IT Value: The Great Divide Between Qualitative and Quantitative and Individual and Organizational Measures

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ABSTRACT: A comprehensive review was conducted of IT value articles in the *Communications of the ACM, Information Systems Research, Journal of Management Information Systems*, and *MIS Quarterly* from 1993 to 1998. IT-value measures published during this period were documented, classified, analyzed, and reported. The review of these journal articles revealed a schism between the use of organization-level measures and other measures. *Communications of the ACM* and *Information Systems Research* also provided strong evidence of a schism between the use of quantitative and qualitative measures in IT-value research. The *Journal of Management Information Systems* and *MIS Quarterly* data provided more limited evidence of this schism as well. These schisms have become more pronounced over time. This may be due partly to an increasing reliance on secondary data set analyses that use only quantitative measures and organization-level analyses. The current research confirmed what many researchers suspect—schisms exist, and may be deepening, in IT-value research.

KEY WORDS AND PHRASES: information technology productivity, information technology investment value.

THERE HAS BEEN MUCH RECENT DISCUSSION OF THE "PRODUCTIVITY PARADOX" in the information technology (IT) literature [14, 38]. A great deal of energy has been focused on describing the paradox, denying the paradox, solving the paradox, and burying the paradox [15, 34, 38, 52]. The debate may have, paradoxically, legitimized the very measures that have not served the IT community particularly well—measures that paint a bleak picture of the value of IT investments.

How so? With so much MIS researcher and practitioner attention focused on the IT

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productivity paradox, a great deal of energy has been poured into studies that seek to demonstrate positive relationships between IT investment and organizational performance [7, 77, 78, 101]. In an attempt to provide evidence that is credible to an executive audience, many of these studies have focused exclusively on quantitative measures of performance. Several have underemphasized the role of individual-level IT benefits and focused almost exclusively on benefits of IT investments that may be observed at organizational and industrial levels. The IT researcher's lens has grown bigger, if not better, over time. With the IT productivity paradox hype, the focus has been on "hard" numbers, not qualitative judgments, and "big IT wins," not incremental process and product-service improvements that may occur one employee at a time.

This study examines IT value articles published in the *Communications of the ACM*, *Information Systems Research*, *Journal of Management Information Systems*, and *MIS Quarterly*—four leading North American MIS journals[1]—in recent years (1993–98). IT value measures published in these journals during this period are documented, classified, analyzed, and reported. Based on this analysis, it is argued that more balanced perspectives of IT value [61] are required.

Discussion of Related Literature

The IT Productivity Paradox

> The relationship between information technology (IT) and productivity is widely discussed but little understood. Delivered computing power in the U.S. economy has increased by more than two orders of magnitude since 1970 yet productivity, especially in the service sector, seems to have stagnated. Given the enormous promise of IT to usher in "the biggest technological revolution men have known," disillusionment and even frustration with the technology is increasingly evident in statements like "No, computers do not boost productivity, at least not most of the time."

SO BEGINS BRYNJOLFSSON'S [14] WIDELY CITED ARTICLE DISCUSSING "The Productivity Paradox of Information Technology." Brynjolfsson highlights earlier studies [75, 103, 104, 105, 115] that suggest an *apparent* IT investment paradox with respect to economy-wide productivity (e.g., total IT investment in relation to gross national product), the productivity of IT capital in manufacturing, and the productivity of IT capital in services. Brynjolfsson states:

> Productivity is the fundamental economic measure of a technology's contribution. With this in mind, CEOs and line managers have increasingly begun to question their huge investments in computers and related technologies. [14, p. 67]

Although the IT productivity paradox was originally defined at the economy level and some studies have been carried out at national and industrial levels, most MIS researchers have addressed the productivity question at the organization level. Sev-

eral MIS researchers have tried to produce hard evidence of productivity gains afforded to firms as a result of IT investments. Mahmood [77] writes:

> Strategic managers clearly need a better understanding of the impact of IT investment on organizational strategic and economic performance. Clearer understanding of the factors that drive such performance could help a firm better utilise resources dedicated to the relevant delivery process, and increase the firm's position vis-à-vis its competitors. . . . Pressures have, therefore, been mounting on information systems researchers to validate empirically the relationship between IT investment and organizational strategic and economic benefits. Kauffman et al. (1988) and Banker and Kauffman (1988) have urged that "hard" evidence be provided that relates IT investment to organizational economic outputs. [pp. 185–186]

The IT Productivity Paradox—Past Measures and Current Results

In his review of research studies investigating the IT productivity paradox, Mahmood [77] suggests that there have been three main categories of studies: those using a "key ratios" approach, others using a "competitive interaction approach," and finally others relying on a "microeconomic" approach. Mahmood does not consider "soft" approaches, although this may be because of his attempt to respond specifically to Kauffman's calls for "hard" evidence. Mahmood focuses on organization-level studies.

Examples of the "key ratios" approach include calculations of the ratio of IT expense to total operating expense and annual IT budget as a percentage of revenue. Mahmood illustrates the "competitive interaction approach" by describing the Banker and Kauffman [6] study that found, while ATM network membership could increase a bank's local deposit market share, at the same time the presence of an ATM contributed little to a bank's economic performance. In the "microeconomic theory-based approach," researchers use microeconomic theory to formulate models to investigate IT's organizational impacts. Variables such as product/service demand, capital costs, labor costs, and the total costs of doing business are examined.

Studies examining these kinds of "hard" organization-level evidence have at times lent support to (i.e., not refuted) the IT productivity paradox. Brynjolfsson [14] provides four possible explanations for this:

- Mismeasurement of inputs and outputs
- Lags due to learning and adjustment
- Redistribution and dissipation of profits
- Mismanagement of information and technology.

Other researchers [38, 52, 121] provide additional reasons why hard evidence may not explain away the paradox (e.g., inadequate traditional accounting systems, IT capital spent primarily to take market share away from competing firms and not to increase the size of the market, and IT investments that merely fuel the need for further IT investments and do not increase productivity outside the computer manufacturing industry). Overall, Brynjolfsson [14] concludes:

> After reviewing and assessing the research to date, it appears that the shortfall of IT productivity is as much due to deficiencies in our measurement and methodological toolkit as to mismanagement by developers and users of IT. [p. 67]

> The closer one examines the data behind the studies of IT performance, the more it looks like mismeasurement is at the core of the "productivity paradox." Rapid innovation has made IT-intensive industries particularly susceptible to the problems associated with measuring quality changes and valuing new products. . . . Increased variety, improved timeliness of delivery and personalized customer service are additional benefits that are poorly represented in productivity statistics. These are all qualities that are particularly likely to be enhanced by IT. [p. 74]

> Researchers must not overlook [the] fact that our tools are still "blunt." . . . The business transformation literature highlights how difficult and perhaps inappropriate it would be to try to translate the benefits of IT usage into quantifiable productivity measures of output . . . Researchers [must] be prepared to look beyond conventional productivity measurement techniques. [p. 76]

The IT Productivity Paradox—Other Lessons from the MIS Literature

Bakos [2] also issues a cautionary warning to MIS researchers:

> In the context of organizational impacts of information technology, alternative perspectives[2] lead to different dependent variables and suggest the use of different theoretical tools for the study of these impacts. Studies based on different perspectives have used different vocabularies and, as a result, have often *talked past each other.* A simple model for the impact of information technology is shown in Figure 1.
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> The technology has an impact on organizational structure and process, thereby affecting organizational performance. . . . The majority of impacts research will belong to one of the first two areas: impact of information technology on (1) organizational performance and on (2) organizational structure and processes. The difference between the two areas can be visualized as whether the structure and process box in Figure 1 is seen as a system that can be modeled and probed, or as a "black box" whose inputs and outputs are the only observable variables. [pp. 12–13, emphasis added]

It is possible that much of the IT value research (i.e., studies that examine the benefits of IT investments) using soft measures "talks past" research emphasizing objective numeric assessments, and vice versa. Although some researchers do use both qualitative and quantitative measures (even in the same studies), others do not and appear to participate in what may best be described as "camps" that are unreceptive to certain research methods and measures.

