Title

IT and Intangible Assets: A Survey of the Different Organizational Assets that Impact Firm Productivity or Performance

Abstract

This paper attempts to provide a comprehensive list of organizational variables that should be considered by researchers who are interested in investigating whether interactions between IT and different organizational assets can explain more accurately the relationship between IT investments and firm performance. The factors identified can be used to assess the true impact of IT on productivity/performance by looking at the relative marginal impact of the interactions between IT and these other factors. Section 2 provides a survey of the research that links IT investments coupled with investments in specific organizational assets to higher firm productivity or improved firm performance. Section 3 provides a survey of the research that directly links different organizational assets to performance. The survey in this section has been given to enable researchers to think about these factors, as they investigate which intangible assets or clusters of assets, possibly when coupled with IT, have the highest impact on firm performance. Section 4 provides the key theoretical lenses that are used to explain heterogeneity in performance levels realized by firms making similar investments in IT. Section 5 provides a summary in the form of 2 useful tables.

This article thus supports further empirical research to answer important questions such as – What organizational variables complement IT? What organizational variables coupled with IT have the highest impact on firm productivity or performance? Which variables are the best predictors of firm performance? What interactions (possibly not including IT) contribute most significantly to firm performance?

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1. Introduction

1.1 "Productivity" or "Performance" Paradox

There is much case-related evidence that shows that investing in technology alone may not translate to desired or expected gains in productivity or performance. Consider a few examples from (Brynjolfsson et al 1997) - In the 1980s, General Motors invested $650 million dollars on technology at one plant but since it failed to simultaneously change the labor management practices at the plant, no significant improvements in productivity levels were realized (Osterman 1991). Similarly, Jaikumar (1986) found that US companies adopting flexible technology did not see same gains as their Japanese counterparts because operating procedures were not changed with the introduction of the technology. Thus, it seems that investments in technology alone cannot lead to guaranteed enhancements in firm performance.

As the above examples show, the "productivity paradox" or "performance paradox" at companies which invest large amounts in IT but fail to see correspondingly significant increases in productivity or performance levels may in fact be attributable to the lack of investment in other complementary factors like human and business resources. Achieving performance gains out of using IT is dependent on coupling IT with other company-specific, inimitable, and possibly intangible organizational, human, and business resources (Miller and Rice 1967; Walton 1989; Benjamin and Levinson 1993; Keen 1993; Powell and Dent-Micallef 1997). Intangible assets do play a potentially important role in explaining heterogeneity in firm performance when similar investments in IT are made.

1.2 Complementary Investments

Much research has been done recently to study the complementarities between organizational investments and IT investments and their impact on the productivity or performance of a firm. It has been hypothesized that having IT resources combined with certain intangible organizational assets is more productive than having just those IT resources or just those organizational assets. In other words, the presence of specific intangible assets increases the marginal returns associated with IT assets or in the mathematical framework developed by Milgrom and Roberts (1990), IT investments and investments in specific intangible assets are "complements." Neo (1988) shows that the interactions between IT and complementary organizational resources can explain to a great extent the heterogeneity in performance

improvements realized by firms through their use of IT. Brynjolfsson, Hitt & Yang (2002) show that "the combination of computers and organizational structures creates more value than the simple sum of their separate contributions." (page 176). This again implies that investments in information technology and investments in specific organizational assets are complements.

As Powell and Dent-Micallef point out (1997), the idea of coupling technology with the human or intangible dimensions of an organization can be traced to the "socio-technical" framework developed over 40 years ago (Trist and Bamforth, 1951; Rice 1958; Emery and Trist). Thus, the concept that performance will be maximized when the technology and related organizational resources are jointly optimized is not new (Miller and Rice 1967; Powell and Dent-Micallef 1997). Notwithstanding this knowledge, firms continue to differ in their capacities to extract the maximum value from the IT in terms of performance or productivity improvements.

1.3 Contributions

Though there is some empirical research that explores what intangible assets could potentially be coupled with IT to produce higher productivity or higher performance, the research on the topic is distributed and a good survey of the different organizational assets that lead to higher productivity is lacking. This paper provides a comprehensive literature survey of research about different organizational assets that can lead to higher firm productivity or higher firm performance.

