

The Effect of Multiple Value Frames of IT Productivity on Business Performance

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Abstract

The ongoing debate over IT productivity has revealed paradoxical effects of IT. This study proposes that IT business value is paradoxical structured. IT impacts are not easy to generalize according to one perspective or paradigm. This study assumes multiplicity in the phenomenon of IT value and explores effects of these multiple interpretations. The study seeks to understand organizational performance. Hypotheses are developed to test the relationship between competing interpretations of IT value and organizational performance. The purpose of this study is to determine whether or not senior managers perceive IT value on the basis of divergent managerial value frames.

1. Introduction

Effects of IT on organizational productivity have been actively discussed since Steven Roach first drew attention to the so-called productivity paradox in the early 1980s. Although corporations have heavily invested in IT and computing power has grown rapidly, it is not clear that these investments have significantly improved productivity. Many early studies failed to find that IT spending yields significant productivity gains (Loveman, 1994; Roach, 1991;

Strassmann, 1990). More recently, positive associations have been found between IT spending and productivity (Brynjolfsson, 1996; Brynjolfsson and Hitt, 1996).

Currently, the situation has changed drastically and technology-driven productivity is now viewed as an essential driver of positive and negative economic outcomes (Reingold and Stepanek, 2000). This research builds a theoretical rationale for this transformation from productivity paradox to technology-driven productivity.

We present the notion that much of the

potential for IT productivity has to do with ways that managers and researchers view this potential. That is, our understanding of how IT can contribute to firm performance frames the realm of possible uses of IT in our firms (Garud and Ahlstrom, 1997).

In cognitive science, researchers have identified various knowledge structures people use to perceive and make sense of complex phenomena, such as paradigms, mental models, interpretative schema, and cognitive frames (Walsh, 1995). We do not make fine-grained distinctions among these terms, choosing instead to use the term "frame" to describe contrasting management viewpoints as to the nature of IT business value.

1.1 Research questions

The purpose of this study is to determine whether or not senior managers perceive IT value on the basis of divergent managerial value frames. Multiple and contrasting managerial beliefs about IT business value are first identified, and on the basis of our previous exploratory study, constructs are then developed for the value frames. To the extent that this first question is true, we can then explore the relationship between these divergent value frames and organizational performance. Specifically, our second research question asks how these competing value frames are

associated with the performance outcomes of an organization.

1.2 Background

In order to investigate this shifting IT value phenomena, we adopt a pluralistic paradox approach from the organizational study literature and apply it to the IT value domain. We believe that this approach provides a useful lens for viewing the multiplicity and contradictions inherent in the phenomenon of IT value. Such a pluralistic approach to the study of paradox has a long tradition (e.g. organization study: see AMR special issue, Oct. 2000). In order to understand the contradictory organizational consequences of information technology, Robey and Boudreau (1999) propose considering the "logic of opposition" and suggest "incorporating opposing hypotheses" into the design of IS research.

Paradox is generally discussed in two ways. First, paradox can be defined as "contradictory to common sense and expectation" (Eisenhardt and Westcott, 1988). The IT productivity paradox was basically drawn upon this definition, since the insignificant effects of IT on firm productivity were unexpected and contradictory to common beliefs at least at the time when this debate ignited. Second, paradox can be defined as "mutually exclusive and contradictory

elements that coexist and operate equally at the same time" (Cameron and Quinn, 1988). This second definition of paradox can be used to understand 'why' paradoxical effects occur. For instance, the coexistence of multiple contradictory forces explains why certain IT benefits do not necessarily reach overall benefits to the organization (Robey and Boudreau, 1999). An important distinction between these two views of paradox is the theoretical embracement of competing frames in the second perspective. Here, these frames are commonly structured by opposing tensions, polarized conceptualizations or juxtaposition. They may not exist "out there" but rather are subjectively or interpersonally constructed. This research adopts this perspective and introduces the theoretical construct that we are calling value frame to elaborate on this paradoxical structure of IT business value. By recognizing the paradoxical elements in the business value of IT, we can understand how managers and researchers can pursue apparently contradictory frames or viewpoints. We further elaborate on the relationship between these structures and organizational performance outcomes.

The estimated contribution of this research is two-fold. First, today's IT can dynamically change the organization and the competitive ground. Thus, the impact of IT may not be easy to

generalize according to one perspective or paradigm. The study adopts the pluralistic paradox approach discussed above and applies it to the IT value domain. Second, IT business value has been discussed mainly in terms of the physical and structural aspects of IT-organizational relationships. In this trend, researchers have not paid much attention to the managerial beliefs and cognitive aspects of human managers. This paper will provide a construct for the value frame on which managers variously interpret the benefits of IT resources.