Despite the call for hard measures of economic impact, the value of IT may not be fully understood without incorporating, at some point, qualitative, individual, and

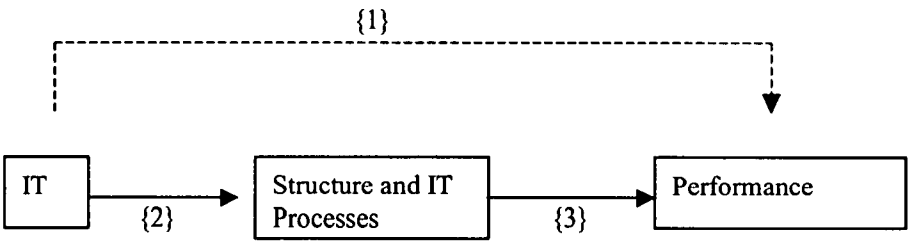

Figure 1. Areas for IT Impact Research (adapted from [2]. Reprinted with permission.)

group-level measures. If this were not the case, we would be subscribing to "black box" approaches where only macro-level inputs and outputs are observed.

Some of the research conducted specifically as part of the IT productivity paradox debate has, in fact, emphasized individual and group-level outcome measures and process measures. For example, Barua et al. [7] examined the effect of IT on "intermediate-level variables" such as capacity utilization, inventory turnover, relative quality, relative price, and new products. They have related these intermediate variables to final performance variables such as market share and ROA. Barua et al. [7] document that other researchers [29, 63, 87, 88] have also found that the effects of IT on organization performance can be best identified through a "web of intermediate level contributions." They argue that these "lower-level impacts" should, in turn, affect organizational/higher-level performance measures [67]. Barua et al. [7] write:

> Our basic thesis is that primary economic impacts or contributions (to performance) of information technologies (if any) can be measured at lower operational levels in an enterprise, at or near the site where the technology is implemented. To capture these impacts, measurements should be taken in the organization where the potential for first-order effects exists. These effects may then be traced through a chain of relationships within the organizational hierarchy to reveal higher order impacts (if any) on enterprise performance. . . . We suspect that as the distance between a first-order effect and higher levels increases, the ability to detect and measure an impact decreases (perhaps rapidly). For this reason, we believe prior research based on conventional microeconomic production theory (attempting to relate variables such as MIS budgets and market share directly) does not have the power to reveal an association with high statistical significance. [pp. 6–7]

Given the numerous recommendations and cautions regarding the study of IT value that have appeared in the MIS literature, one might expect to find an increasing number of articles that examine first-order and intermediate IT effects. One might expect to see researchers developing less conventional and less "blunt" investigative tools. This study's review of recent IT value articles documents the extent to which this has, in fact, been the case.

The IT Productivity Paradox—Other Issues Raised in the Organization Development Literature

It can be argued that much of the IT productivity paradox debate has been couched in a rational-economic paradigm. However, task interdependence in organizations makes collaboration a necessary prerequisite for ongoing organizational effectiveness [110, p. 172], suggesting that, in evaluations of long-term organization performance, human relations and task issues need to be reviewed along with short-term economic outcomes.

Organizations accomplish their work through motivated people [122]. Generally, information systems are used by people (e.g., customers, suppliers, employees). IT investments can be used to alter tasks, customer interactions, employee psychological contracts, expectations, motivation, and productivity. IT value measures may then usefully assess organizational processes and tasks, and organizational health and renewal [73].

Because an organization is a complex system, when one factor is changed, meaningful assessment may need to go beyond immediate, isolated outcomes, to encompass long-term system changes as well. Longitudinal IT evaluation studies may be required. Schein [110] writes:

> One rarely, if ever, finds a real-life situation in which there is only *one* goal operating. It is a characteristic of all human systems to have multiple goals, all of which are generally operating simultaneously, and among which the priorities are shifting constantly. Progress toward any goal can be measured, and that measure has usually been defined as the *efficiency* of an organization. But choosing the right priorities among goals, ensuring that the ultimate [purposes] of the organization are met, is a more complex process, one that approximates the concept of effectiveness.
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> . . . Organizations do have multiple functions and multiple goals, . . . some of these are actually in conflict with each other. . . . The dilemma of effectiveness, then, is clear. Is effectiveness the ability to maximize profit in the short run (which would require a definition of "short run"), or does effectiveness have something to do with the ability to *maintain* profits over some longer period of time to which the concepts of survival and growth are more applicable?
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> . . . One attempted resolution . . . has been to define effectiveness in terms of systems-level criteria . . . A system's effectiveness can be defined as its *capacity to survive, adapt, maintain itself, and grow* . . . [a] more general concept of "health." [pp. 230–231]

Schein's remarks point out the limitations of assessing IT impact with only an organization-level approach to analysis, or with any single number (e.g., ROI or NPV). A more complete assessment of technology innovations might involve several levels of analysis (e.g., individual and group) and several sets of "numbers." Unfortunately, the difficulties encountered in responsibly integrating findings at various analytic levels are not insignificant. For instance, if individuals are highly satisfied with a system but there is no visible short- or long-term economic benefit, can the

system be described as successful? Or, conversely, if the "bottom line" is vastly improved through radical reengineering using technology but employee morale is at an all-time low, is the organization more effective? To some extent, these questions involve difficult value judgments. Perhaps part of the challenge associated with technology evaluations is the need to let go of narrow, one-dimensional, win/lose pronouncements, and to accept instead mixed, multidimensional, multistakeholder, explicitly value-based assessments. In doing so, it may be necessary to examine researcher and practitioner assumptions and biases [50].

Schein's comments also lead us to question the appropriate boundaries for IT investments. Perhaps investments do not originate when funds are formally approved for new systems, but earlier, for example, when proposed systems are seriously being considered and employees are reacting, possibly negatively. Researchers conducting IT value studies may consider explicitly identifying appropriate boundaries or limits of the impacts to be investigated. Also, because the organization is a dynamic system with feedback loops, secondary, tertiary, and other indirect impacts may be measured if this is deemed appropriate. In order to do this, however, the relevant environments need to be identified. If IT evaluation approaches are designed with static, closed systems in mind, they may be inadequate.

Technology investments generally are initiated by one or more individuals who seek to make system changes in order to accomplish certain objectives. Much of the recent discussion in the literature on alignment focuses on the context of the IT investment [19]. The technology is often expected to leverage business strategic orientation [124], streamline tasks, and leverage human capital. Thus, similar technology investments (e.g., similar hardware-software installations using the same systems development methodology) frequently have quite different outcomes. This raises the issue of whether IT investments can be characterized adequately outside their organizational and industrial settings. In order to make accurate evaluations, strategic contexts and human contexts may need to be documented also.

It is difficult, however, for any single study to investigate and measure a complete sociotechnical system and its environments. Social science research can be conducted carefully, though, with the recognition of ever-present research limitations. At times, apparent paradoxes may simply be the result of these limitations.

Research Objectives

A KEY PURPOSE OF THE CURRENT STUDY HAS BEEN TO INVESTIGATE a possible trend in "IT value measurement" (i.e., the documentation of benefits provided by IT investments) to examine only hard, organization-level measures of value. Such a trend, as we have seen above, can be shortsighted but may be a direct result of the amount of press that has been given to the apparent IT productivity paradox (see, e.g., [121]). However, much of the organization development literature stresses the importance of the human resource function (e.g., individuals, teams, and networks), which uses business processes, in combination with technology, to achieve organizational goals. The MIS literature also underscores the value of technology in the management of

human/intellectual capital (e.g., individual and group knowledge). It would seem that hard and soft measures, and organizational, group, and individual-level measures, all have the potential to inform the discussion of IT value.

For this reason, this article focuses not on the many strengths of "hard" IT value research streams, but on their weaknesses. Certainly, there are many limitations of soft or subjective measures (see [20] and [84] for criticisms of the user satisfaction construct, for example, and questions raised in [16] regarding weak relationships between job satisfaction and job performance). The article does *not* call for an exclusive return to the use of soft, individual, and group-level measures or process-focused measures but instead reminds us of the importance of these measures and examines their usage in recent studies of IT value.

Research Design

IN ORDER TO SYSTEMATICALLY REVIEW MEASURES USED IN RECENT IT VALUE research, the author, with the assistance of two MIS graduate students, examined all studies discussing IT impacts published in four top North American MIS journals—*Communications of the ACM (CACM), Information Systems Research (ISR), Journal of Management Information Systems (JMIS),* and *MIS Quarterly (MISQ)*. These journals were chosen because they are regarded primarily as *MIS* (as opposed to management) journals and are consistently highly ranked (e.g., [125]). Time and resources did not permit a review of a wider selection of journals. In order to determine current trends in IT value research, all studies published in these journals between 1993 and 1998 (inclusive) were examined. Initially articles were selected for consideration, and their measures—if any—examined, only if they involved research in business settings, *and* their titles, abstracts, or key words emphasized computers, systems, technology,[3] *and* also evaluation, efficiency, investment, payoffs, productivity, performance, usefulness, or value. Because some articles appeared to be IT value articles but did not have any of the latter key words, the following key words were also eventually added: benefits, competitiveness, competitive advantage, effectiveness, and innovation.[4] Because many *CACM* articles had no abstracts or key words, title information often had to be supplemented with a scan of the body of the article. Appendices A–D document the *CACM, ISR, JMIS,* and *MISQ* articles that were classified as IT value articles.