Though impact of IT on performance and productivity are two related but separate questions (Brynjolfsson and Hitt 1996) and it may be true that improved productivity does not lead to better performance measured in terms of financial indicators such as profitability, we will consider here generally the idea of investments in IT and organizational assets to produce higher performance levels, where higher or better performance could be interpreted to mean "better" in one dimension, such as productivity levels.

This paper attempts to provide a comprehensive list of organizational variables that should be considered by researchers who are interested in investigating whether interactions between IT and different organizational assets can explain more accurately the relationship between IT investments and firm performance. The factors identified can be used to assess the true impact of IT on productivity/performance by looking at the relative marginal impact of the

interactions between IT and these other factors. The factors represent the "unobserved" or omitted variables in the regression that attempts to assess the contribution of IT assets to performance. Brynjolfsson and Hitt (2002) point out that these omitted variables lead to unusually high (or unrealistic) coefficients on computer assets in the regression relating those assets to firm market value, and that including specific interaction terms to indicate the coupling of IT and other hypothesized complementary organizational variables lowers the coefficients to more reasonable values.

This article thus supports further empirical research to answer important questions such as – What organizational variables complement IT? What organizational variables coupled with IT have the highest impact on firm productivity or performance? Which variables are the best predictors of firm performance? What interactions (possibly not including IT) contribute most significantly to firm performance?

1.4 Structure

The paper is divided into 6 sections, including this introductory section. Section 2 provides a survey of the research that links IT investments coupled with investments in specific organizational assets to higher firm productivity or improved firm performance. Section 3 provides a survey of the research that directly links different organizational assets to performance. Section 4 provides the key theoretical lenses that are used to explain heterogeneity in performance levels realized by firms making similar investments in IT. Section 5 provides a summary in the form of 2 useful tables. Section 6 concludes the paper. For the survey, peer-reviewed scholarly journals and highly-reputed practitioner journals were consulted. Examples include *Administrative Science Quarterly, American Economic Review, Bell Journal of Economics, Harvard Business Review, Journal of Management Information Systems, Journal of Production Economics, Management Science, MIS Quarterly, Organization Science, Sloan Management Review, Strategic Management Journal, Quarterly Journal of Economics, Rand Journal of Economics, Review of Economics and Statistics.* What makes the survey unique and useful (we hope) is the fact that we looked at not only IT and economics literature, but also strategy, organizational science, and social psychology literature to give a comprehensive understanding of the different organizational factors that could potentially be combined with IT to positively impact firm performance.

2. IT and its organizational complements

This section reviews the research on the impact of IT coupled with different organizational assets on firm productivity or performance. The seven primary (possibly inter-dependent) organizational variables identified are human capital measured in terms of worker skills and education levels, workplace organization measured in terms of the degree of decentralization, business process redesign or redesign of tasks, CEO or senior management attitude/practices, organizational culture, organizational learning, and worker composition.

2.1 Coupling IT with Human Capital (Skills, Education) and Workplace Organization

Bresnahan, Brynjolfsson, and Hitt (2002) find that "IT, work organization, and human capital interactions (but not levels of these variables individually) positively predict firm productivity." (2002, page 370) Specifically, they find that IT combined with a more skilled or a more highly-educated work force leads to higher productivity levels. IT coupled with a more decentralized work organization also leads to higher productivity. Their work thus presents evidence for the complementarities between IT, work organization, and human capital measured in terms of skills and education. In yet another study, Brynjolfsson, Hitt & Yang (2002) relate higher firm performance to greater decentralization of the work organization.

2.2 Coupling IT with Business Process Reengineering (BPR)

Many studies find empirical evidence in support of the "contingency theory" that organizational performance is the result of a "fit" between factors. Only when there is synergy or a good fit between the different factors, higher/better organizational performance can be obtained. This theory supports the view that IT alone cannot achieve growth in firm performance, but IT combined with several "good fit" or congruent factors can achieve better performance. Value derived from IT in terms of its impact on performance is thus contingent on the presence of other synergistic factors. One such factor is BPR (Business-Process Re-engineering) implementation, which is defined by Hammer and Champy (1993) as the redesign of a process according to some performance measure such as cost, quality, service and speed.

