TESTING THE TRANSFORMATION HYPOTHESIS OF INFORMATION AND COMMUNICATIONS TECHNOLOGIES (ICTS)

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Abstract

Purpose – This research examines whether the extent to which organizations use information and communications technologies (ICTs) is correlated with ICT investments and organizational characteristics, particularly within what is termed the "transformation hypothesis" of ICTs. The two goals are to: 1) test the hypothesis that ICTs provide clear, bottom-line benefits to organizations that use them, and 2) provide a subjective measure of ICT-intensity and benefits of ICT utilization.

Design/methodology/approach –Data were gathered via a survey instrument based in small part on Georgia Manufacturing Survey (Youtie, 2005, 2008) and the IT-Barometer (Samuelson, 2002, 2008; El-Mashaleh, 2007) to assess the level of ICT utilization in a region, rather than a sector, and the impacts of utilization. The survey was conducted via the internet, targeting organizations that made at least minimal use of ICTs. Respondents were recruited from a four county area in Georgia surrounding the Atlanta Metropolitan Statistical Area.

Findings – The results suggest the extent of ICT utilization (ICT-intensity) is positively correlated with reduced costs, increased revenues, and new sources of income. But, there is no significant correlation between ICT-intensity and ICT assets including broadband connections, computers, or support personnel, or between ICT-intensity and organizational characteristics such as organizational form, overall growth, or size.

Research limitations/implications – ICTs are critical for competitive organizations in dynamic macro-environments. The relationship between ICT benefits, quantity, and spending suggests that ICT-intensive organizations have higher quality ICTs, more fully integrated ICTs, and/or experiment with newer and more varied ICTs. Future research should overcome the limitations of this exploratory research and expand upon the small sample size. The research is limited in its definition of the characteristics that encompass ICT-intensity and additional research is needed to explore the relationship to productivity and profitability and other organizational characteristics, and to further validate and extend the transformation hypothesis of ICTs.

Practical implications – These conclusions are detailed and possibilities for future research are discussed. Implications for organizations and their use of information and communication technologies are provided.

Originality/value –Research in the determination of the relationship between ICT benefits and the intensity of ICTs in organizations is limited at best. This research adds value by providing information to fill this dearth of literature.

Keywords: Information, Communication, Technologies, Transformation Hypothesis, ICT Impact

Article Type: Research paper

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INTRODUCTION

The aim of this research is to determine the relationship between information and communications technology (ICT) benefits and the intensity of ICTs in organizations to expand the dearth of literature on ICTS. The rationale for investing in ICTs is that they are business tools, means for producing goods and services, and solutions that can make organizations more productive, profitable, and successful. This rationale is supported by research studying the general effects of investing in ICTs (Mahmood & Mann, 1993; Melville, Gurbaxani & Kraemer, 2007) and by research in various industries and with specific technologies (Mukhopadhyay, Rajiv, & Srinivasan, 1997; McAfee, 2002; Bartel, Ichniowski, & Shaw, 2007). ICTs require learning, and learning takes time, so the benefits from ICTs tend to lag costs. Productivity and other output tend to decrease immediately after deployment before rising above pre-ICT levels (Attewell, 1992; Nilsson, 1995; Greenwood, 1999; Lee & Barua, 1999; McAfee, 2002).

This research examines whether the extent to which organizations use information and communications technologies (ICTs) is correlated with ICT investments and organizational characteristics, particularly within what is termed the "transformation hypothesis" of ICTs. The two goals are to: 1) test the hypothesis that ICTs provide clear, bottom-line benefits to organizations that use them, and 2) provide a subjective measure of ICT-intensity and benefits of ICT utilization.

LITERATURE REVIEW

What factors determine whether ICTs increase performance and improve outcomes? Organizations that utilize ICTs tend to have integrated products and services, complex and informal structures, a melding of technical and manual jobs, and participative management (Burris, 1998; Wozny & Regli, 1996; Vizard & Neel, 2000; Black & Lynch, 2001). The more organizations invest in ICTs the smaller and less vertically integrated they tend to be, with closer working relationships with a relatively smaller set of suppliers (Reddi, Row, & Clemons, 1993; Brynjolfsson & Hitt 1994). Organizations in diverse, dynamic industries realize greater benefits from ICTs than those in highly concentrated, static industries (Melville, Gurbaxani & Kraemer, 2007) as do organizations in advanced economies as compared to those in developing countries (Tam, 1998). Clearly, there are contextual and cultural issues that impact the utilization of ICTs and that in turn are impacted by their use. Organizations must have a form and structure and be in an environment that enables them to capitalize on ICTs.