Articles were classified as "related empirical" articles if their titles, abstracts, and key words emphasized other effects, impacts, or improvements (e.g., decision-making quality) due to the use of systems or technology, but the articles, although empirical, were not concerned *primarily* with demonstrating the value of IT investments. Measures used in "related empirical" studies were not analyzed. (A number of software-development articles were excluded because they addressed the issue of IT value indirectly or not at all. A number of group support systems studies were classified as "empirical related" articles because there was some discussion of IT value, but this was still not their primary goal—see appendices A–D.) A number of IT value articles focused on the derivation of theoretical proofs. These articles were classified

as "related theoretical" articles. Generally, there were no measures in these articles to document or analyze.

If any uncertainty existed about the correct classification of an article based on the information contained in the title, abstract, and key words, the researchers read the full article. In order to be particularly careful in the identification and classification of articles related to IT value, the procedure carried out was as follows:

1. Initial meetings were held to discuss the classification process and the handling of articles that did not clearly fit main categories.
2. The author and graduate students examined the journals independently and identified all articles on the subject of IT value/impacts. The author reviewed all articles in all four journals. The graduate students each reviewed articles in two journals. To ensure that there would be no bias in the selection of articles, initially the graduate students were not told how the data gathered from the IT value articles would be used.
3. The author and graduate students independently classified journal articles as articles to be analyzed, related empirical articles, related theoretical articles, and unrelated articles.
4. Later, the author and graduate students reviewed each others' article classifications.
5. Where there was disagreement among two researchers about the correct classification of an article, the article was also reviewed by the third researcher (a graduate student) who was not told how the article had previously been classified. This researcher then presented to the other two researchers his final classification decision.
6. Graduate students documented and analyzed measures used in the IT value articles. The full text of each IT value article was examined during this analysis.
7. The author reviewed step 6.
8. Final project debriefing sessions were held.

This process, although time-consuming, reduced error in the identification and classification of IT value articles (see the appendices) and increased the validity of the research findings. The author and the graduate student reviewing *CACM* and *JMIS* disagreed on the classifications of six (out of 1,060) articles—in other words, they were in agreement almost 100 percent of the time. The third researcher reviewed these six articles independently and classified them in a manner similar to the author's classification. This graduate student reviewed *ISR* and *MISQ* articles. There was 100 percent agreement between his classification of these articles and the author's classification.

Research Findings

AS TABLES 1 AND 2 SHOW, ONLY 2 PERCENT OF THE ARTICLES PUBLISHED in *CACM* since 1993 addressed the topic of IT value. However, significantly more *ISR*, *JMIS*, and *MISQ* articles—19 percent, 14 percent, and 25 percent, respectively—published

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Table 1. Journal Issues and Articles Reviewed

Journal	Period	No. journal issues examined	No. articles examined	No. articles on the topic of IT value or addressing "related" topics
CACM	January 1993–December 1998	72	843	14
ISR	March 1993–December 1998	24	118	23
JMIS	March 1993–December 1998	24	217	30
MISQ	March 1993–December 1998	24	126	31

Table 2. Classification of IT Value and Related Articles

Journal	No. articles analyzed in detail	No. related empirical articles	No. related theoretical articles	Total no. articles
CACM	7	7	0	14
ISR	5	9	9	23
JMIS	11	10	9	30
MISQ	15	13	1	31

during the same period addressed this topic. The relatively scant attention paid by *CACM* to IT value may reflect its broad readership base, as described in the *CACM* information provided to prospective authors.[5]

In contrast, the significant attention paid to IT value studies by *MISQ* no doubt reflects the journal's explicit emphasis on publishing research of managerial relevance. It follows that *MISQ* would devote relatively more pages to the benefits of IT. *ISR* and *JMIS* fall closer in their IT value publication profiles to *MISQ* than to *CACM*. Interestingly, although *ISR* published significantly fewer IT value articles than *JMIS* in the 1993–98 period (23 versus 30), because *JMIS* publishes more articles per issue, a greater proportion of *ISR* articles focused on IT value.

ISR, although somewhat concerned with managerial relevance, has historically sought to publish particularly rigorous research. It is described as "a leading international journal of theory, research, and intellectual development focused on information systems in organizations, institutions, the economy, and society" (summary statement on the editorial page, September 1996 issue). Perhaps not surprisingly,

given its theoretical bent, 9 of the 23 IT value articles published in this journal (i.e., 39 percent) could not be analyzed in terms of measures because they focused on the development of proofs and were entirely theoretical. Similar figures for *CACM, JMIS,* and *MISQ,* respectively, were 0 percent, 30 percent, and 3 percent.

The *JMIS* editorial statement describes the journal as "a widely recognized forum for the presentation of research that advances the practice and understanding of organizational information systems. It serves those investigating new modes of information delivery and the changing landscape of information policy making, as well as practitioners and executives managing the information resource. A vital aim of the quarterly is to bridge the gap between theory and practice of management information systems" (editorial statement, Fall 1998 issue). With respect to the publication of IT value articles, *JMIS* appears to be slightly less receptive to theoretical proofs than *ISR,* but significantly more receptive than *CACM* and *MISQ.*

The Use of Quantitative Versus Qualitative Measures

Table 3 shows that all five of the *ISR* IT value articles published during the 1993–98 period used secondary analyses (e.g., of Compustat data) and drew conclusions based largely, if not only, on an examination of quantitative measures. This is despite the fact that:

> IT is said to enhance organizational capabilities, resulting in improved product variety, quality, and customer satisfaction, while enabling the streamlining of administrative processes and facilitating improved labor and management productivity. However, such improvements are often not reflected in improved financial performance, as benefits may be redistributed within or across organizations or passed on to consumers.
>
> . . . Hitt and Brynjolfsson (1994) argue that IT has the capacity to lower and increase entry barriers and to intensify and reduce competitive rivalry. They also cite this equivocal effect of IT on competitive strategy and industry structure as an important reason for the lack of relationships between IT investment and measures of profitability, such as ROA and ROE. Our results also suggest that while various measures of IT investment can increase firm output and lower firm costs, their effect on financial measures of business performance is less consistent. [101, pp. 90, 91, 95]

The data in Table 3 describing IT value articles in the other three journals paint a somewhat more balanced picture of the use of hard and soft measures. To some extent, *CACM* favored the use of quantitative measures. Five of the seven studies relied on quantitative measures only. In *JMIS* and *MISQ,* however, roughly equal numbers of articles used only quantitative measures or only qualitative measures. Several articles used both quantitative and qualitative measures.

It is interesting to reflect on differences in the prevalence of hard measures and the reliance on secondary data analyses in *ISR* and *CACM* relative to *JMIS* and *MISQ.* IT value articles in the former two journals relied primarily on secondary data analyses and quantitative measures. However, the IT value articles in *JMIS* and *MISQ,* on

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Table 3. Research Methods and Measures Used in IT Value Articles

Journal	Research methods used in IT value articles*	Quantitative and/or qualitative measures used	Financial and/or nonfinancial measures used
CACM	4 secondary data analyses; 2 case studies; 1 survey	5 studies used quantitative measures only; 2 studies used quantitative and qualitative measures	2 studies used financial measures only; 1 study used nonfinancial measures only; 4 studies used financial and nonfinancial measures
ISR	5 secondary data analyses	5 studies used quantitative measures only	2 studies used financial measures only; 3 studies used financial and nonfinancial measures
JMIS	4 secondary data and market data analyses; 5 case studies; 4 surveys; 1 historical analysis	4 studies used quantitative measures only; 5 studies used qualitative measures only; 2 studies used quantitative and qualitative measures	5 studies used financial measures only; 5 studies used nonfinancial measures only; 1 study used financial and nonfinancial measures
MISQ	3 secondary data analyses; 8 case studies 4 surveys	5 studies used quantitative measures only; 6 studies used qualitative measures only; 4 studies used quantitative and qualitative measures	6 studies used nonfinancial measures only; 9 studies used financial and nonfinancial measures

