is found between charging for service and external data processing use. Evidently, banks using external suppliers are no more likely to charge for service than banks using in-house service. Consequently, no support is found for hypothesis H4.

In summary, while banks using external services do not spend proportionately more of their resources on data processing, they do have fewer areas with installed application systems. This suggests that obtaining service externally acts to inhibit the diffusion of application systems. No difference is found in methods of controlling data processing use.

There are many measures that can be used to evaluate firm performance and these are likely to be industry specific. Altman (1977), in a study of the Savings and Loan industry has identified 12 variables particularly useful for evaluating the performance of banks. Of these, net worth/total assets, net operating income/gross operating income, and real estate owned/ total assets were among the measures that consistently ranked high in discriminating among banks with no problems, temporary problems, and serious problems. Of these net worth/total assets is probably the most appropriate for Mutual Savings

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banks; however, net worth was not gathered as part of the study. The National Association (as well as the NY Times) uses net operating income/total assets to assess bank performance over a period. The strength of the measure is that it is accepted within the industry and it uses total assets as the normalizing parameter. Its disadvantage is that the numerator, net operating income is sensitive to events taking place over the period which, because they are non-recurring, may distort the measure (e.g., a decision to write-off bad loans). Net income may not be stable from period to period. Considering that the industry was in good shape during the time of the study, and there were few dislocations, the measure seems reasonable to apply. However, no one measure of performance will capture all of the factors that contribute to high performance, and consequently the use of any measure is relatively arbitrary.

Table 4 presents the association of bank performance

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with the other variables. No association is found between the relative proportion of resources allocated to data processing and bank performance. However, the closeness of the association to being significant and its negative direction does suggest, disturbingly, that the allocation of resources to data processing may be negatively related to bank performance (no causality is implied; it may be that banks that are performing poorly decide to reduce their data

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processing allocation for this period). On this basis hypothesis H7 is rejected.

Many factors may influence the profitability of a bank including demand for services, capital expenditures, cost of money, and cost of operations, as well as other factors. It may be that data processing, which, at the operating level, is a labor displacement and cost reduction strategy, is too far removed to produce a systematic effect on net income.

A measure of bank performance more closely related to the types of changes associated with the use of data processing is cost of operations (total operating cost - cost of money). It is reasoned that a heavy investment in applications for routine data processing should be reflected in a reduced cost of operations. Whether lower operating cost results in increased profitability is more problematic.

Table 5 presents the association of cost of operations with the other variables.

Place Table 5 about here.

Contrary to what would be expected, no association is found between the relative proportion of resources allocated to data processing and cost of operations. However, positive associations are found between the number of functional areas and the number of routine areas with applications and operations cost. Evidently, an increased number of

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applications is associated with increased (rather than decreased) operations cost. This finding suggests that data processing contributes to inefficiency! Decentralization of data processing service is found to be negatively related to operations cost.

In summary, although no relationship is found between the relative proportion of a bank's resources that are allocated to data processing, larger banks do tend to develop in-house services while smaller banks obtain these services externally. Although no difference is found in methods of controlling data processing, banks that use external services have decentralized more decisions concerning data processing and have fewer application systems installed than do banks with in-house services. No relationship is found between the intensity of data processing use and bank net income.

It was then argued that the absence of a relationship between the intensity of data processing use and bank performance might be due to the use of performance measures that were too far removed from the likely effects of an intensive strategy. An outcome measure more directly related to data processing, cost of operations, was used and the findings indicate that data processing intensity is negatively related to operations cost.

There are a number of qualifications and limitations to this study. The implied model - that an investment in data processing leads to reduced cost of operations (or increased income) - relates events in time. The method of investigation, a cross-sectional design, measures events at one point in time. This design does not

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permit determining causality; only covariation. Thus, if an association is found the research approach does not permit identifying factors that produced the association. Additionally, since the events of interest are linked in time, data captured at one point may not reflect future consequenses of events that have taken place. For example, while a bank may have invested heavily in data processing, the returns may not have materialized by the time data was gathered for the study. In the present study, the sample is sufficiently large for this not to be a serious deficiency. Also, the mean number of system versions (across all applications for a bank) is close to 2, providing time for affects to have taken place.