Devaraj and Kohli (2000) find that investments in IT when combined with BPR initiatives have a positive impact on firm performance. They find that impact of technology is higher when there is a higher degree of BPR activity and lower when there is a lower degree of BPR activity. In other words, BPR implementation and IT investment activity are complements

(Milgrom and Roberts, 1990) and more BPR investments increase the returns associated with technology investments. Specifically, they present evidence that BPR initiatives coupled with IT capital investments improves profitability of firms. This finding is in line with the theory of "business value complementarity" presented by Barua et al (1996), which implies that investments in IT and reengineering achieve higher performance when they are coupled and not when they are pursued in isolation.

Successful BPR initiatives can themselves be viewed as initiatives that require consideration of other complementary aspects, such as social, human, and technical aspects of process change. As Roy et. al argue (1998), it is important not to loose sight of the human and social aspects in BPR initiatives, if true gains in productivity are to be realized. To maximize chances of re-engineering success in improving firm performance in some dimension, they argue that it is important to jointly optimize two classes of interdependent variables – "organizational adequacy" variables, which are related to the social and human aspects of the organization and "technical adequacy" variables, which are related to technical aspects such as the efficiency of the production processes. For example, use of IT to redesign a process should be combined with redesign of human tasks to fully exploit individual worker potential and with techniques to minimize worker resistance to process change by carefully managing anxieties and expectations. Only joint optimization of these complementary variables can ensure the success of BPR in increasing performance.

Davern and Kauffman (2000) further underscore the importance of complementary assets in creation of potential value from IT and in impacting what they call "value-conversion contingencies." According to them, conversion from "potential IT value" to "realized IT value" is dependent on the satisfaction of several "value-conversion contingencies" that include investments in various complementary assets. They present several examples of generalized value conversion contingencies across multiple levels of analysis (2000, Table 1). For example, to realize maximum value from new software applications being introduced, firms need also to invest in a complementary asset, the infrastructure, which is needed to leverage and integrate the applications.

2.3 Coupling IT with specific management practices

Both Davern and Kauffman (2000) and Tallon, Kraemer, and Gurbaxani (2000) underscore the importance of management practices in realizing higher IT value. The involvement of senior management in making sure that adequate resources are allocated to the implementation of a new business application can be a key contingency in realizing value from the IT investment. Management practices that focus on aligning the IT investment strategy with the business strategy of the company (Henderson and Venkatraman, 1993; Woolfe 1993) and that encourage extensive IT investment evaluation will lead to higher values of perceived IT payoffs. Management practices can thus be viewed as a crucial complementary asset that can impact the realization of maximum value from IT.

The CEO or senior management can play a significant role in determining whether maximum performance gain can be obtained from IT. For example, CEO commitment to IT will enhance the effectiveness of implementation and use of IT (Henderson and Venkatraman, 1993), as adequate resources will be devoted to the adoption of IT and to its proper alignment with the business strategy (Kettinger et al., 1994). Neo (1988) similarly concludes that the organizational leadership of the firm can be a crucial factor that separates companies that successfully leverage IT from companies that fail at obtaining IT performance improvements. Ginsberg and Venkatraman (1992) identify the relationship between IT performance and CEO attributes. Keen (1993) also acknowledges that "management difference" can explain why some firms perform better than others, since some managers are better than others in "fitting" or coupling IT with the different complementary organizational and business resources.

2.4 Coupling IT with Organizational Culture

In a paper investigating the relationship between organizational culture and successful IT implementation, Harper and Utley (2001) identify five cultural variables that show a significantly positive correlation with successful IT implementation and five cultural variables that hinder successful IT implementation. Autonomy, trust, team-oriented work, flexibility, and free flow of information are shown to support success while cultural variables such as rigid rules, compliance, carefulness, preciseness, predictability are shown to be negatively correlated with success (Page 14). Sutherland and Morieux (1988) also imply that the right "fit" between the use of IT and organizational culture can be a determinant of the effectiveness and efficiency of firms. They argue that organizational culture can promote or hinder the adoption of new technology and