Organizations that are most successful with ICTs digitize their processes as well as their products (McAfee & Brynjolfsson, 2008). These organizations focus on non-routine information, delegating routine information tasks to their information systems (Martin, 1999) and they experiment with various types of ICTs (Haltiwanger, Jarmin, & Schank, 2003). They have small production runs, make frequent changes in production (Kelley, 1986; 1994), and have more customized products. They have higher skill requirements, particularly for problem-solving and technical skills, for executives and managers as well as workers, than companies that do not benefit from ICTs (Swanson 1994; King & Teo, 1994; Thong & Yap, 1995; Mata, Fuerst, & Barney, 1995; Burris,

1998; Bartel, Ichniowski & Shaw, 2007). The implication, which is not explicit in the literature, is that firms benefitting from ICTs are not low-quality commodity producers who compete solely on cost or price. Firms that benefit from ICTs are flexible, yet specialized firms, with highly collaborative and knowledgeable employees, that compete on the basis of relationships, quality, and uniqueness or differentiation.

The broad conclusions are that ICTs drive economic growth, particularly increases in labor productivity (Oliner & Sichel, 2000), but "the business value of computers is limited less by computational capability and more by the ability of managers to invent new processes, procedures and organizational structures that leverage this capability" (Brynjolfsson & Hitt, 2000, pg. 24). The quality of the information, services, and system determine the net benefits of ICTs and user satisfaction (DeLone & McLean, 2003), but the use must be appropriate to the competitive environment (Soh & Markus, 1995). Return on ICT investment is increased by assuring that executives, technologists, and users share reasonable assumptions and expectations for the technology and by having focused goals for ICT investment that align with the organization's strategic goals (Orlikowski & Gash, 1994; Tallon, Kraemer, & Gurbaxani, 2001)

Researchers (see for example, McAfee, 2002; Bartel, Ichniowski, & Shaw, 2007; Melville, Gurbaxani & Kraemer, 2007; McAfee & Brynjolfsson, 2008) suggest the competitive environment itself is experiencing fundamental changes enabled by ICTs. Popular press business books reiterate and expand this thesis. One of the earliest such books, *Re-inventing the Corporation* (Naisbitt & Aburdene, 1985), argued the very nature of organizations and work was going to change from the bottom up, driven by ICTs. The

predicted changes were not about ICTs. Many, such as fostering employees' personal growth and the paramount importance of quality, seem to have little to do with ICTs. It is a broader shift in the environment, enabled by ICTs, driving these changes. Naisbitt and Aburdene's (1985) predictions are borne out in ways that even they could likely not have imagined [as documented in books such as *A Whole New Mind* (Pink, 2005), *The Spider and the Starfish* (Brafman & Beckstrom, 2006), *Wikinomics* (Tapscott & Williams, 2006), *Here Comes Everybody* (Shirky, 2008), and *Tribes* (Godin, 2008)] by decentralized and open organizations that tap their customers' as well as their employees' capabilities to solve intractable problems, radically reduce costs, and create innovations and new knowledge that overturn markets and traditional market leaders as ICTs reduce the need for formal organizational structures.

The literature makes bold propositions about the impact of ICTs and suggests ICTs are not just tools for increasing productivity, or even for changing what is produced, although the use of ICTs is having these effects. ICTs are changing the way production is carried out and even the concept of what it means to produce in what is termed the 'transformation hypothesis" of ICTs (Baldersheim, Haug, and Ogard, 2009). Organizations that use ICTs to digitize processes and products will attract capital investment and customers. They will create economic opportunity and generate wealth. Those that do not use ICTs will not. But it is not enough to have ICTs. They must be integrated into the organization to the extent that they disappear even as they transform the organization. ICTs must become infrastructure (Star, 1999) for organizations to fully benefit from them, but organizations must fundamentally change the way they do business by eliminating hierarchy, opening up to customers, developing intangibles

assets, and, most of all, focusing on customer-defined quality. ICTs do not invariably lead to these changes but they enable such changes when coupled with willingness to learn and direction from disciplined, visionary leaders.