* Several studies used more than one research method, so column totals are unequal.

average, tended to be balanced in their use of a variety of research methods and their reliance on quantitative and qualitative measures. No doubt this difference may be related to the editorial statements and policies published by these journals during the period examined:

> *CACM* general interest articles . . . cover material of substance and emphasize concepts and principles. An article sets the background, defines fundamental concepts, compares alternate approaches, and explains the significance or application of a particular technology or result by means of well-reasoned text and pertinent graphical material. . . . All submissions in this category are reviewed for technical accuracy. [*CACM* Information for Authors][6]

> *Information Systems Research (ISR)* is dedicated to advancing the understanding and practice of information systems in organizations through theoretical and empirical research . . . . Submitted articles should make a contribution to knowledge in the field. Either or both quantitative and qualitative research methods may be employed. . . . Acceptable research articles will most frequently join theoretical analysis with empirical investigation . . . . Rigorous argument and presentation are expected throughout; however, the use of more complex mathematics and statistics than is necessary is discouraged. [*ISR*, March 1993]
>
> *ISR*'s interests are wide ranging, seeking contributions that build on established lines of work as well as break new ground. High-quality work from any analytical or research tradition is welcome, including theoretical, analytical, and empirical studies. [*ISR*, September 1998]
>
> [*JMIS*] accepts empirical and interpretive submissions that make a significant contribution to the field of management information systems. Such contributions may present:
>
> - experimental, survey-based, or theoretical research relevant to the progress of the field
> - paradigmatic designs and applications
> - analyses of informational policy making in an organizational, national, or international setting
> - investigations of social and economic issues of organizational computing. [*JMIS*, Fall 1998]
>
> On the empirical side, we [at *MISQ*] welcome research based on positivist, interpretive, or integrated approaches. Traditionally, *MIS Quarterly* has emphasized positivist research methods. Though we remain strong in our commitment to hypothesis testing and quantitative data analysis, we would like to stress our interest in research that applies interpretive techniques, such as case studies, textual analysis, ethnography, and participant observation. [*MISQ*, March 1993]

The above statements suggest greater explicit receptiveness, on the part of *JMIS* and *MISQ*, to interpretive and other nonpositivist approaches. It would appear that, while recent IT value articles in *ISR* and *CACM* (especially the former) suggest a "divide" between quantitative and qualitative measures, with the use of quantitative measures being viewed particularly favorably, this pattern is only partially supported by the data gathered from *JMIS* and *MISQ*. It is supported in these latter journals to the extent that only a minority of recent articles use both quantitative and qualitative measures within the same study.

The greater receptivity, on the part of *JMIS* and *MISQ*, to nonpositivist approaches is also seen in the use of financial and nonfinancial measures in IT value articles. In *JMIS* and in *MISQ*, a large number of studies relied solely on nonfinancial measures (see Table 3). In fact, in *MISQ*, no studies used only financial measures. However, in *CACM* and in *ISR*, the reverse was true—almost no studies relied solely on nonfinancial measures.

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Table 4. Research Methods, Measures and Levels of Analysis

Research methods used in IT value articles	Quantitative and/or qualitative measures used	Levels of analysis used
16 secondary data and market data analyses	All 16 studies used quantitative measures only	1 study examined international-level analyses; 11 studies used organization-level analyses only; 1 study used organization and national-level analyses; 2 studies used organization and industry-level analyses; 1 study used organization and group-level analyses
9 surveys	2 studies used quantitative measures only; 3 studies used qualitative measures only; 4 studies used quantitative and qualitative measures	3 studies used organization-level analyses only; 1 study used organization and industry-level analyses; 5 studies used individual-level analyses only
15 case studies	2 studies used quantitative measures only; 7 studies used qualitative measures only; 6 studies used quantitative and qualitative measures	1 study used nation-level analyses only; 1 study used national- and individual-level analyses; 1 study used industry-level analyses; 1 study used industry- and organization-level analyses; 8 studies used organization-level analyses only; 1 study used organization-, group-, and individual-level analyses; 2 studies used organization- and individual-level analyses
1 historical analysis	The study used qualitative measures	The study used national- and individual-level analyses

Investigating Links Between Research Methods and the Use of Quantitative and Qualitative Measures

As Table 4 demonstrates, in IT value studies, the choice of research methods and measures was interdependent. All 16 studies using secondary data analyses relied entirely on quantitative measures only. Interestingly, a number of the surveys used soft measures (e.g., user-satisfaction measures) and a number of case studies incorporated hard measures. Almost half of the surveys and case studies used both quantitative and qualitative measures. The single historical analysis used qualitative measures. The "divide" then may be most apparent with respect to studies using secondary data analyses.

Table 5. Levels of Analysis Used in IT Value Articles

Journal	Level(s) of analysis used in IT value articles
CACM	1 study used international-level analyses
	1 study used national- and organization-level analyses
	4 studies used organization-level analyses
	1 study used organization- and individual-level analyses
ISR	4 studies used organization-level analyses
	1 study used organization- and group-level analyses
JMIS	2 studies used national- and individual-level analyses
	1 study used industry-level analyses
	3 studies used industry- and organization-level analyses
	4 studies used organization-level analyses
	1 study used individual-level analyses
MISQ	1 study used national-level analyses
	8 studies used organization-level analysis
	1 study used organization-, group-, and individual-level analyses
	1 study used organization- and individual-level analyses
	4 studies used individual-level analyses

The Use of Individual, Organizational, and Other Levels of Analysis

Let us now examine the frequency of individual-level, group-level, organization-level, and industry-level analyses in IT value studies. In all four journals, IT value articles used organization-level analyses in the main, either solely or in conjunction with other analytic approaches (see Table 5). Six of the seven *CACM* articles, all 5 *ISR* articles, 7 of the 11 *JMIS* articles, and 10 of the 15 *MISQ* articles used organization-level measures. This is not in itself problematic. However, it suggests that the IT productivity paradox discussion may indeed have helped shift researcher attention to organization-level outputs. As the organization development literature cited above indicates, however, organization effectiveness is achieved, and IT contributions are made, at many different levels (e.g., the individual and group).

Rai et al. [101], in their commentary on IT value research, write:

> In various studies, there is no uniform conceptualization of IT investment or identification of appropriate performance measures. For instance, if IT investments are conceptualized at the firm level, the value of IT needs to be measured at the firm level as well. On the other hand, if IT investments are conceptualized at the activity or department level, performance should be measured at these lower levels. [p. 90]

Barua et al. [7] also argue that the effects of IT on organization performance can best be identified through a "web of intermediate level contributions." However, the data indicate that this intermediate (e.g., process, individual, and group) approach to analysis has *not* been the norm. Instead, a "black box," input–output approach cur-

rently appears to dominate the IT value literature. Although it can be difficult to combine multiple levels of analysis (e.g., group and organizational) within the same study, a small number of the articles examined [7, 10, 31, 123] demonstrate that it can be done.

In all four journals, organization-level analyses were carried out significantly more often on their own than in conjunction with other (e.g., individual, group, industry, or national) approaches. Relatively few studies combined multiple approaches (e.g., analyses at the individual, group, and organization levels). This suggests a divide between the use of organization-level variables and other variables in recent IT value research.

One might think that, given the macroeconomic origins of the IT productivity paradox debate (see, e.g., [75, 103, 104, 105, 115]), in the past, quantitative, organization-level measures have not served researchers particularly well in their search for IT productivity gains. Interestingly enough, instead of reevaluating our reliance on these measures and promoting new concepts and measures of IT value, several researchers appear to have redoubled their efforts to uncover quantitative, organization-level evidence of IT value. Certainly, IT value studies using organization-level analyses appear to be the ones primarily being published in North American journals today.

Investigating Links Between Research Methods and Levels of Analysis Used

Table 4 reveals that IT value studies using secondary data analyses relied primarily on organization-level analyses only. A small number of these studies conducted analyses at other levels also. Surveys appeared to be split roughly equally between the use of organization-level analyses and individual-level analyses. No surveys incorporated analyses at both levels. Case studies focused on organization-level analyses. A very small number of these studies addressed both organization- and individual-level variables. The single historical analysis that was reviewed addressed both national-level and individual-level phenomena. These findings suggest strong ties between levels of analysis and research methods. In some ways, this is not surprising. Certain research methods may be better suited to investigate individual-level or organization-level issues. What may be surprising, however, is the depth of the divide between specific research methods and levels of analysis. For instance, one might have expected to find more surveys and case studies that used both organization- and individual-level analyses.