consequently impact the value that can be extracted from the technology. For example, an "IT phobic" culture can negatively impact firm performance because new technology is either not deployed or its correct use not properly understood and adopted. Powell and Dent-Micallef (1997) also show that the presence of cultural variables like open organization, open communications, and organizational flexibility that are complementary to IT lead to higher performance levels. They show that heterogeneity in firm performance can be traced to how well firms use IT resources to leverage complementary, though intangible, human and business resources. They identify six complementary human resources: open organization, open communications, organizational flexibility, organizational consensus, CEO commitment, and IT-strategy integration. The complementary business resources identified are supplier relationships, IT training, business process design, team orientation, benchmarking, and IT planning. They find that the complimentary human resources explain the performance differentials to a greater degree than do the complimentary business resources

2.5 Coupling IT with Organizational Learning

Organizational learning is defined as a process via which new organizational knowledge gets created (Slater and Narver, 1995). It can be viewed as consisting of four main parts – information acquisition, information dissemination, shared interpretation, and development of organizational memory (Tippins and Sohi, 2003). Much research has been done to show the positive relationship between organizational learning and firm performance (Day 1994; Slater and Narver 1995). Tippins and Sohi (2003) show that the relationship between IT competency and firm performance is mediated by "organizational learning." In other words, they show that IT affects firm performance not directly but indirectly through its effects on how an organization learns. For example, firms that effectively use IT to learn more about their customers and competitors can achieve better performance.

2.6 Coupling IT with Worker Composition

Francalanci and Galal (1998) present evidence of the impact of the combined effect of IT and worker composition on productivity. They define worker composition as the percentage distribution of managers who perform supervisory tasks, professional workers who perform specialized production-related tasks, and clerical workers, who perform administrative tasks.

They find that increases in IT coupled with increases in the proportion of managers lead to higher productivity levels. They also find that decreases in fraction of professional workers and clericals combined with increases in IT lead to higher productivity. This is consistent with theoretical predictions. Information processing theory provides support for decentralized decision-making as a way to increase the information processing capacity of an organization. As information processing requirements of an organization increase, firms tend to decentralize decision-making by increasing the number of self-contained, functional units (Galbraith 1973, 1977). This decentralization in response to increased requirements to do quick and unstructured decision-making leads to an increase in the managerial component of work or higher number of managers in the organization. At the same time, transaction economics tells us that decentralized decision-making makes it costlier to coordinate between units and agency theory tells us that decentralization increases the probability of opportunistic behavior that cannot be directly observed by the principal (i.e. the organization) (Jensen and Meckling, 1992). In other words, decentralized decision-making increases both transaction and agency costs. This is where IT can be extremely useful. As Francalanci and Galal point out (1998), IT can be useful in supporting and extending management control by increasing the monitoring that can be done. IT can also enable easier coordination between groups and independent units. Thus, it is expected that as the managerial component of the organization increases, higher use of IT can reduce transaction costs and agency costs and thereby increase productivity.

At the same time, IT has a deskilling effect on professional workers, in the sense that some of the routine tasks performed by professional staff can be substituted away by IT. Clerical workers performing mainly administrative roles face the greatest threat of substitution from IT. Consequently, it would be expected that increases in IT resources combined with decreases in professional workers and in clerical staff will lead to improvements in productivity levels.

Another theoretical lense, namely “self-attention” theory (from social psychology) (Carver & Scheier, 1981) also sheds some light as to how increasing the relative fraction of managers in an organization can increase organizational productivity. According to this theory, as the size of a subgroup decreases, the members of the subgroup become more self-attentive or more aware of their personal behavior. The increased focus on one’s personal performance may translate to higher overall productivity of the organization. Using the self-attention perspective, Mullen, Johnson, and Drake (1987) present evidence of this relationship between group

composition and organizational productivity. Specifically, they find that as the number of subordinates decreases in relation to the number of supervisors, organizational productivity improves.

3. Relationship of Organizational Assets/Intangible assets to Firm Performance

This section reviews the research on the impact of different organizational assets on firm productivity or performance. The six primary (possibly inter-dependent) organizational variables identified are human capital measured in terms of worker skills, education, and training levels, human resource management practices, connective capital, trust capital, knowledge capital and organizational culture.