METHODOLOGY

Organizations chosen to participate in the study were located in Dawson, Lumpkin, Union, and White counties of Georgia, just outside the Atlanta, GA metropolitan statistical area. Firms were surveyed about their investments in and uses of ICTs. Specifically, as was suggested in the literature in ICTs, questions polled respondents on hardware, human, and software resources, ICT spending and spending trends, training and support, and benefits of and barriers to ICT utilization. The survey also addressed other relevant organizational factors: size (number of employees and locations), past and expected growth, strategic priorities, and location type (branch plant, headquarters, or single location).

For this research, a non-probability convenience sampling procedure was used. Data were gathered via a survey instrument, to assess organizational ICT utilization, types of ICTs and functions to which they were applied, along with basic organizational characteristics. It was based in small part on Georgia Manufacturing Survey (Youtie, 2005, 2008) and the IT-Barometer (Samuelson, 2002, 2008; El-Mashaleh, 2007), but was largely originally developed to assess the level of ICT utilization in a region, rather than a sector, and the impacts of utilization. The core of the survey are questions about the extent to which various functions are automated, about the extent to which employees use

particular ICTs in their work, and about the impacts of ICTs on costs, revenue, and innovation.

The survey was conducted via the Internet, targeting organizations that made at least minimal use of ICTs. Respondents were recruited from a four county area via e-mails sent by area Chambers of Commerce to their members, and via other local business and civic organizations. Respondents were also recruited during in-person meetings of these organizations and via their newsletters. Respondents were promised a summary report comparing their responses to others in their county and the region, but otherwise received no benefit from participating. The e-mails contained a universal resource locator (URL) to the online survey. The survey consisted of 29 questions, several of which had multiple parts. For example, the questions about automation of functions and use of technologies each had over ten items to rate.

An index of ICT-intensity was constructed from two Likert-type questions. One polled respondents about the extent to which various business functions were automated, from "does not exist" through "fully automated via online application." The "does not exist" responses were excluded from the index, and the other responses assigned ordinal values, 1 through 5. These values were averaged across all functions to create an automation measurement on a scale of 1 to 5. The other component of the ICT-intensity index was a question that asked respondents about their utilization of various technologies, from "rarely used by a few employees" through "regularly used by most employees." Non-response was interpreted to mean, "this technology is not used." The Likert-type response levels were assigned ordinal values from 1 through 5, and the responses were averaged across all technologies. The average level of use was multiplied

by the number of technologies that received some response (i.e., all technologies used by that respondent) and divided by the total possible sum (i.e., fully utilization of all technologies) to provide a utilization measurement on a scale of 0 to 1. The automation measurement and utilization measurement were then multiplied for a measurement of overall ICT-intensity, again on a scale from 1 to 5. ICT-intensity was analyzed in two ways, via correlation to other factors and by dividing the respondents into three groups based on ICT-intensity and comparing means for other factors.

Other factors of interest are ICT benefits, ICT skills, broadband connections, and website features. The survey featured nine items on ICT benefits, three each related to cost reduction, revenue increase, and creation of new income. All were rated on a five point Likert-type scale from strongly disagree to strongly agree, which were converted to a scale ranging from -1 to +1. Items were averaged to create indices for cost reduction, revenue increase, new income, and overall (average of all items) benefits. ICT skills were rated on a reverse scale from 1 (“excellent”) to 5 (“none”).

Respondents were polled about the number of various types of high-speed, always-on Internet connections within their organizations. The total number of connections was then divided by the number of full-time equivalent (FTE) employees. This is a somewhat problematic variable because it treats cellular telephone connections as equivalent to fiber optic connections. But it was impractical to ask about the bandwidth of connections respondents would be highly unlikely to know. So this variable simply acts as an indicator or proxy measure of connectivity. Personal computers and servers were treated similarly. Respondents were asked for the number of each,

regardless of performance characteristics, and those quantities were divided by the number of full-time equivalent employees.

The survey asked whether organizations had websites, and if so, which ten key features were part of the website. The number of features reported was divided by the total possible to provide an index of website functionality. These were yes/no responses, with no information about the performance of the website or its features. The ten features included: (1) Clients can access and update their account information; (2) Detailed information about your organization, including location and contact information; (3) Detailed information about your organization's products and/or services; (4) Electronic payment of bills, fees, invoices, purchases, etc.; (5) Interactive map(s); (6) Interactive query of the availability of goods and/or services; (7) Means for scheduling services and/or tracking order fulfillment; (8) Online, electronic forms for applying for jobs, ordering product or services, etc.; (9) Secure intranet (for employees) or extranet (for clients); and (10) Website activity measurement for monitoring.