Interestingly, journals had a significant impact on the findings here. For instance, in studies using the survey research method, when the use of levels of analysis is examined (see the appendices also), we find that all four surveys reported in *MISQ* on IT value, during 1993–98, used individual levels of analysis only. The other five surveys reported in *CACM* and *JMIS* (*ISR* published no surveys on the subject during this period) used organization-level analyses primarily. When we examine case studies on IT value during 1993–98, we see that 8 (just over half) of the 15 studies were published by *MISQ* alone. Of these case studies, most relied only on organization-level analyses. However, of the five case studies published by *JMIS* (*ISR* published

no IT value case studies, and *CACM* published two during 1993–98), several relied on industry- and national-level analyses. This once again underscores the strong links seen between journals examined and the kinds of analyses published.

In the case of IT value research, there appear to be complex interactions among journals, research methods, the use of quantitative and qualitative measures, and levels of analysis. The gatekeepers of IT value research (i.e., the journals) may themselves be divided in terms of the research that is published. Journal editors may find it useful to review their journal's positioning in the MIS "research industry" periodically, and their journal's explicit or implicit role in promoting or eliminating research "divides."

Examining Trends over Time

Table 6 examines the emergence of trends over time in the kinds of IT value articles that have been published by North American journals. First, it is clear that there has been no noticeable surge or tapering off of interest in the subject. With the exception of 1997, approximately seven articles have been published each year between 1993 and 1998 in the four journals reviewed. Second, prior to 1996, the quantitative–qualitative pendulum swung backward and forward. In different years, different measures were seen most commonly. However, from 1996 onward, studies using quantitative measures appear to have dominated the IT value literature. Third, the data suggest that organization-level analyses have continually dominated the IT value literature throughout the six-year period examined. Between 1993 and 1996, in each year, roughly half the studies relied only on organization-level analyses. In 1997, there was an interesting anomaly where the divide between organization-level analyses and other analyses appeared to have been bridged. Several studies combined organization-level analyses with analyses at other levels. In 1998, however, the divide was once again very apparent and perhaps wider than seen previously. Five of the seven studies published used organization-level analyses only.

Summary: Hard Versus Soft? High Versus Low?

The review of recent *CACM, ISR, JMIS,* and *MISQ* articles on IT value revealed a schism between the use of organization-level measures and other measures. *CACM* and *ISR* also provided strong evidence of a schism between quantitative and qualitative measures. The *JMIS* and *MISQ* data provided more limited evidence of this schism. The data suggested that the schisms are getting more noticeable over time. This may be partly due to an increasing reliance on, and receptivity to, secondary data set analyses that tend to use only quantitative measures and organization-level analyses. The current research confirms what many researchers suspect—schisms exist, and may be deepening, in IT value research.

The *CACM, ISR, JMIS,* and *MISQ* data suggest a need for renewed recognition by MIS researchers of the importance of using a *variety* of measures and levels of analysis when conducting IT value studies. In order to promote rich understanding and meaningful analyses of the benefits of IT investments, more balanced perspectives of

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Table 6. Longitudinal View of Measures and Levels of Analysis Utilized

Year*	Quantitative and/ or qualitative measures used	Levels of analysis used
1993 (6 IT value articles)	3 studies used quantitative measures only; 1 study used qualitative measures only; 2 studies used quantitative and qualitative measures	1 study used national- and organization-level analyses; 1 study used national- and individual-level analyses; 3 studies used organization-level analyses only; 1 study used individual-level analyses only
1994 (7 IT value articles)	1 study used quantitative measures only; 4 studies used qualitative measures only; 2 studies used quantitative and qualitative measures	1 study used national-level analyses; 1 study used national- and individual-level analyses; 4 studies used organization-level analyses only; 1 study used organization-, group-, and individual-level analyses
1995 (7 IT value articles)	3 studies used quantitative measures only; 3 studies used qualitative measures only; 1 study used quantitative and qualitative measures	1 study used industry- and organization-level analyses; 3 studies used organization-level analyses only; 1 study used organization and group-level analyses; 2 studies used individual-level analyses only
1996 (7 IT value articles)	4 studies used quantitative measures only; 2 studies used qualitative measures only; 1 study used quantitative and qualitative measures	1 study used industry-level analyses; 1 study used industry- and organization-level analyses; 4 studies used organization-level analyses only; 1 study used individual-level analyses only
1997 (4 IT value articles)	2 studies used quantitative measures only; 1 study used qualitative measures only; 1 study used quantitative and qualitative measures	1 study used industry- and organization-level analyses; 1 study used organization-level analyses only; 2 studies used organization- and individual-level analyses

(continued)

Table 6. Continued

1998 (7 IT value articles)	6 studies used quantitative measures only; 1 study used quantitative and qualitative measures	1 study used international-level analyses; 5 studies used organization-level analyses only; 1 study used individual-level analyses only

*1993–94 data were included in 1993. 1994–95 data were included in 1994. 1995–96 data were included in 1995. 1996–97 data were included in 1996.

IT value (e.g., combinations of organization and nonorganization level analyses, and hard and soft measures) are required.

Research Limitations

BEFORE CLOSING, A NUMBER OF LIMITATIONS OF THIS RESEARCH must be acknowledged. First, this article draws its conclusions from studies published in only four North American journals since 1993. Admittedly, these publications are leading MIS publications. Possible additional extensions to this research, however, could include analyses covering longer time periods (say, ten years), and/or examining additional journals, such as research published in European journals on the subject of IT value.

Another limitation of the current study is one of "small numbers." Thirty-eight articles were examined in detail, which precludes broad generalizations about the subject of IT value research. The findings discussed above are intended primarily to raise the awareness, and heighten the sensitivity, of MIS researchers to trends in the methods and measures used to investigate IT value. The findings provide some evidence of a deepening analytic divide, despite repeated calls in the literature for the use of multiple methods and measures.

An additional limitation of this study involves the subjective judgments made by the author and two graduate students (e.g., about which articles qualified as "IT value" articles and which articles were "related'). However, the process followed in selecting, classifying, and analyzing articles was designed to be as rigorous as time and resources would allow. Several independent checks were carefully built into the article selection, classification, and analysis process.

Yet another limitation is that this study focused on *published research*. It did not examine all IT value research submitted to journals for their review. So it may tell us more about powerful editors' and reviewers' views of valid IT value measures than about those of IT value researchers. Similarly, the study has not examined IT value research that is currently under way (i.e., still to be submitted to journals). It may therefore tell us more about research undertaken several years ago than about current research on IT value, because of the significant publishing time lags.

Finally, the study tells us little about the use of IT value measures in MIS *practice*. Questions such as the following can usefully be addressed in future studies: To what extent do business managers look to published research as sources of information on

IT value measures? How strong are the links between IT value research and practice? And do business managers experience similar schisms in their corporations?

Research Implications

SEVERAL IMPLICATIONS FOR IT VALUE RESEARCH ARISE from this study. The data suggest that researchers, in the future, may be better served by:

- *Emphasizing theory generation*, and reducing the reliance on isolated, input–output "black box" approaches. It may be that more concepts in IT value research can usefully be identified at individual and group (i.e., intermediate) levels. Innovative models (e.g., dynamic, process-focused, open system models of IT investments) may be quite helpful. As Kauffman and Weill [65, p. 385] argue, "IT value research is still in its adolescence." There are many promising reference disciplines (e.g., organization development, psychology, sociology, and industrial relations) that researchers can draw on also as they carry out future IT value studies.
- *Explicitly recognizing the limitations of current methods and measures* in IT value research, and focusing on creating additional, unconventional methods and measures. It is expected that new measures would complement (not replace) existing conventional (e.g., microeconomic) measures. For example, IT value studies could explicitly monitor messy phenomena such as culture—the set of shared, taken-for-granted implicit assumptions that determine how a group perceives and reacts to its environments [109] and its investments. As Schein [108, p. 229] writes: "I believe our failure to take [phenomena like] culture seriously enough stems from our methods of inquiry, which put a greater premium on abstractions that can be measured than on careful ethnographic or clinical observation of organizational phenomena. . . . I also hope that we as researchers will come to recognize how much our own methods and concepts are a product of our own culture."
- *Becoming more aware as researchers of our own assumptions and biases*, periodically challenging these views, and examining our receptivity to change. One might expect that the current study would paint a very different picture—one with a great deal of innovation in IT value research, as researchers heeded recommendations made in earlier studies. Instead, the study has served to highlight recommendations that have been made previously, but that have not been acted on, in the main. Unless we are willing to change, our research camps may remain divided, our methods fossilized, and our tools blunt.