The approach used assumes that application systems are all equally valuable, while it is evident that certain applications have the potential to contribute more heavily to reductions in cost of operations or net income. Also, the assumption is made that all of a bank's application systems perform equally well, when there are likely differences in performance.

The measures used in this study, particularly relative net income, may fluctuate from year to year due to non-recurring events. Better measures would be those that permitted some averaging, such as income averaged over a three year period or net worth. Unfortunately, these maesures were not collected.

Finally, since the population studied consists of one industry, the study provides no basis for extending the findings to other settings. While nothing in the study suggests that the findings are restricted to mutual savings banks, and they should be extendable to

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other financial institutions, only additional studies will show whether this is the case. None of these limitations are considered serious.

6. Interpretation

The initial question raised in this study is whether firm size effects methods of obtaining and managing data processing resources. Larger banks, in acquiring internal data processing staffs and equipments, must cope with a variety of managerial issues. Supervision must be provided for the technical staff, which in turn implies the involvement of top management in providing technical guidance, in identifying application opportunities, in setting objectives, in establishing priorities, and in resolving conflicts. Budget allocations for data processing applications and equipment must be defended.

Managers must accept a certain degree of risk and criticism from peers in running current data processing operations and in developing new applications. Career paths must be established, resources allocated to technical training, and qualified replacements found when key staff depart. Professional staffs and equipments take on a life of their own, creating dependencies, building constituencies and promoting new applications. Decisions must be made on equipments in the face of consistent (and even increasing) technological change, making even rational decisions at one point in time seem ill-intentioned in the light of future events.

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All of this may be acceptable when data processing is peripheral to what a firm does. But, when it is a firm's core technology, poorly conceived actions become too conspicious. No firm or individual can long survive repeated disruptions in its production systems. It is an area of uncertainty and high personal risk.

Smaller banks tend to obtain their data processing services from outside suppliers, thereby replacing the issues surrounding acquisition of staff and equipment with those of an external dependency. Using external systems may work well as long as a service bureau has only one primary customer. But, with many customers conflicts arise and compromises must be made. These will likely not be in the best interests of any one customer.

Control over an external supplier's performance is less direct than with internal groups since two organizational boundaries must be crossed. If services are obtained from multiple external suppliers, coordination among application systems may prove difficult, data may be redundent and inconsistent, and there are fewer opportunities for integration. It also makes it more difficult for top management to know it's total exposure. As competition for new products and services grows within banking (this appears to be a current trend) firms without the flexibility to restructure support services that comes from standization, consistency and data integration may find themselves disadvantaged.

Although direct control over the service provided is relinquished to an external supplier, this strategy does have the benefit of hiding many of the factors involved in data processing management. It is,

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thus, harder for others in the organization to tamper with the details of what is happening since communication about these events is restricted.

One qualitative result of the study is the observation that banks using outside service centers are less aware of the details of their application systems (for example, transaction volumes, number of accounts on a master file, when update cycles take place, etc.) as well as the amount of bank resources allocated to data processing than are banks with internally provided services. Bank officers frequently indicated that only people at the service bureau knew anything about the details of their application systems. Because services were provided externally, bank management felt they did not have to monitor these systems closely or to be aware of their details. It would seem that these managements are more vulnerable to difficulties with their applications since they are less involved with them and less aware of their status than are managers with internal systems. An interesting question is whether there are qualtative and performance differences between external and internal systems in the same application area.