This paper is organized as follows: First, we propose a comprehensive framework to integrate competing views of IT business value. In relation to this framework, findings from a preliminary exploratory study are shortly discussed. Second, we develop hypotheses on the basis of paradoxes that underlie IT business value, specifically in efficiency, effectiveness, and core-competence. These hypotheses also take into account the relationship between the value frame and business performance. In the method section, issues of measurement validation and statistical validity to conduct this study will be addressed. Finally, implications of this study are discussed.

2. Development of the Framework

	Efficiency	Effectiveness
Endogenous Valuation	<p>Efficiency perceived by looking inside of an organization</p> <p>Example of value: cost reduction, cost displacement, primary activity efficiency, support activity efficiency</p>	<p>Effectiveness perceived by looking inside of an organization</p> <p>Example of value: competence enhancement, idiosyncratic capability, business network</p>
Exogenous Valuation	<p>Efficiency perceived by comparing and positioning with other organizations</p> <p>Example of value: rents from structural advantage, cost leadership, economies of scale, economies of scope</p>	<p>Effectiveness perceived by comparing and positioning with other organizations</p> <p>Example of value: market share, market preemptiveness, threat</p>

Figure 1 - Multiple models of value interpretation

In order to take into account the diverse value frames involved in perceiving IT impacts, a two-by-two matrix model is proposed as shown in <Figure 1>, the model highlights two dimensions of contrasting values. Identifying opposing elements is essential to approaching paradox (Robey and Boudreau, 1999). Organizational studies have viewed the tradeoff between efficiency and effectiveness as a central concept in organizational design. Traditionally, efficiency has been understood as "doing things right" while effectiveness as "doing the right things" (Drucker, 1964). Efficiency concerns the reduction of inputs to produce a given set of goals, while effectiveness emphasizes tuning and achieving the "right" goals (Daft and Steers, 1986). IS researchers have also seen the benefits of IT in

terms of this major distinction between efficiency and effectiveness (Hamilton and Chervany, 1981). The other value dimension

in our framework endogenous vs. exogenous is widely viewed in the strategy field as two contrasting sources of competitive advantages. Contrary to the economic view that humans seek to maximize their own gains, literature in game theory suggests that some people seek to maximize relative gains (Griesinger and Livingston, 1973; Liebrand and van Run, 1985; Messick and McClintock, 1968). Managers that do this tend to make decisions guided by exogenous factors such as market share and competitive advantage in the industry, rather than endogenous ones such as maximizing the company's own gain.

	Efficiency	Effectiveness
Endogenous Valuation	<p align="center"><u>Routinizing</u></p> <p><i>Paradigms:</i> scientific management, division of labor, value chain model</p> <p><i>Value Perception:</i> cost displacement, primary activity efficiency, support activity efficiency</p> <p><i>Value Creation:</i> routinizing, automating, programming, reengineering</p>	<p align="center"><u>Learning</u></p> <p><i>Paradigms:</i> knowledge-based view, dynamic capability, organizational learning</p> <p><i>Value Perception:</i> learning synergy, competence enhancement, idiosyncratic capability</p> <p><i>Value Creation:</i> learning, enacting, knowing, networking</p>
Exogenous Valuation	<p align="center"><u>Cost-structuring</u></p> <p><i>Paradigms:</i> transaction cost, business relatedness</p> <p><i>Value Perception:</i> economies of scale, economies of scope, rents from structural advantage</p> <p><i>Value Creation:</i> make-or-buy decision, restructuring, relating businesses</p>	<p align="center"><u>Positioning</u></p> <p><i>Paradigms:</i> competitive advantage, market competition</p> <p><i>Value Perception:</i> market pre-emptiveness, threat, market share</p> <p><i>Value Creation:</i> creating switching cost, creating new-entry barriers, increasing market share</p>

Figure 2 - The value frame models

In the spring of 2000, we conducted an exploratory study. For the detail, see Kwon, Watts-Sussman, and Collopy (2002). In order to understand the implications of these two dimensions in the domain of IT value. In this study, four frames of IT business value were developed: routinizing, cost-structuring, positioning, and learning <Figure 2>. A short summary describing these four value frames follows.

Routinizing : IT can help an organization automate and program a series of business activities. When systems are used for this purpose, IT benefits are usually viewed in terms of the endogenous-efficient domain.