Management Implications

THIS STUDY ALSO HAS SEVERAL IMPLICATIONS FOR MANAGERS, ARISING both from the literature that has been reviewed and from the data analyses that have been conducted. They are as follows:

- *IT value is discussed meaningfully in the context of the organization's goals, strategies, culture, structure, and environment. IT investments can usefully be viewed as organization change initiatives* [74]. The management task related to obtaining benefits from IT investments involves facilitating ongoing system adaptation and continuous learning. System boundary identification is a challenging, but necessary task, if IT paybacks are to be correctly assessed. A variety of internal and external stakeholder (e.g., employee and customer) impacts should be monitored.

- *Because systems are dynamic, an assessment of IT value that relies heavily on a few key numbers at a single point in time will be incomplete and possibly misleading*. Managers evaluating IT investments may wish to identify and report on a number of performance dimensions (e.g., customer impacts, profitability, stock prices, and employee satisfaction), at different points in time [61].

- *In order to fully harvest economic benefits of IT investments, ongoing management processes must be established.* IT investments unfold, and must be managed, over time. This requires open systems planning [110]. Unfortunately, while many organizations are prepared to spend large sums on technology, at the same time they may resist spending even modest sums on ongoing management systems required to ensure that expected IT paybacks are realized. What we often have are short-term "transaction" (single event) approaches to obtaining IT value, when what we often need are long-term "relationship" (multiple event) approaches. Perhaps, in the final analysis, IT valuation is less concerned with producing a single number and more concerned with promoting informed, thought-provoking, and ongoing discussion about IT investments.

- *IT evaluation approaches are also systems. They should evolve with the organization, and be adapted to specific information systems under consideration.* Evaluation approaches themselves need to be periocally reviewed and redesigned [74].

Closing Remarks

IN SUMMARY, WHEREAS MOST CURRENT IT VALUE RESEARCH APPEARS TO ADDRESS the question "*what* value do IT investments provide?" this research may not yet be adequately addressing the related set of questions, "*why, where, when, how,* and *to whom* do these investments provide value?" These questions in turn may require an examination of a variety of qualitative and quantitative measures, and the use of individual, group, process, and organization-level measures. Meaningful and rich documentation of the value of IT investments may ultimately require us to unite the "hard" and "soft" camps, and the "high" and "low" camps, and to bridge the great divide.

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1. For MIS journal rankings, see ISWorld Net (http://is.lse.ac.uk/iswnet/profact/journal.htm).
2. The rational, goal-oriented perspective is just one of three organizational perspectives outlined by Bakos.
3. The technology set of key words screened out non-IT value articles such as those focused on the performance of meeting facilitators or the usefulness of a particular methodology.
4. Innovation has multiple meanings. Here it was used strictly to refer to the adoption of new technology.
5. See http://catt.bus.okstate.edu/isworld/journal2.htm.
6. See http://catt.bus.okstate.edu/isworld/journal2.htm.

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118. Tam, K.Y. The impact of information technology investments on firm performance and evaluation: evidence from newly industrialized economies. *Information Systems Research, 9*, 1 (March 1998), 85–98.

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APPENDIX I

Communications of the ACM JUN0150

I. ARTICLES ANALYZED

STUDY	RESEARCH METHOD(S)	MEASURES USED TO ASSESS DEPENDENT VARIABLES	QUANTITATIVE and/or QUALITATIVE MEASURES	FINANCIAL and/or NON-FINANCIAL	LEVEL(S) OF ANALYSIS—individual/group/organizational/industry/national/international	RESULTS
[14]: Brynjolfsson, E. (1993)	Secondary Data Analysis (Literature Review)	Labour productivity Output	Quantitative	Financial and Non-financial	Organizational and National	Apparent lack of productivity is due to mismeasurement of outputs and inputs, lags due to learning and adjustment, redistribution and dissipation of profits, and mismanagement of information and technology.
[76]: Lucas, H.C. Jr.; Berndt, D.J.; Truman, G. (1993)	Case Study	Changes in organizational structure Changes in workflows and functions Changes in interface operations Changes in technology Numerical measures of stability, obsolescence, change, extent of automation, system-wide change (based on data flow diagram analysis)	Qualitative and Quantitative	Financial and Non-financial	Organizational	Introduction of financial imaging system resulted in improvements to customer service, control of certificates, higher quality images, improved search speed, cost reduction, research time reduction, staff reduction.
[31]: Desmaris, M.C.; Leclair, R.; Fiset, J-Y.; Talbi, H. (1997)	Case Study	Cost-benefit analysis Software development costs Operating costs Reduction in training time Annual monetary benefits	Quantitative	Financial	Individual and Organizational	Introduction of an electronic performance support system is expected to reduce employee training time, resulting in a financial break-even point between 1 and 3 years.
[101]: Rai, A.; Patnayakuni, R.; Patnayakuni, N. (1997)	Secondary Data Analysis (Information Week and Compustat)	Labor and related expenses Total property, plant, and equipment Total number of employees Company sector Sales Return on assets Return on equity Labor productivity Administrative productivity	Quantitative	Financial	Organizational	All measures of IT investment are positively associated with firm output. IT capital and client/server expenditures are positively associated with return on assets. Most expenditures except software and telecom are associated with increased labor productivity. IS staff, hardware, software, and telecom expenditures are negatively related with administrative productivity.

[47]: Grover, V.; Teng, J.T.C.; Fiedler, K.D. (1998)	Survey	Ranking of importance among investments in strategic systems, traditional development, decision support systems, infrastructure, business process redesign, and maintenance.	Qualitative and Quantitative	Non-financial	Organizational	When IS is in a support role and when there is a lack of broad managerial attention, companies tend to develop transaction processing systems and information reporting systems. An IS planning culture among top management is associated with strategic systems investments. Diversity of types of IT is associated with BPR and infrastructure investment and does not favor traditional systems investment. Managing IT requires change management skills. Both IS and business inputs need to be used in prioritizing investments.
[15]: Brynjolfsson, E.; Hitt, L.M. (1998)	Secondary Data Analysis (Literature Review)	Productivity Decentralization IT spending	Quantitative	Financial and Non-financial	Organizational	Investment in computers does not automatically increase productivity, but is part of a broader system of organizational changes that does increase productivity.
[34]: Dewan, S.; Kraemer, K.L. (1998)	Secondary Data Analysis (Labor productivity data)	Gross domestic product IT stock Non-IT stock Number of workers GDP per worker IT capital per worker Non-IT capital per worker	Quantitative	Financial and Non-financial	International	Increases in IT capital spending per worker are associated with an increase in GDP per worker, on average. Developed countries are receiving a positive and significant return on their IT investments.

II. RELATED EMPIRICAL STUDIES

STUDY
[93]: Nelson, P.; Richmond, W.; Seidmann, A. (1996)
[90]: Nam, K.; Rajagopalan, H., Raghav, R.; Chaudhury, A. (1996)
[3]: Bakos, Y. (1998)
[32]:Dewan, R.M.; Freimer, M.L.; Seidmann, A. (1998)
[119]: Teng, J.T.C.; Jeong, S.R.; Grover, V. (1998)
[39]: Duchessi, P.; Chengalur-Smith, I. (1998)
[30]: De, P.; Ferrat, T.W. (1998)