Upon review by the research team, several responses contained information that was clearly inaccurate, such as more "employees providing ICT support" than "full time equivalent employees" or more "mainframes, servers, or other shared use computers" than "full time equivalent employees." Thus, several responses were dropped from the analysis due to concerns about their reliability.

RESULTS

This explanatory survey data provide some information on the level of intensity of ICT organizations and how ICT-intensity relates to key organizational characteristics. The correlation coefficients for ICT-intensity variables are provided in Table 1, where the significant variables at 95% confidence are marked by an asterisk (*). The strongest

correlations link to the various benefits of ICT (cost reductions, revenue increase, new income sources, and overall benefits) and particularly to "past ICT spending trends." Correlation coefficients of approximately 0.2 are found for indicators of size, connectivity, support, training, and ICT spending. Organization past growth, future growth, full-time equivalent (FTE) employees, locations, PCs per FTE employee, servers per FTE employee, Web features, and ICT skills all have weak correlation to ICT-intensity.

Insert Table 1 - Approximately Here

The responses were divided into three classes of high, medium, and low based on ICT-intensity. The classes were created by equally dividing the ICT-intensity data range, as shown in Table 2.

Insert Table 2 - Approximately Here

Only 108 of the 120 respondents provided responses necessary to calculate ICT-intensity indices. A comparison of means was conducted for several key factors, based on the null hypothesis of no difference between classes. The results of this analysis are summarized in Table 3.

Insert Table 3 - Approximately Here

The *t* statistics and *p*-values in the third and fourth columns of Table 3 are for tests of one class to the next, such that the values for "High" are in comparison to "Medium," those for "Medium" are in comparison to "Low," and those for "Low" are in comparison to "High." While there is an apparent difference between means for each

class for many of the variables, few are statistically significant at the 0.05 level of confidence. In table 3 the significant variables are marked by an asterisk (*).

Emphasized in bold text, there are significant differences in means for connectivity, cost, revenue, and new income benefits from ICTs, average number of ICT training days per employee, average ICT expenditures per employee, and past ICT spending trends. There was a significant difference in broadband connections per employee between medium and low ICT-intensity classes. The significant differences in means for ICT benefits were between low and high ICT-intensity classes and between medium and low classes for new income benefits only. Differences for training, ICT spending per employee, and past ICT spending trends were statistically significant among all ICT-intensity classes.

Tables 4, 5, 6, and 7 compare the ICT-intensity strategic priorities, barriers to ICT utilization, respondents' location type, and ICT approach. Table 5 shows the average ranking (forced rank order 1 through 6) of key strategic factors. Assuming respondents not providing data necessary to assign an ICT-intensity were lower ICT-intensity firms; these data suggest ICT-intensive organizations focus more on customization/flexibility, customer relationships, and quality. This supports the findings suggested by the literature (Mahmood & Mann, 1993; Melville, Gurbaxani & Kraemer, 2007; McAfee, 2002). Low ICT-intensity organizations were oriented more toward low prices and uniqueness. Customer relationships and product quality were the highest priority for all groups.

Insert Table 4 - Approximately Here

The barriers to ICT utilization data shown in table 5 suggest ICT-intensive firms perceive fewer or lower barriers to ICT utilization. In one area, the difficulty of replacing existing systems, the high ICT-intensity class perceives more of a barrier than the others. Lack of acceptance by personnel is also ranked higher than average for high ICT-intensity organizations than by medium ICT-intensity organizations. More telling, however, is low ICT-intensity organizations seem to face large barriers due to costs, management commitment, and potential reductions in efficiency.

Insert Table 5 - Approximately Here

The literature suggests ICT strategy, benefits from executive capabilities and organizational culture (Thong & Yap; 1995; Bartel, Ichniowski & Shaw, 2007; Oliner & Sichel, 2000). Data in table 6 suggests that headquarters in this study were more ICT-intensive than branch plants and both headquarters and branches were more ICT-intensive than single locations.

Insert Table 6 - Approximately Here

Table 7 shows an even greater difference in ICT-intensity between organizations implementing a standardized approach to ICTs and those following centralized or independent approaches. While these differences are not statistically significant, they suggest differences in strategic orientations toward ICTs, particularly if one assumes headquarters have more knowledge workers (who need high quality, more integrated ICTs to learn faster) and that standardized approaches toward ICTs reflect a flat, flexible, focused organization.