3.1 Relationship between human capital (measured in terms of skills, education, training) and productivity

Black and Lynch (1996, 2001) find that human capital plays an important role in determining productivity. Specifically, they find that the average level of education in the firm is positively and significantly correlated with productivity in both manufacturing and non-manufacturing firms. They also find that although current training seems to reduce productivity, past training raises current productivity (1996). The lagged effect of training on productivity seems to be consistent with the analysis that as new skills are introduced into the workplace, there are initial adjustment costs, but after some time, the new skills learned lead to higher productivity (1996). In a separate study, Koch and McGrath (1996) find a positive relationship between investments in training and development of workers to labor productivity.

Black and Lynch also find that it is the content of training and not the number of workers trained that determine firm productivity (1996, 2001). Also, labor turnover is negatively correlated with productivity (1996). As Black and Lynch remark, factors like training and work practices like TQM (Total Quality Management) have a complex relationship to productivity and measures that take into account only incidence of these factors may not be sufficient to correctly capture their impact on productivity.

3.2 Relationship between human resource management (HRM) practices and productivity

Ichniowski et al. (1997) empirically document the complex relationship between human-resource management practices and productivity. They find evidence that while individual work practices may have no significant impact, clusters of complementary work practices are important determinants of productivity. Specifically, they find that a system that has a cluster of innovative work practices such as incentive pay, teams, flexible job assignments, employment security and training has higher productivity than a system with more traditional work practices such as narrow job definitions, strict work rules and hourly pay with close supervision. In a related paper (1999), Ichniowski and Shaw find evidence that systems of complementary HRM practices that promote employee participation such as problem-solving teams, rotation across jobs, extensive employee orientation, employment security policies, and profit-sharing based compensation improve a firm's economic performance. These empirical studies confirm the significance of systems of complementary work practices as predicted by theoretical research (Holmstrom and Milgrom, 1994, page 990) that advances the notion that work practices need to be analyzed "not in isolation but as part of a coherent inventive system."

Confirming the observation in (Black and Lynch, 1996) that mere incidence of work practices such as TQM does not have a significant impact on productivity, Black and Lynch (2001) find evidence that work practices that promote group decision-making are linked to higher productivity when combined with incentive-based pay, as predicted by economic theory. They find that unionized labor forces that have incentive-based pay and group decision-making have higher productivity than non-unionized labor forces or unionized labor forces with more traditional labor relationship management practices. This is consistent with the theoretical prediction that unionized labor forces should generally have higher productivity because employers incur lower costs in negotiating with employees by dealing directly with the union and also because employees are more willing to accept innovative work practices approved by the union.

3.3 Relationship between "connective capital" and productivity

Related to the notion of human capital, the notion of organizational capital, as a source of higher productivity, has been extensively studied. Ichniowski, Shaw & Gant (2003) relate higher levels of a form of organizational capital, that they call "connective capital," to higher productivity. Connective capital is defined as the stock of human capital that employees can

access through their connections to other workers. Connective capital is hypothesized to increase the ease of sharing of knowledge among workers. As the authors remark, connective capital has important positive externalities as workers getting access to knowledge possessed by other workers improve their own productivity. The acquired knowledge can in turn be shared with other employees. Work practices that increase the amount of connective capital by encouraging higher levels of employee participation and enabling richer communication links between the employees are found to lead to higher productivity levels. The authors hint at the important role "trust" can play in the process of building new worker relationships that can lead to increased knowledge-sharing and higher connective capital. The lack of trust between management and labor can indeed make it difficult for innovative work practices to be effective.

3.4 Relationship between trust capital and productivity

The notion of "trust" capital (another form of organizational capital) and its relationship to productivity has been investigated in a theoretical paper by Wintrobe and Breton (1986). They define this capital as "networks or lines of trust in one another" and remark that aspects of organizational structure affect the distribution of trust capital. A key result is that it is the distribution of trust and not the absolute amount of trust that is a determinant of productivity. The authors define two types of trust capital – vertical trust (between superior and subordinate) and horizontal trust (between subordinate and subordinate) and propose that "organizations differ in efficiency primarily because of differences among them in the amounts of vertical and horizontal trust." Specifically, high levels of vertical trust and low levels of horizontal trust are suggested to lead to rapid accumulation of physical and human capital that ultimately increase productivity. The authors further suggest that differences between levels of vertical trust and horizontal trust can be related to aspects of organizational structure such as turnover rate, promotion possibilities, availability and flexibility of non-contractual payments like perks.