Cost-structuring : IT can help an organization leverage cost advantages by enhancing economies of scale and scope.

When systems are seen in this perspective, benefits are usually recognized in the exogenous-efficient domain.

Positioning : IT can help an organization achieve a better industrial position. When systems are seen in this perspective, benefits are usually captured in the exogenous-effective domain.

Learning : IT can help an organization become smarter and promote learning synergies. When systems are seen in this perspective, benefits are usually captured in the endogenous-effective domain.

3. Development of Hypotheses

This section investigates relationships

between multiple modes of IT value interpretation and business performance. Hypotheses are developed in terms of the paradoxes underlying IT benefits aimed at efficiency, effectiveness and core-competence.

3.1 The efficiency paradox

The application of IT to the improvement of organizational efficiency is paradoxical. IT applications can help an organization save labor by automating and programming a series of business activities. However, this preconception was challenged by unexpected findings that IT-based efficiency does not lead to overall increases in organizational profits (Hitt and Brynjolfsson, 1996). There are two explanations of such findings. First, automating business processes by adopting IT is replicable by others. For example, many companies may implement EDI in a similar fashion (Benjamin, et al., 1990). Initial increases in efficiency do not manifest as "strategic advantage" for any one company, but rather as "strategic necessity" for many companies. Second, automation in some business activities does not simply replace traditional labor. It often requires additional resources for coordination and knowledge-related tasks. For these reasons, it is hard to simply estimate that automation is directly linked to business performance.

On the other hand, efficiency gains

through cost structuring enabled by economies of scale and scope are more difficult to imitate. For instance, IT can enable a firm to deal with a large number of products. In this case, although competitors have similar IT applications, structural differences of a firm can create difficulties which keep others from attaining similar efficiencies. Capturing entrepreneurial rents stemming from these sorts of firm-level efficiencies can be a more substantial source of advantage (Barney, 1991; Teece, et al., 1997).

Thus, we propose the following hypotheses.

Hypothesis 1a : Value interpretation of IT on the basis of **routinizing** (endogenous-efficient) is not positively associated with a firm's performance.

Hypothesis 1b : Value interpretation of IT on the basis of **cost-structuring** (exogenous-efficient) is positively associated with a firm's performance.

3.2 The effectiveness paradox

A paradox also exists in our views of IT effectiveness. The use of IT can be an effective "competitive weapon" and a tool to achieve superior industrial positions. However, such uses of IT have not been found to be related to higher company performance (Landauer, 1995). Two explanations for this have been proposed. First, such competitive

uses of IT can result in over-competition without expanding the economic pie. Where this occurs, IT may not be a source of value added (Nault, 1995). Secondly, comparing and positioning actions may not be enough to make a company effective. Nonaka and Takeuchi (1995:41) point out that one of the fallacies in strategy may be that it treats effectiveness as analyzable and comparable.

However, effectiveness gains derived from a firm's idiosyncratic and difficult-to-imitate resources (Barney, 1991) tend to create sustainable advantages. These advantages occur when IT experiences are combined with other management skills and resources (Mata, et al., 1995). Complementary supports of IT for human capital and business learning can provide an important source of value added (Powell and Dent-Micallef, 1997). In addition, because customers' search costs tend to increase in heterogenous markets (Bakos, 1991), profit margins can also be increased in such situations (Moore, 1996).

Thus, we propose the following hypotheses.

Hypothesis 2a : Value interpretation of IT on the basis of **positioning** (exogenous-effective) is not positively associated with a firm's performance.

Hypothesis 2b : Value interpretation of IT on the basis of

learning (endogenous-effective) is positively associated with a firm's performance.

3.3 The core-competence paradox

Another paradox exists in the area of firm-specific competencies. IT can be used to enhance these competencies when it is combined with structural efficiencies or unique managerial skills. However, this can create core-rigidities in situations where a firm's core-competences are challenged by serious environmental changes (Leonard-Barton, 1992). This paradoxical situation can be explained as follows. First, when the logic of industrial competition changes, a current competence can constrain a company's growth. Second, a broader economic cycle can redefine the potential of IT. For instance, when facing a bad economic situation, a company's ambitious efforts to develop competence by investing in IT can turn out to be a strategic burden. Both combinative capabilities and external discontinuities need to be addressed to counter this problem of core-rigidity. To the extent that this take place, firms can exploit their core competencies fully. However, March (1991) points out that for organizations to thrive for an extended period, both the exploitation of current advantages and the exploration of new ones are necessary. This suggests that significant benefits of IT can emerge

when structural efficiencies and learning capabilities are combined.