The study does suggest that using outside service reduces the number of areas with applications installed. Whether this is because each new application represents additional costs (that must be separately approved and budgeted) which acts to inhibit the diffusion of technology or in-house staffs actively promote unnecessary applications, or some other factor is not clear. However, while banks using outside services are less likely to have the range of applications that banks with in-house systems have, they are more likely to have assigned control of data processing to user

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departments. Banks are about twice as likely to charge users for external service than they are to charge for internal service, but this occurs for only about fifty percent of the use. Banks that charge users for external service tend to have more application systems (NAREA - EXCHARG: r=.243, n=55, p=.037) suggesting that giving users control over resources encourages the diffusion of technology. It may be that this decentralized control is indicative of better planning and greater accountability than with central control that eminates from a data processing department.

The lack of an association between relative data processing expense and the number of areas with applications (r=.002, p=.495) does raise questions about how efficiently banks convert inputs (i.e., capital and labor) into installed systems. Most studies of computerization intensity use an input measure (such as the proportion of an operating budget allocated to data processing or the amount of funds allocated to data processing as a proportion of gross sales - see the Datamation yearly surveys and Dieb67). If there is no relationship between this input measure and the base of installed systems, then using the input measure as representation automation intensity is misleading. It biases results in favor of firms that allocate proportionately more resources to data processing, but are not necessarily efficient converters of inputs into installed systems. Furthermore, conversion efficiency is really a representation of implementation success, which may be a better indicator of a firm's ability to innovate than is the absolute level of resource commitment.

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The finding of a positive relationship between the number of areas with applications and operations cost (as well as the absence of an association between either of the data processing intensity measures and bank performance) is disturbing. Even at the group level, evidence for productivity gains is mixed. For example, Kraemer, et al. (Krae81) in studying the use of data processing in a number of operational areas of local government, found personnel reductions in only one out of five application areas, and little difference in performance between automated and non-automated systems. Turner (Turn80) found labor productivity gains for mortage loan servicing groups that were users of computer systems, but not for higher level workers. Even if productivity improvements occur at the group level it is not evident how these combine to influence the cost of operations or what other inefficiencies result when applying this technology (for example, large crews on automated trains).

There is general agreement in the literature that it is cost effective to apply data processing to routine operational functions. Yet, the results of this study suggest otherwise. Quite possibly the study is flawed. Or, maybe, mutual savings banks are atypical of other industries. Another explanation could be that computer application systems are used for other purposes (for example, increased individual control) and, thus, appear inefficient when only operational measures are considered.

In any case, the consequences of adopting an intensive data processing strategy have been neglected. After twenty five years of investing heavily in data processing, CEOs have good reason to wonder what benefits have occured. Maybe this is an important enough

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question to be persued at some length. A first important step is to figure out what the results of past commitments have been. If negative or inconsistent patterns emerge it may be possible to build models, through more detailed study, that will suggest how changes can be made to improve bottom line benefits. At a minimum, organizational decision makers will become more aware of those aspects of system implementations that are critical to acheiving benefits.

A number of factors have been shown to govern the diffusion of technology including the extent the economic advantage the technology has over present methods, the amount of uncertainty associated with applying the technology, the financial commitment required, and the rate of reduction of uncertainty in applying the technology (Mans73). The economic advantage of computer applications for routine data processing increases as the cost of computers decrease, the cost of labor increases, and with the availability of packaged applications, trends which are currently accelerating. Uncertainty in applying computer technology arises mostly out of an inability to manage the process of implementation, which, unfortunately, does not appear to be improving, as well as a lack of knowledge about the consequenses of applying the technology. The financial commitment needed for major operational applications is quite high.

Diffusion is a slow process; initiators tend to be conservative, late adopters are influenced by early experiences. A concentration of research attention on the consequenses of using computer and communication technology can provide the information needed to accelerate diffusion and to acheive elusive benefits.