Insert Table 7 - Approximately Here

CONCLUSIONS AND DISCUSSION

ICT Quality, Integration, and Experimentation

The findings suggest the more ICT-intensive organizations spend more on ICTs, particularly on training, and realize more benefits from ICTs. The amount of ICT resources does not appear to differ significantly between classes, in spite of differences in ICT expenditures. High ICT-intensity organizations spend more on ICTs, but have fewer ICTs. They benefit more from ICTs, suggesting these ICT-intensive organizations have higher quality ICTs that are highly functional. Medium ICT-intensity organizations hold on to ICT assets longer, or buy less expensive and therefore less functional (fast, reliable) ICT assets. High ICT-intensity organizations may more fully integrate ICTs into their practices and structures as infrastructure. It is also possible ICT-intensive organizations "throw away" money experimenting with new ICTs to accelerate their learning about ICTs and thus realize benefits earlier. The quality, integration, and experimentation explanations all align with the transformation hypothesis that ICTs enable fundamental changes in the means and meaning of production.

Limitations

These conclusions must be tempered by limitations of the study including the sample size for high ICT-intensity. It used a convenience sample: members of Chambers of Commerce with e-mail and web access. This sample is inherently biased towards organizations that predisposed to participate in associations and surveys, and which may

have a more open culture and few norms against sharing information. Membership in a Chamber of Commerce may involve other systematic biases. Due to the means of publicizing and responding to the survey—both electronic, via e-mail and the worldwide web—respondents can be expected to be generally more technologically savvy and ICT-intensive than non-respondents.

Respondents were from a wide variety of industry sectors. Most sectors had only a few respondents, while others represented over 20% of the responses. Therefore, there may be a systematic bias due to line-of-business or other fundamental organizational characteristics. The high ICT-intensity class was one-third the size of the medium intensity class, which was half the size of the low intensity class. The within class variance for many of these statistics was relatively high.

Since the number of variable in Table 8 is very large, only the variables that are significant at 95% confidence are presented. The variables included FTE, sites, past and future performance, PCs, servers, and broadband per FTE, web features, cost, revenue, and new income benefits, training days and support per FTE, ICT expenditures per FTE, and finally past and future ICT spending trends. In all cases (high to medium; low to medium; and low to high ICT-intensity firms), past ICT spending trends are significant. Comparing the low to medium ICT-intensity respondents variables of significance also included training days, support per FTE, and future ICT spending trends. Finally in low-to-high ICT-intensity organizations significant variables included cost, revenue, and new income benefits again along with past ICT spending trends.

Nevertheless, the results of this exploratory study suggest some organizations are digitizing processes as suggested the literature to be competitive. ICT-intensive

organizations are not growing faster than other organizations, suggesting that ICT investment is a competitive imperative or qualifier rather than a growth strategy or order-winner.

Insert Table 8 - Approximately Here

Many of the broader operating transformations suggested by Naisbitt and Aburdene (1985), Pink (2005), Brafman and Beckstrom (2006), Tapscott and Williams (2006), Shirky (2008), and Godin (2008) are difficult to quantitatively analyze. It may be that such profound changes have not diffused to geographic areas on the fringe of larger metropolitan statistical areas such as those examined in this research. But, this research does show ICT-intensive organizations take more flexible and specialized approaches to production and have closer ties to customers. Given the functional characteristics of ICTs, is seems reasonable that flexibility and relationships would be important benefits ICT-intensive firms receive from their technology investments. This conclusion aligns with the initial transformation hypothesis.

IMPLICATIONS FOR PRACTITIONERS

This study has practical implications. Specifically firms should invest in quality ICTs, fully integrate them into the organization, and learn to use ICTs more effectively through experimentation. ICTs are critical for competitively pressed organizations. Concentrating on flexibility, including small production runs, frequent changeovers, customer relationships and product quality are necessary to make the most of ICTs. This has important implications for organizations that need numerous ICT assets, and may not

be able to afford quality or experimentation, especially organizations that produce large quantities of standardized commodities at low prices. It may be that ICTs are more difficult to absorb into such organizations. It is also possible that commodity producers do not have the capabilities, connections, or vision necessary to fully adopt ICTs. A general strategy for economic development might be to support the high ICT-intensity organizations but assist the medium ICT-intensity organizations learn about and integrate ICTs to transform their operations.