We could also hypothesize that the nature of IT value can change by the discontinuities of external environment. More specifically, enhanced structural efficiencies seem to be associated with a firm's performance in hostile economy while enhanced learning capabilities is associated with the performance in benign situations. In a hostile environment, companies tend to focus on price factors and tightly planned strategies (Slevin and Covin, 1997). Tightening cost structures and exploiting current capabilities are wiser movements during such a situation. Contrarily, the value created in a benign environment tends to accrue to those who challenge the existing logic of an industry (El Sawy, et al., 1999; Kim and Mauborgne, 1999). Sustainable value effects from IT tend to result from learning opportunities that arise during usage (Copeland and McKenney, 1988) and from creative explorations of unforeseen value potential (Coombs and Hull, 1998; Hopper, 1990).

Thus, we propose the following hypotheses.

Hypothesis 3a : The value interpretation of IT on the basis of the **combination of cost-structuring and learning** is positively associated with a firm's performance.

Hypothesis 3b : The effect of cost-structuring on a firm's performance

tends to be amplified in a **hostile environment**.

Hypothesis 3c : The effect of learning on a firm's performance tends to be amplified in a **benign environment**.

4. Methodology

In this section, methodological propositions are presented to approach and empirically test this trend of pluralistic competing hypotheses. Since our interest is in the relationship between various value-interpretations of IT investment and organizational performance, the level of analysis of this study is the firm. Regarding to the organizational performance, this study uses generally accepted performance outcomes such as company profitability and growth (Dos Santos and Peffer, 1993; Powell and Dent-Micallef, 1997; Strassmann, 1990).

Senior IS managers' and CIOs' perceptions can be used to assess the value frame construct. This construct, Frame-based Perceptions of IT Business Value (FP-ITBV), is defined as the extent to which the business effects of IT are perceived on the basis of managers' different value frames. The measurement structure of this construct is developed as second-order as is shown in <Figure 3>.

Cost-structuring : In order to

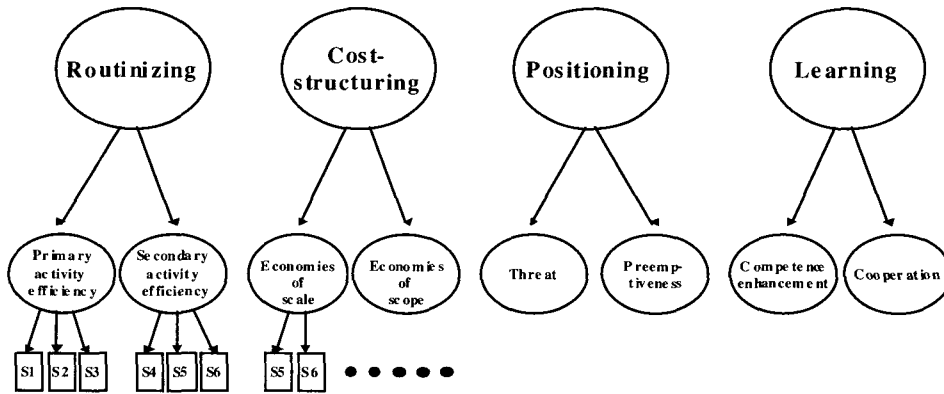


Figure 3 – The structure of the value frame construct

4.1 Measurement

IT performance performance at the firm level has been assessed in previous studies by measuring the impacts of IT on profit performance. Constructs from previous research have been adapted, and additional measurement items can be developed. Organizational performance (Dependent Variable): While a profit performance measure, ROA can be used as the main performance measure, other outcome measures such as shareholder return and net sales increase are to be used to check for measurement bias. Routinizing: In order to operationalize the routinizing frame, the two latent constructs, primary activity efficiency and support activity efficiency are used. Previously validated instruments from Sethi and King (1994) are adapted.

operationalize the cost-structuring frame, the two latent constructs, economy of scale and economy of scope are used. Previously validated instruments are adapted from the cost leadership scale (Zahra and Covin, 1993), and additional items are developed.

Positioning : In order to operationalize the positioning frame, the three latent constructs, threat, preemptiveness, and market aggression are used. Previously validated instruments are adapted from the threat, preemptiveness (Sethi and King, 1994) and strategic posture scales (Covin and Slevin, 1989).