JOM015

APPENDIX II

Information Systems Research

I. ARTICLES ANALYZED

STUDY	RESEARCH METHOD(S)	MEASURES USED TO ASSESS DEPENDENT VARIABLES	QUANTITATIVE and/or QUALITATIVE MEASURES	FINANCIAL and/or NON-FINANCIAL	LEVEL(S) OF ANALYSIS—individual/group/organizational/industry/national	RESULTS
[37]: Dos Santos, B.L.; Peffers, K.; Mauer, D.C. (1993)	Secondary Data Analysis (PR Newswire, PTS Prompt)	Stock price reactions around announcements of IT investments (abnormal daily stock returns)	Quantitative	Financial	Organizational	On average, IT investments are zero net present value investments; they are worth as much as they cost. Innovative IT investments increase the value of the firm.
[7]: Barua, A.; Kriebel, C.H.; Mukhopadhyay, T. (1995)	Secondary Data Analysis (Strategic Planning Institute MPIT database)	Five intermediate variables: Capacity utilization, inventory turnover, relative price, relative inferior quality and new products Final performance variables: market shares, return on assets	Quantitative	Financial and Non-financial	Group and Organizational	Partial support was received for the positive impacts of the economic input variables on five intermediate variables. The five intermediate variables had significant positive impacts on the final performance variables of the strategic business units.
[13]: Brynjolfsson, E. (1996)	Secondary Data Analysis (U.S. Bureau of Economic Analysis; government GDP data)	Consumer welfare: Marshallian surplus, exact surplus, non-parametric estimates, value based on the index number	Quantitative	Financial and Non-financial	Organizational	IT investments generate approximately three times their cost in value for consumers.
[35]: Dewan, S.; Michael, S.C.; Min, C-K. (1998)	Secondary Data Analysis (Computerworld and Compustat data)	Demand for IT investment (total stock of IT capital, net of depreciation)	Quantitative	Financial and Non-financial	Organizational	The level of IT investment is positively related to the degree of firm diversification. Furthermore, related diversification demands greater IT than unrelated diversification. Firms that are less vertically integrated have a higher level of IT investment. Finally, firms with fewer growth options in their investment opportunity set tend to have a higher IT investment.
[118]: Tam, K.Y. (1998)	Secondary Data Analysis (Asia Computer Directory; PACAV and GV financial databases)	Total shareholder return Return on equity Return on assets Return on sales Book value of assets Market value	Quantitative	Financial	Organizational	IT investment is not correlated with shareholder return. Level of computerization is not valued by the stock market in developed and newly developed countries. There is no consistent measurement of IT investment.

II. RELATED EMPIRICAL STUDIES

STUDY
[100]: Premkumar, G.; King, W.R. (1994)
[28]: Coopersmith, J. (1996)
[80]: Manning, P.K. (1996)
[106]: Robey, D.; Sahay, S. (1996)
[11]: Bensaou, M. (1997)
[60]: Kambil, A.; Van Heck, E. (1998)
[70]: Kraemer, K.L.; Dedrick, J. (1998)
[127]: Wong, P.-K. (1998)
[58]: Jarvenpaa, S.L.; Leidner, D.E. (1998)

III. RELATED THEORETICAL STUDIES

STUDY
[86]: Mookerjee, V.S.; Dos Santos, B.L. (1993)
[48]: Gurbaxani, V.; Mendelson, H. (1994)
[25]: Clemons, E.K.; Weber, B.W. (1996)
[33]: Dewan, S. (1996)
[9]: Barua, A; Lee, C.H.S; Whinston, A.B. (1996)
[91]: Nault, B.R. (1997)
[5]: Bakos, Y.J.; Nault, B.R. (1997)
[8]: Barua, A.; Lee, B. (1997)
[111]: Seddon, P.B. (1997)

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APPENDIX III

Journal of Management Information Systems

I. ARTICLES ANALYZED

STUDY	RESEARCH METHOD(S)	MEASURES USED TO ASSESS DEPENDENT VARIABLES	QUANTITATIVE and/or QUALITATIVE MEASURES	FINANCIAL and/or NON-FINANCIAL	LEVEL(S) OF ANALYSIS—individual/group/organization/industry/national	RESULTS
[78]: Mahmood, M.A.; Mann, G.J. (1993)	Field Survey & Secondary Data Analysis (Computerworld "Premier 100")	Return on investment, return on sales, growth in revenue, sales by total assets, sales by employee, market value to book value.	Quantitative	Financial	Organization	Individual IT investment variables were found to be weakly related to organizational strategic and economic performance. However, they were significantly related to performance when grouped and analyzed by canonical correlation.
[113]: Sheffield, J.; Gallupe, R.B. (1993-94)	Multiple Case Study	Meeting effectiveness: Overall effectiveness, effectiveness of facilitation, effectiveness of technology, reducing barriers, participation, information exchange, meeting outcomes, and average effectiveness.	Qualitative	Non-financial	Individual and National	Study participants thought that the use of group support technology was effective and efficient in supporting economic development processes. GSS was helpful in meetings where participants came from a variety of backgrounds (e.g., business competitors, different ethnic groups) and where meeting urgency and efficiency were of prime importance.
[114]: Sheffield, J.; Gallupe, R.B. (1994-95)	Modified Historical Analysis	Link between action plans and competitive advantage. Implementation activities and outcomes: projects that became inactive within 1 month, projects that became inactive after 1-18 months, continuing joint projects, continuing stand alone projects. Meetings as "unfreezing" events: absence of perceived conflict, participation, information exchange, consensus for cooperative action. Change: additional electronic meetings held to involve related groups. Refreezing: recommended organizational form adopted. Perceived success in plan implementation.	Qualitative	Non-financial	Individual and National	The electronically assisted meetings promoted interorganizational learning and were effective catalysts of industry-wide change in situations previously characterized by dysfunctional conflict.

[12]: Brown, R.M; Gatian, A.W.; Hicks, J.O. (1995)	Event Study, Market Data (Compustat)	Announcements that firms are using information systems (investment)	Quantitative	Financial	Organization and Industry	The stock market reacted favorably to announcements that firms were using successful strategic information systems (SIS). In subsequent years these firms tended to be more productive and more profitable than other firms in their respective industries.
[49]: Henderson, J.C.; Lentz, C.M.A. (1995-96)	Case Study	Organizational learning New products and services Improved operating effectiveness	Qualitative	Non-financial	Organization	The benefits anticipated from IT investments (e.g. innovation) are marginal unless integrated, dynamic processes exist to actively manage and adapt these investments.
[21]: Choe, J.-M. (1996)	Survey	User accounting information system (AIS) satisfaction: information system satisfaction resulting from the correspondence between the job requirements and system functionality User AIS use: frequency and willingness of use	Qualitative	Non-financial	Individual	There are significant positive correlations between the performance of an AIS and influence factors such as user involvement, capability of IS personnel and organization size.
[22]: Clark, T.H.; Stoddard, D.B. (1996)	Case Studies, Survey	Interorganizational redesign, use of electronic data interchange (EDI) and continuous replenishment (CRP)	Qualitative and Quantitative	Financial	Organization	It is important to merge technological and process innovations. Interorganizational business process design, in the form of CRP using EDI, represented a dramatic performance improvement for the channel overall, benefiting both retailers and manufacturers.
[85]: Mitra, S.; Chaya, A.K. (1996)	Secondary Data Analysis (Computerworld)	Level of IT investments made by the firm IT budget as a percentage of sales (ITB/S), averaged over a period of time.	Quantitative	Financial	Organization and Industry	Higher IT investments are associated with lower average production costs, lower average total costs, and higher average overhead costs. Larger companies spend more on information technology as a percentage of their revenues than smaller companies. There was no evidence that IT reduces labor costs in organizations.
[117]: Tam, K.Y. (1996)	Secondary Data Analysis. (Bureau of Economic Analysis (BEA); Computerworld)	Organizational adoption of IT Mainframe purchases Price elasticity of mainframe computing	Quantitative	Financial	Organization	Price is an important factor in the innovation diffusion process. Organizations' reactions to price changes (i.e., price elasticity) are not constant. Elasticity dynamics can serve as an innovation attribute that provides a continuous characterization of adoption behavior over the life cycle of an innovation.
[72]: Lee, H.G.; Clark, T.H. (1996-97)	Case Study	Innovation in traditional market transaction processes via the use of electronic markets. Three transaction process dimensions: information gathering, contract formation, and trade settlement.	Qualitative	Non-financial	Industry (electronic markets)	Successful deployment of electronic markets requires consideration of barriers resulting from market process reengineering along with projected economic benefits. Most risks and barriers stem from social and economic factors, rather than IT-related obstacles. Success is as dependent on the management of barriers as it is on the economic benefits enabled by IT.
[120]: Teo, H-K; Tan, B.C.Y.; Wei, K.-K. (1997)	Case Study, Survey, Change Point Analysis	Changes in organizational structure Business process changes Business network changes Business scope changes Efficiency Effectiveness	Qualitative and Quantitative	Financial and Non-financial	Organization and Industry	The use of EDI in conjunction with organizational transformation can lead to phenomenal gains in organization efficiency and effectiveness.