This research provides some validity for an index of ICT-intensity and for the subjective measures of ICT benefits. These two key variables seem to be meaningfully related to each other and to ICT investment. The relationship between ICT benefits, quantity, and spending suggests ICT-intensive organizations have higher quality ICTs, more fully integrated ICTs, and experiment with newer, more varied ICTs. This research provides suggestions of how ICT-intensity is related to other organizational characteristics and factors support the finding of other research and align with the transformation hypothesis.

Further research is needed to analyze ICT-intensity and ICT benefits and control for organizational factors, reduce systematic bias and reliability issues, and relate these measures to qualitative transformation in operations. Further research should more clearly define characteristics that encompass ICT-intensity, to explore its relationship to productivity and profitability and other organizational characteristics, and to further validate and extend the transformation hypothesis of ICTs.

These findings are also important for practitioners. More technology is not necessarily better. It is not how much you technology have, but it is how you use the

technology to automate and transform processes. This requires learning and experimentation with the technology. However, this is another cost because the experimentation requires additional time and effort. Instead of tactically buying technology, to obtain the maximum benefits is to strategically invest in ICT. Technology expenditures should be planned and executed to increase knowledge about how to use ICTs, as well as improve the overall value chain.

While this advice primarily applies to business practitioners, it also has implications for economic development. Economic development must facilitate this process by assisting organizations finance and maximize their return on their investments and learning from ICTs by special financing mechanisms to pay for learning processes (as opposed to training) and by facilitating cross-organizational collaboration for technology learning.

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Table 1 - Correlation of Key Variables to ICT-Intensity, *N* = 120

key organizational characteristics	*Correlation to ICT-intensity*	*P-value*
Past growth	0.10	0.091
Future growth	0.08	0.077
FTE employees	0.18	0.053
Locations	0.06	0.112
PCs per FTE employee	0.17	0.059
Servers per FTE employee	0.01	0.112
Broadband connections per FTE employee	0.20	0.048*
Web features	0.11	0.772
Cost benefits	0.34	0.026*
Revenue benefits	0.31	0.041*
New income benefits	0.37	0.037*
Overall benefits	0.37	0.000*
ICT skills	0.08	0.067
Training days per year	0.19	0.055
Support employee per FTE employee	0.18	0.081
ICT expenditures per FTE employee	0.21	0.055
Past ICT spending trend	0.44	0.032*
Future ICT spending trend	0.18	0.061

* Significant at $\alpha = 0.05$.

Table 2 - ICT-Intensity Class Definition, *n* = 108

	ICT-Intensity		
	Upper	Lower	Size
High	3.18	2.15	11
Mid	2.15	1.11	34
Low	1.11	0.07	63
Total			108

Table 3 - Difference of Means Test Results Summary

	ICT-intensity	Mean	*t* statistic	*p*-value
Past growth	High	0.16	0.85	0.40
	Medium	0.09	-0.25	0.80
	Low	0.07	1.02	0.31
Future growth	High	0.19	0.71	0.48
	Medium	0.14	0.01	0.99
	Low	0.14	-0.86	0.39
FTE employees	High	46.27	-0.12	0.91
	Medium	51.85	-1.89	0.06
	Low	12.48	-1.92	0.06
Locations	High	1.45	-0.49	0.63
	Medium	1.88	-0.57	0.57
	Low	1.56	0.14	0.89
PCs per FTE employee	High	1.42	-0.62	0.54
	Medium	1.78	-1.81	0.07
	Low	1.22	-0.53	0.60
Servers per FTE employee	High	0.35	-0.08	0.94
	Medium	0.37	0.18	0.86
	Low	0.40	0.19	0.85
Broadband connections per FTE employee	High	1.57	-0.52	0.60
	Medium	2.14	-1.99	**0.05***
	Low	1.12	-1.09	0.28
Web features	High	0.39	-0.89	0.38
	Medium	0.46	-1.96	0.05
	Low	0.37	-0.22	0.83
Cost benefits	High	0.58	1.47	0.15
	Medium	0.33	-1.73	0.09
	Low	0.16	-2.72	**0.01***
Revenue benefits	High	0.61	0.89	0.38
	Medium	0.47	-1.93	0.06
	Low	0.27	-2.06	**0.04***
New income benefits	High	0.53	1.07	0.29
	Medium	0.35	-2.90	***0.00**
	Low	0.04	-2.99	***0.00**
Training days	High	6.55	-0.88	0.39
	Medium	11.06	-2.75	**0.01***
	Low	4.11	-1.14	0.26
Support employee per FTE employee	High	0.36	-0.28	0.78
	Medium	0.42	-1.29	0.20
	Low	0.28	-0.64	0.53