Learning : In order to operationalize the learning frame, the two latent constructs, competence enhancement and cooperation are used. Previously validated instruments are adapted from

the business resources scale (Powell and Dent-Micallef, 1997), and additional items are developed.

4.2 Instrument development and validation

A three-step approach to developing and validating multifaceted, multidimensional measurement can be used (Singh and Rhoads, 1991). <Figure 4> summarizes this approach.

Step 1 : Domain specification

The first step in the operationalization of constructs is delineating the domain of interest. To this end, the existing

literature on strategic management and IS needs to be reviewed for relevant constructs. CIOs, IT managers, and researchers can be contacted for this purpose, and pilot tests can be conducted of the initial version of the questionnaire.

Step 2 : Scale Refinement

The measurement instrument can be refined on the basis of the pretest data by using the following iterative processes. First Order Analysis: First-order dimensions can be examined under each facet second order frame constructs - by using EFA (Exploratory Factor Analysis). The reliability and unidimensionality of each dimension is to be assessed. Second

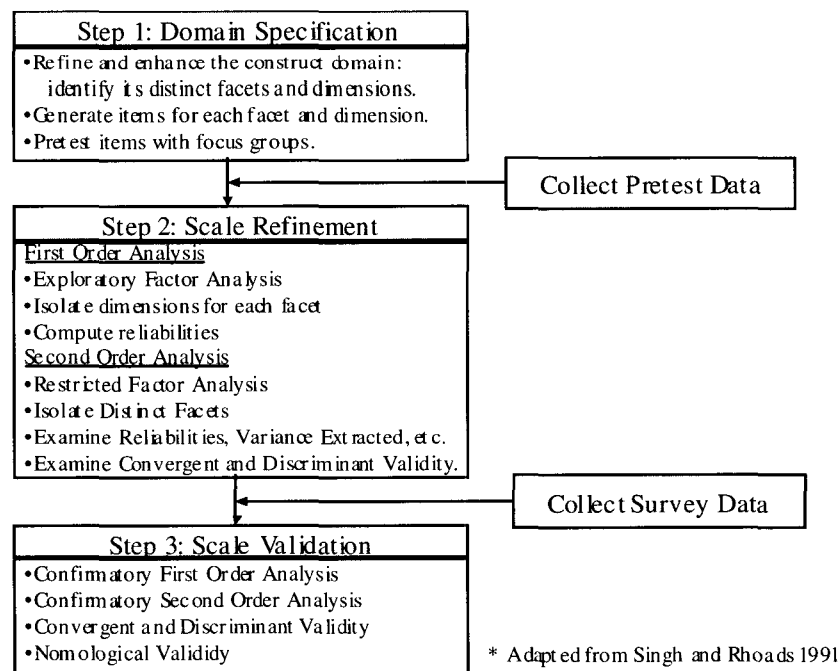


Figure 4 - Method for developing the multifaceted and multidimensional measurement

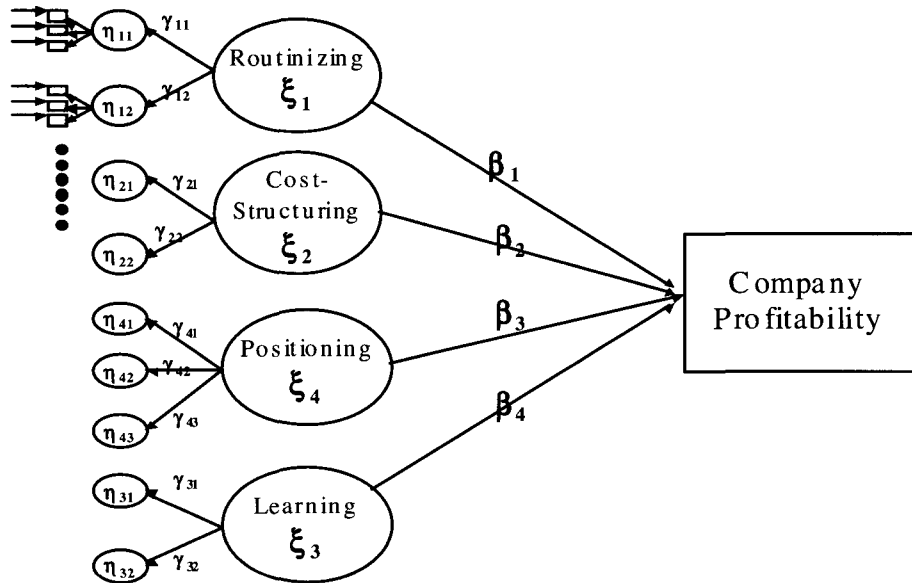


Figure 5 - Hypothesis Testing Model

Order Analysis: The second-order model can be examined by using RFA (Restricted Factor Analysis). The frame construct can be tested for acceptable levels of reliability and convergent and discriminant validities, using such techniques as composite reliability (Hair, et al., 1998), intercorrelations, and Fornell and Larcker's criterion (Singh, 1991).