II. RELATED EMPIRICAL STUDIES

STUDY
[102]: Rice, D.E. (1994)
[56]: Holden,T.; Wilhemij, O. (1995-6)
[62]: Karami, J.; Gupta, Y.Y.; Somers, T.M. (1996)
[116]: Subramanian, G.H.; Zarnich, G.E. (1996)
[68]: King, W.R.; Teo, T.S.H. (1996)
[40]: Edberg, D.T.; Bowman, B.J. (1996)
[23]: Clemons, E.K.; Croson, D.C.; Weber, B.W. (1996)
[53]: Hitt, L.M.; Brynjolfsson, E. (1997)
[79]: Maier, J.L.; Rainer, K. Jr. ; Snyder, C.A. (1997)
[27]: Clemons, E.K.; Weber, B.W. (1998)

III. RELATED THEORETICAL STUDIES

STUDY
[87]: Mukhopadhyay, T.; Cooper, R.B. (1993)
[24]: Clemons, E.K.; Reddi, S.P., Row, M.C. (1993)
[4]: Bakos, J.Y., Brynjolfsson, E. (1993)
[26]: Clemons, E.K.; Weber, B.W. (1994)
[107]: Sampler, J.L.; Short, J.E. (1994)
[126]: West, L.A. Jr. (1994)
[99]: Post, G.V.; Kagan, A.; Lau, K.-N. (1995)
[71]: Kumar, R.L. (1996)
[112]: Seidmann, A.; Sundararajan, A. (1997)

APPENDIX IV

JM015 3

Management Information Systems Quarterly

I. ARTICLES ANALYZED

STUDY	RESEARCH METHOD(S)	MEASURES USED TO ASSESS DEPENDENT VARIABLES	QUANTITATIVE and/or QUALITATIVE MEASURES	FINANCIAL and/or NON-FINANCIAL	LEVEL(S) OF ANALYSIS—individual/group/organizational/industry/national	RESULTS
[69]: Kraemer, K.L.; Danziger, J.N.; Dunkle, D.E.; King, J.L. (1993)	Survey	Perceived usefulness of computer based information (CBI) for financial management Perceived usefulness of CBI for operations management	Qualitative and Quantitative	Non-financial	Individual	Computer based information is important for most managers, and many report they are extremely dependent on it. The managers surveyed found CBI more valuable for the control of financial resources than the management of operations. Quality and accessibility of CBI and manager's style of computer use affected the manager's perception of usefulness. Managers most satisfied with CBI used support staff to mediate the CBI environment rather than using the computer to access information directly.
[10]: Belcher, L.W.; Watson, H.J. (1993)	Case Study	Productivity improvements Decision making improvements Information distribution cost savings Services replacement cost savings Software replacement cost savings Other intangible benefits Out of pocket direct costs Indirect personnel costs	Qualitative and Quantitative	Financial and Non-financial	Individual, group, and organizational	Benefits included improved productivity, improved decision making, information distribution cost savings, services replacement cost savings, and software replacement cost savings. Costs included the direct costs of maintaining the EIS and the indirect costs absorbed by operating groups who provided personnel to perform EIS-related tasks. Benefits were found to exceed the system's costs.
[18]: Cats-Baril, W.L.; Jelassi, T. (1994)	Case Study	Existence of: Subsidies to end users State-of-the-art telephone and data transmission network Easy-to-use interface Inexpensive terminals Transparent billing system	Qualitative	Financial and Non-financial	National	Building an advanced national information technology infrastructure can provide a competitive advantage for the countries that develop it as well as for the companies that operate in those countries. The French national videotex system was profitable and successful.
[94]: Newman, J.; Kozar, K.A. (1994)	Case Study	Positive identification of jewelry Time required for item evaluation Availability of decision support for gemologist throughout evaluation process	Qualitative	Financial and Non-financial	Organizational	System resulted in: Better asset management and financial control Increased productivity Reduced costs and increased revenue Better quality merchandise
[66]: Kettinger, W.J.; Grover, V.; Guha, S.; Segars, A.H. (1994)	Content Analysis and Secondary Data Analysis (COMPUSTAT II)	Relative profitability Relative market share	Quantitative	Financial and Non-financial	Organizational	Establishment of technological base and capital availability are both needed for sustainability of competitive advantage.

[59]: Jelassi, T.; Figon, O. (1994)	Case Study	Number of customers using EDI Return on investment Cost comparisons Market share	Qualitative and Quantitative	Financial and Non-financial	Organizational	Implementation of EDI system improved relationship with customers, lowered costs, improved speed of internal order processing, reduced errors, increased productivity, and provided competitive advantage.
[51]: Hess, C.M.; Kemerer, C.F. (1994)	Case Study	Development of electronic markets for home mortgages Changes in market structure Customer driven movement toward electronic markets Evolution of electronic markets	Qualitative	Non-financial	Organizational	CLOs provided limited support for the establishment and evolution of electronic markets.
[128]: Yoon, Y.; Guimaraes, T.; O'Neal, Q. (1995)	Survey	Expert system success measured by user satisfaction	Qualitative	Non-financial	Individual	Expert system success was found to be positively related to developer skill, end-user characteristics, desirability, shell characteristics, user involvement, problem difficulty, domain expert quality, and management support.
[89]: Mukhopadhyay, T.; Kekre, S.; Kalathur, S. (1995)	Case Study	Inventory turnover Obsolete inventory Premium freight % of material dollars under EDI program Annual production volume Parts variety New parts introduction	Quantitative	Financial and Non-financial	Organizational	EDI resulted in cost reductions ($100 savings per vehicle, annual savings of $220 million)
[46]: Goodhue, D.L.; Thompson, R.L. (1995)	Survey	Perceived effectiveness, productivity and performance Utilization or perceived system dependence	Qualitative	Non-financial	Individual	For IT to have a positive impact on individual performance: Technology must be utilized Technology must fit task
[92]: Nault, B.R.; Dexter, A.S. (1995)	Case Study	Price of fuel Convenience, credit and control provided to customers	Qualitative and Quantitative	Financial and Non-financial	Organizational	Application of IT yielded price premiums between 5% and 12% of the retail fuel price.
[54]: Hitt, L.M.; Brynjolfsson, E. (1996)	Secondary Data Analysis (IDG Annual IT Spending Survey)	Production function: Productivity Business profitability Consumer surplus	Quantitative	Financial and Non-financial	Organizational	IT increased productivity and consumer value, but did not result in supranormal business profitability. There is no inherent contradiction between increased productivity, increased consumer value, and unchanged business profitability.
[123]: Vandenbosch, B.; Huff, S.L. (1997)	Case Study	Perceived improvements in organizational performance: efficiency and effectiveness	Qualitative	Non-financial	Individual and Organizational	EISs contributed to gains in efficiency more frequently than to gains in effectiveness. However EISs could also be used to help formulate problems and foster creativity.
[43]: Francalanci, C; Galal, H. (1998)	Secondary Data Analysis (LOMA)	Productivity: Premium income per employee Total operating expense to premium income	Quantitative	Financial and Non-financial	Organizational	Increases in IT investment were associated with productivity benefits when accompanied by changes in worker composition.
[97]: Pinsonneault, A., Rivard, S. (1998)	Survey	Logs of time spent in various managerial activities Logs of time spent online	Quantitative	Non-financial	Individual	Managerial IT usage is sometimes, but not always, associated with spending more time in information roles and less time in decisional and interpersonal roles. Companies that are experiencing discontinuous change in strategy are likely to exhibit this pattern, while those that are focused on incremental change are not.

II. RELATED EMPIRICAL STUDIES

STUDY
[96]: Pinsonneault, A; Kraemer, K.L. (1993)
[17]: Caron, J.R.; Jarvenpaa, S.L.; Stoddard, D.B. (1994)
[42]: Finlay, P.N.; Mitchell, A.C. (1994)
[44]: Gill, T.G. (1995)
[98]: Pitt, L.F.; Watson, R.T.; Kavan, C.B. (1995)
[57]: Iacovou, C.L.; Benbasat, I.; Dexter, A.S. (1995)
[1]: Abdul-Gader, A.H.; Kozar, K.A. (1995)
[81]: Massetti, B. (1996)
[129]: Ytterstad, P.; Akselsen, S.; Svendsen, G.; Watson, R.T. (1996)
[45]: Gill, T.G. (1996)
[82]: Massetti, B.; Zmud, R.W. (1996)
[41]: El Sawy, O.A.; Bowles, G. (1997)
[95]: Nidumolu, S.R.; Knotts, G.W. (1998)

III. RELATED THEORETICAL STUDIES

STUDY
[83]: Mata, F.J.; Fuerst, W.L.; Barney, J.B (1995)