	ICT-intensity	Mean	*t* statistic	*p*-value
ICT expenditures per FTE employee	High	2,315.10	0.32	0.75
	Medium	1,967.72	-2.80	**0.01***
	Low	984.98	-1.42	0.16
Past ICT spending trend	High	0.22	2.55	**0.02***
	Medium	0.09	-2.60	**0.01***
	Low	0.03	-5.31	**0.00***
Future ICT spending trend	High	0.09	0.48	0.64
	Medium	0.06	1.14	0.26
	Low	0.04	1.35	0.18

*Significant at 95% confidence

Table 4 - Strategic Priorities by ICT-Intensity
(Forced Ranking, 1 = "Most Important" Through 6 = "Least Important")

ICT-intensity	Low cost to customer	Customization, flexibility	Rapid fulfillment, responsiveness	Unique product/ service	Highest quality	Customer relationship
High	4.40	3.56	4.10	4.50	2.70	1.10
Medium	4.14	3.93	3.87	4.63	2.48	1.24
Low	3.67	4.15	3.65	3.82	2.78	1.38
None indicated	3.13	3.71	3.50	3.78	2.75	1.88
Overall	3.84	3.99	3.75	4.11	2.68	1.35

Table 5 - Barriers to ICT Utilization
(Reverse Ranking 1 = "Major Barrier" Through 3 = "Not A Barrier")

	Continual demand for upgrading	Difficulty of replacing existing systems	Greater know-how required from IT staff	Investment costs too high	Lack of acceptance by personnel	Lack of commitment from management	Risk that IT leads to inefficiency
High	2.00	1.82	2.10	1.73	2.36	2.64	2.80
Medium	1.85	1.85	1.94	1.45	2.58	2.70	2.61
Low	1.98	1.88	1.98	1.60	2.35	2.49	2.41
Overall	1.94	1.86	1.98	1.56	2.42	2.58	2.52

Table 6 - ICT-Intensity by Location Type

	Average of ICT-intensity
Branch plant	1.25
Headquarters	1.31
Single location	1.07
None indicated	0.24
Overall	1.10

Table 7 - ICT-Intensity by ICT Approach

	Average of ICT-intensity
Centralized	1.05
Independent	1.07
Standardized	1.53
None indicated	0.71
Overall	1.10

Table 8: Details of Difference of Means Tests – Significant Variables

Variable	Class	Mean	Variance	Obs.	t Stat	p-value
Difference of Means: High ICT-intensity to Medium ICT-intensity						
ICT spending trend past	Hi ICT	0.22	0.03	10	2.55	0.02
	Mid ICT	0.09	0.01	29		
Difference of Means: Low ICT-intensity to Medium ICT-intensity						
Training days	Low ICT	0.04	0.24	57	(2.90)	0.00
	Mid ICT	0.35	0.22	33		
Support per FTE	Low ICT	4.11	43.69	55	(2.75)	0.01
	Mid ICT	11.06	277.87	32		
ICT spending trend past	Low ICT	984.98	1,920,513.38	38	(2.80)	0.01
	Mid ICT	1,967.72	1,881,101.89	26		
ICT spending trend future	Low ICT	0.03	0.01	49	(2.60)	0.01
	Mid ICT	0.09	0.01	29		
Difference of Means: Low ICT-intensity to Hi ICT-intensity						
Cost benefits	Low ICT	0.16	0.21	58	(2.72)	0.01
	High ICT	0.58	0.30	11		
Revenue benefits	Low ICT	0.27	0.26	57	(2.06)	0.04
	Hi ICT	0.61	0.22	11		
New income benefits	Low ICT	0.04	0.24	57	(2.99)	0.00
	Hi ICT	0.53	0.29	11		
ICT spending trend past	Low ICT	0.03	0.01	49	(5.31)	0.00
	Hi ICT	0.22	0.03	10		

(Only variables significant at α = 0.05 are better are included)