Step 3 : Scale validation

In this step, confirmatory factor analyses can be conducted to compare the loadings, dimensions and facets of the pre-test sample with those of the actual sample. First Order Validation: CFA (Confirmatory Factor Analysis) can be conducted for each facet in order to confirm that the

dimensions are equivalent in both samples. Second Order Validation: CFA analysis can be conducted to test whether the second order measurement model is equivalent in both samples. The next step is to test for reliability and convergent and discriminant validity of the facets. Facet reliability, convergent validity and discriminant validity are tested in the same manner as they are during scale refinement.

4.3 Hypothesis Testing

The research hypotheses developed in the previous section can be tested on the sampled data as follows. The empirical test model for first four hypotheses is depicted in <Figure 5>.

The overall fit of the path model can be first tested. The statistics provided by EQS such as χ^2 , BBNF(>.90), CFI(>.95), RMR (<.08), RMSEA (<.08) can be used to evaluate the overall fit of the path model. The values in the () represent the cut points of the threshold. (Hair et al. 1998)

Hypotheses 1, 2, 3, and 4 test the model, $\text{Company Profitability} = \beta_0 + \beta_1(\text{routinizing}) + \beta_2(\text{cost-structuring}) + \beta_3(\text{positioning}) + \beta_4(\text{learning}) + \epsilon$. If the value of the coefficient β_k is significant at the level $<.05$, we can reject the null hypothesis of $\beta_k = 0$. We can also statistically answer which frame is more influential than other frames regarding the company profitability. Standard coefficients for 1, 2, 3, and 4 are used to compare the relative impact sizes of frame constructs on the business performance.

5. Conclusions

In this section, we discuss methodological issues, limitations, and contributions of the study.

Methodological concerns

Basically, this study relates perceptual variables with objective outcome measures such as firm ROA. Although the advantage of this approach is the ability to investigate how IT directly

affects organizational outcomes (Sethi and King, 1994), factors other than the ones under investigation may be associated with ROA, necessitating careful selection of control variables and noise factors. Control variables can be considered including company size, types of IT, and the ratio of IT investment to revenue. Some potential noise factors could be turnover rates of senior IT managers and time lags between IT investment and its effects. Another consideration is the complexity of the model, common in pluralistic research. For this reason, key dimensional constructs, instead of all possible dimensions for each value frame, have been derived from our exploratory study. The number of instrument items and sample size needs to be addressed regarding the model's statistical power.

Limitations

The scope of this study is limited to validating the concept of value frame and investigating its effect on the performance. The instrument can be developed to test managers' retrospective perceptions without aiming at investigating effects of particular types of IT. This study does not investigate potential relationships between the interpretive frames and other variables, such as company culture and types of management. Future research will examine how these factors are related to changes of value interpretation and

management actions (e.g. specific types or patterns of investment). Doing so will provide a more extensive understanding of the antecedents and consequences of multiple value interpretations. Also, longitudinal studies would be helpful to understanding changes of value interpretations and their consequences.

Contribution/Implication

Today's IT can dynamically change organizations and their competitive ground. Beliefs about the potential of technology are often pluralistic, and divergent ways of interpreting IT resources can change the direction of business. Hence, IT impacts are not easy to generalize according to one perspective or paradigm. This study assumes multiplicity in the phenomenon of IT value and explores effects of these multiple interpretations. The theoretical construct of value frame is conceptually developed and can be validated on the basis of management perceptions. These concepts and proposed validation are expected to make contributions to future research, regarding how IT value frames are related to various managers, organizations, and their action outcomes. We expect to find that the frames of cost-structuring and learning are positively associated with the organizational performance. This implies that comparative metaphors will be useful in the context of efficiency. For the

effective use of IT resource, human interpretations and subjectivities will be important. In sum, the approaches taken in this study and expected results are in contrast to the traditional management thinking, which tend to emphasize the trade-off between efficiency and effectiveness. Instead, more emphasis should be given to integrating our understanding of the two.

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