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TABLE 1

SUMMARY STATISTICS

VARIABLE NAME	DESCRIPTION	MEAN	s.d	N
BKSIZE	Bank Size Index	2.00	0.57	52
DPEXP	Data Processing Expense[6]	595.33	703.74	76
TASSET	Total Assets[3]	1257.81	931.15	57
TOPEXP	Total Operating Expense[5]	1144.75	1014.30	56
TINTEXP	Total Interest Expense[5]	402.46	408.56	56
NETINC	Net Income[4]	541.23	604.36	56
NAREA	Number of Areas with Applications[2]	11.86	2.33	58
NROUT	Number of Routine Areas with Applications[2]	8.47	1.23	58
ANVER	Average Number Versions	1.71	0.59	56
ANYR	Average Age Last Version	2.78	0.85	58
EXTERN	External DP[7]	41.54	36.98	56
DECENT	DP Decentralized[7]	32.46	28.5	55
INCHARG	Internal DP Charged	1.41	0.62	54
EXCHARG	External DP Charged	1.89	0.77	55

NOTES

1. All variables coded unless noted otherwise
2. True value
3. 10^6 dollars
4. 10^5 dollars
5. 10^4 dollars
6. 10^3 dollars
7. Percentage

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TABLE 2

ASSOCIATION OF BANK SIZE (BKSIZE) WITH DEPENDENT VARIABLES

DEPENDENT VARIABLE	CORRELATION COEFFICIENT (No. of Cases) Level of Significance	INTERPRETATION
RDPEXP (DPEXP/TASSET)- Relative DP Expense	-.130 (51) .182	No association between data processing expense permit of asset and bank size.
NAREA - Number of Areas with Applications	.379* (52) .003	Larger banks tend to have more functional areas with application systems than smaller banks
NROUT - Number of Routine Areas with Applications	.237* (52) .046	Larger banks tend to have more routine functional areas with application systems than smaller banks
ANVER - Average Number of Application System Versions	-.006 (50) .485	No association between average number of application system versions
ANYR - Average Age of Last Application Version	.231* (50) .050	Larger banks tend to have Application Versions that are older than smaller banks
EXTERN - DP Services Obtained Externally	-.475* (51) .000	Larger banks tend to have in-house data processing equipments and staffs. Smaller banks use external services.
DECENT - DP Services Decentralized	-.237* (51) .047	Larger banks tend to have more centralized data processing than smaller banks
INCHARG - Users Charged for Internal DP Services	.170 (49) .122	No association between charging users for internal data processing resources and bank size
EXCHARG - Users Charged for External DP Services	.094 (49) .260	No association between charging users for external data processing services and bank size

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TABLE 2 (cont.)

ASSOCIATION OF BANK SIZE (BKSIZE) WITH DEPENDENT VARIABLES

DEPENDENT VARIALBE	CORRELATION COEFFICIENT (No. of Cases) Level of Significance	INTERPRETATION
RNETINC (NETINC/TASSET)- Relative Net Income	.182 (52) .098	No association between net income per unit of asset and bank size
RCOPS (TOPEXP-TINTEXP/TASSET)- Relative Cost of Operations	.151 (52) .142	No association between cost of operations per unit of asset and bank size

*-Significant at the 0.05 level or better

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TABLE 3

ASSOCIATION OF EXTERNAL DATA PROCESSING SOURCE (EXTERN) WITH DEPENDENT VARIABLES

DEPENDENT VARIABLE	CORRELATION COEFFICIENT (No. of Cases) Level of Significance	INTERPRETATION
RDPEXP (DPEXP/TASSET) Relative DP Expense	-.129 (55) .173	No difference in the data processing expense per unit of asset between banks that use external data processing sources and those that use in-house sources
NAREA - Number of Areas with Applications	-.218* (56) .050	Banks that obtain data processing externally tend to have fewer areas with applications than banks that use in-house data processing
NROUT - Number of Routine Areas with Applications	-.364* (56) .003	Banks that obtain data processing externally tend to have fewer areas with routine applications than banks that use in-house data processing
ANVER - Average Number of Application System Versions	-.154 (54) .134	No difference in the average number of application versions between banks that use external data processing sources and those that use in-house sources
ANYR - Average Age of Last Application Version	-.165 (55) .114	No difference in the average age of application versions between banks that use external data processing sources and those that use in-house sources
DECENT - DP Services. Decentralized	-.475* (54) .000	Banks that obtain data processing externally tend to have decentralized data processing
INCHARGE - Users charged for Internal DP Services	-.145 (52) .152	No difference in whether users are charged for internal data processing services

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TABLE 3 (cont.)