3.5 Relationship between knowledge capital and productivity

As the knowledge economy takes shape, traditional tangible means of production become less important than knowledge workers in determining firm productivity. Dess and Picken (2000) underscore the importance of creating and sharing knowledge capital, an intangible asset, as a means to enhancing business productivity. Loof and Heshmati (2002) find that differences in

knowledge capital (operationalized using the ratio of innovation sales to total sales) explain differences in firm productivity levels and in productivity growth rates.

Knowledge capital is often generated by companies via the process of research and development (R&D). Many studies have found that higher investments in research and development lead to higher levels of productivity. For example, Grabowski and Mueller (1978) find that firms that invest heavily in R&D capital realize above-average returns and that heterogeneity in firm profit rates can be linked to differences in amounts of R&D capital. Similarly, Giriliches (1986) and Klette (1996) find that higher amounts of R&D lead to higher firm performance.

3.6 Relationship between Organizational Culture and Productivity

Organizational culture has been recognized as an important multi-dimensional variable in the determination of organizational performance. Different researchers have identified different numbers of dimensions of organizational culture – for example, Reynolds (1986) identifies 14 possibly inter-related dimensions, whereas Hofstede el al use six independent dimensions of organizational culture to compare firms . Marcoulides and Heck (1993) explain that organizational culture consists of three main dimensions: "a socio-cultural system of the perceived functioning of the organization's strategies and practices, an organizational value system, and the collective beliefs of the individuals working within the organization" (Page 212). A highly detailed "organizational cultural profile (OCP)" composed of 54 attributes has also been developed by O'Reilly et. al (1991).

Marcoulides and Heck (1993) operationalize the concept of organizational culture using organizational structure and purpose, organizational values, task organization, climate and worker attitudes. Organizational structure included the size and complexity of the organizational hierarchy and whether the organization focused on products or services. Organizational values included the amount of emphasis placed by organizations on professionalism, security of employees, productivity, and innovative research and development. Task organization included the strategies used by firm to recruit new employees, to evaluate performance and to provide employees opportunities to do stimulating work. Organizational climate included worker's perceptions of information flow mechanisms and how sensitive organizations were to the effects of stress on workers. Worker attitudes included the perceived importance among workers of

common courtesy, punctuality and commitment to the organization. The authors provide evidence that organizational performance is significantly affected by these organizational culture latent variables. The authors also mention that their results are consistent with previous research that has indicated a relationship between organizational culture and organizational performance (Hofstede et al, 1990).

In trying to explain the theoretical relationship between organizational culture and organizational performance, Wilkins and Ouchi (1983) use the transaction cost/agency cost perspective. They show that organizational culture can be used to bring individual goals/beliefs in congruence with the goals/beliefs of the organization and thus reduce the transaction costs associated with monitoring individuals. The influence of a strong organizational culture can induce otherwise self-interested individuals to form beliefs and act in a way that is in line with the organizational goals. This can reduce the need to implement measures to carefully monitor employees or evaluate their employees.

4. Key theoretical lenses

The following are some of the key theoretical lenses that are used to study how IT can lead to significant productivity or performance gains -

4.1 Resource-based View (RBV) and the "Strategic Necessity" Hypothesis

According to the resource-based view, differences in firm performance arise out of the heterogeneous distribution of resources among firms (Barney 1991, Tippins and Sohi, 2003). Firms that have unique or relatively scare, inimitable resources have a performance-advantage over firms that do not. According to this view, the mere presence of IT does not guarantee improvements in firm performance, as IT can be easily acquired by rival firms (Clemons and Row, 1991; Powell and Dent-Micallef 1997); however, when IT is coupled with other complementary organization-specific intangible resources, optimal performance gains can be realized. The observation that even though firms cannot expect to achieve a sustainable performance advantage through the deployment of IT, they must nevertheless invest in IT to be cost-wise competitive, is what is called as the "strategic necessity hypothesis" One possible way to make IT give a sustainable performance-related advantage is to embed it in the organization in such a way that maximally leverages the complementarities between IT and different organizational resources (Powell and Dent-Micallef, 1997). Also, co-specialization of

complementary resources (such that the resources have little or no value without the others) can also lead to a performance advantage that can be hard to achieve otherwise (Powell and Dent-Micallef, 1997).