ASSOCIATION OF EXTERNAL DATA PROCESSING SOURCE (EXTERN) WITH DEPENDENT VARIABLES

DEPENDENT VARIABLE	CORRELATION COEFFICIENT (No. of Cases) Level of Significance	INTERPRETATION
EXCHARGE - Users charged for External DP Services	.033 (53) .406	No difference in whether users are charged for external data processing services
RNETINC (NETINC/TASSET) Relative Net Income	.031 (55) .412	No difference in relative net income between external and internal data processing users
RCOPS (TOPEXP-TINTEXP/TASSET) Relative Cost of Operations	-.179 (55) .095	No difference in relative cost of operations between external and internal data processing users

* Significant at the 0.05 level or better.

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TABLE 4

ASSOCIATION OF BANK PERFORMANCE (RNETINC) WITH INDEPENDENT VARIABLES

Independent Variable	CORRELATION COEFFICIENT (No. of cases) Level of Significance	INTERPRETATION
RDPEXP (DPEXP/TASSET)- Relative DP Expense	-.216 (55) .057	No difference in relative performance between banks that are heavy and light investors in Data Processing.
NAREA-Number of Areas with Applications	.170 (56) .105	No difference in relative performance between banks that have many or few areas with applications.
NROUT-Number of Routine Areas with Applications	.020 (56) .441	No difference in relative performance between banks that have many or few routine areas with applications.
ANVER-Average Number of Application System Versions	-.117 (54) .199	No difference in relative performance between banks that have many or few application versions.
ANYR-Average Age of Last Application Version	.182 (55) .092	No difference in relative performance between banks on the basis of their last application system version age.
DECENT-DP Resources Decentralized	-.240* (54) .040	Banks that have centralized Data Processing tend to perform better than banks with decentralized DP.
INCHARG-Users Charged for Internal DP Services	-.018 (52) .449	No difference in relative performance between banks that charge users for internal DP service and those that do not charge users.
EXCHARG-Users Charged for External DP Services	.011 (53) .468	No difference in relative performance between banks that charge users for external DP services and those that do not charge.
RCOPS (TOPEXP-TINTEXP/TASSET)	.210 (56) .060	No difference in relative performance between banks that have a lower relative cost of operations and those that have a high cost.

*-Significant at the 0.05 level or better

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TABLE 5

ASSOCIATION OF RELATIVE COST OF OPERATIONS (RCOPS) WITH INDEPENDENT VARIABLES

INDEPENDENT VARIABLES	CORRELATION COEFFICIENT (No. of cases) Level of Significance	INTERPRETATION
RDPEXP (DPEXP/TASSET)- Relative DP Expense	.145 (55) .146	No difference in relative cost of operations between banks that are heavy and light investors in Data Processing.
NAREA-Number of Areas with Applications	.255* (56) .029	Banks that have more areas with applications have a relatively higher cost of operations.
NROUT-Number of Routine Areas with Applications	.253* (56) .030	Banks that have more routine areas with applications have a relatively higher cost of operations.
ANVER-Average Number of Application System Versions	.236* (54) .043	Banks that have fewer application systems have a relative higher cost of operations.
ANYR-Average Age of Last Application Version	.091 (55) .254	No difference in relative cost of operations between banks on the basis of last application version age.
DECENT-DP Services Decentralized	-.315* (54) .010	Banks that have greater DP Service centralization have a relatively higher cost of operations.
EXCHARG-Users Charged for External DP Services	.132 (53) .172	No difference in relative cost of operations between banks that charge users for external service and those that do not charge.
INCHARG-Users Charged for Internal DP Services	.122 (52) .194	No difference in relative cost of operations between banks that charge users for internal service and those that do not charge users.

*-Significant at the 0.05 level or better

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