4.2 Contingency Theory and the Concept of "Fit"

According to contingency theory, optimal firm performance can be obtained by using resources that are congruent or "fit" well with each other. Thus, when IT is combined with complementary (or in one sense "congruent") organizational resources, better performance can be realized. Specifically, the role of these other resources is that of a mediator (in the sense of "fit as mediation", see Venkatraman (1989)). Thus these resources can be viewed as a significant intervening mechanism that mediate the link between IT and performance. As Davern and Kauffman (2000) point out, extraction of maximum value from IT in terms of performance gain requires the satisfaction of what are known as "value-conversion contingencies." For example, extraction of full value from an ERP (Enterprise-Resource Planning) application deployment is contingent on the redesign of current business processes to take full advantage of the application.

4.3 Information Processing Theory, Agency Theory and Transaction Cost Economics

Information processing theory predicts increasing decentralization of work, as the information processing requirements of organizations increase. Higher decentralization leads to higher transaction costs in communicating and coordinating across groups and also higher agency costs in terms of increased monitoring costs. The higher transaction and agency costs can be circumvented by increased use of IT coupled with presence of organizational cultural attributes that promote open communication and free flow of information. IT can also be deployed to enable senior management or organizational leadership to efficiently communicate the goals of the organization to the employees and reduce moral hazard or opportunism on the part of employees and the resulting negative effect on productivity by bringing their goals in line with those of the organization.

5. Summary

Tables 1 and 2 summarize information presented in sections 2 and 3, respectively. Table 1 shows the different organizational factors that have been theorized or empirically shown to have a complementary relationship to IT in terms of their impact on firm productivity or

performance. Table 2 shows the different organizational factors that have been theorized or empirically shown to have a link to organizational productivity or performance.

IT and Workplace Organization	Brynjolfsson, Hitt, Yang (2002)
IT and Worker Composition	Francalanci and Galal (1998)
IT and Skills, Education	Bresnahan, Brynjolfsson, and Hitt (2002)
IT and BPR	Devaraj and Kohli (2000) Roy et. al (1998)
IT and Management Practices	Davern and Kauffman (2000) Tallon, Kraemer, and Gurbaxani (2000) Kettinger et al. (1994) Henderson and Venkatraman (1993) Keen (1993) Ginsberg and Venkatraman (1992) Neo (1988)
IT and Organizational Culture	Harper and Utley (2001) Powell and Dent-Micallef (1997) Sutherland and Morieux (1988)
IT and Organizational Learning	Tippins and Sohi (2003)

Table 1. Summary of studies that relate IT and different intangible organizational assets to firm productivity/performance

Human Capital (Skills, Education, Training)	Black and Lynch (1996, 2001)
HRM Practices	Ichniowski and Shaw (1999) Ichniowski et al. (1997) Black and Lynch (1996, 2001) Holmstrom and Milgrom (1994)
Connective Capital	Ichniowski, Shaw & Gant (2003)
Trust Capital	Wintrobe and Breton (1986)
Knowledge Capital	Loof and Heshmati (2002) Dess and Picken (2000) Klette (1996) Giriliches (1986) Grabowski and Mueller (1978)
Organizational Culture	Marcoulides and Heck (1993) Wilkins and Ouchi (1983)

Table 2. Summary of studies that relate different organizational assets to organizational productivity/performance

6. Conclusion

This paper has attempted to provide a comprehensive survey of the different organizational factors that are complementary to IT in their impact on firm productivity or performance. Also, a survey of the different organizational resources/practices that have been linked to organizational performance has been given to enable researchers to think about these factors, as they investigate which intangible assets or clusters of assets, possibly when coupled with IT, have the highest impact on firm performance. We hope that this survey will be useful not only to researchers but also to practitioners who want to know what factors to consider when implementing strategies to improve organizational performance.

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