



## **Inter-Organizational Information and Communication Technology (IICT) in the Customer Interface**

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## **Abstract**

### Purpose

To investigate four dimensions of customer interface IICT adoption: 1) impact on internal business process efficiency, 2) impact on customer relationships, 3) impact on information diffusion with customers, and 4) impact on competitive position.

### Methodology

The sample frames for the study were the 250 largest companies by 2004 sales from four U.S. manufacturing industry sectors; two representing lead IICT adopters (chemicals and food) and two representing sectors with low adoption rates (paper and wood products). Marketing executives were selected as informants. The research was conducted using mail surveys conducted in accordance with the Tailored Design method developed by Dillman.

### Findings

Results indicate that customer interface IICT adoption can improve information sharing with customers, reduce operational inefficiencies along the value chain, enhance competitive position on the market, and deepen customer relationships. Business impacts were perceived to be positive across all tested constructs.

### Research Limitations

Results are based on respondents' subjective opinions and not underlying objective measurements of IICT impact. In addition, the research was limited to customer interface IICT and only four industry sectors were investigated. Third, despite previous research findings that marketing executives are often responsible for eBusiness implementation in the customer interface, future research could consider other informants.

### Practical Implications

When Inter-organizational Information and Communication Technology (IICT) implementation is properly managed, IICT can help manage the flow of goods, services, and information between business partners in the supplier-customer dyad, thus reducing transaction costs.

### Originality

Although the literature provides research results for impacts of various inter-organizational information technologies in buyer/supplier dyads, this paper is unique in that it examines four IICT impact constructs specific to the business/customer interface.

**KEYWORDS:** Information and Communication Technology (IICT), Business to Customer Interface, Relationships, Competitive Positioning

Category: Research Paper

## Introduction

When implementation is properly managed from the technical, but more importantly from the business perspective, Internet-based information technologies (IT) can help manage the flow of goods, services, and information within and between organizations, thus reducing transaction costs along the entire value chain (Clemmons and Row 1991). Armstrong and Sambamurthy (1999) argue that effective application of IT supports, shapes, and enables business strategies and value-chain activities. According to Bharadwaj (2000) firms with a high level of IT capability tend to outperform rivals on a variety of profit and cost-based performance measures. Possibilities for achieving competitive advantage in the context of IT capability have been suggested by Porter and Millar (1985) (in Bharadwaj et al. 1993). They suggested that an innovative IT system can provide a company with competitive advantage by: 1) enabling companies with new ways of doing business; 2) lowering cost of doing business; 3) improving ability to quickly respond to market shifts; 4) differentiating or customizing the value offer; 5) improving service quality; 6) outperforming competitors by extended value offerings; and 7) building switching costs and barriers to entry. Srivastava et al. (1999) argue that product development, supply chain management, and customer relationship management are the three core marketing embedded business processes that generate value for customers. IT resources and capabilities can be used to support all of these processes. Collaborative platforms over the Internet can be used in product development connecting functions and organizations to jointly manage, evaluate, and provide product development feedback. IT and Internet tools have taken supply chain management to a new level of efficiency with up-to-date information flow through the supply chain and real time information integration into business processes and workflows. Information system applications for customer relationship management keep track on customer transactions and profitability supporting strategic customer management.

Anandarajan et al. (1998) segment Internet technology benefits into three categories: strategic, operational, and marketing/tactical. This classification directs attention and investigation of the effects of information and communication technologies in the customer interface to a strategic level in the context of generic competitive strategies, to the operational level with linkages to value-chain activities, and to a marketing/tactical level as a potential tool for gaining competitive advantage. However, while many firms are making significant investments in IT, not all have been able to successfully integrate IT into their value-chain activities and business strategies (Harper and Utley 2001; Armstrong and Sambamurthy 1999; Clegg et al. 1997). Many companies have experienced a significant learning curve and initial drop in productivity as they try to initiate and deploy new IT initiatives (Harper and Utley 2001). Clegg et al. (1997) found that 80-90 percent of IT investments in general do not meet performance objectives.

Inter-organizational Information and Communication Technology (IICT) describes Internet-based (or proprietary) inter-organizational information technologies in the supplier-customer exchange dyad. IICT facilitates inter-organizational communication, commerce, collaboration, and integration. IICT can be regarded as a valuable resource because it enables firms to capture and implement customer interface strategies and operations that improve efficiency and effectiveness by either reducing firm costs or differentiating products, services, or relationships. Mizik and Jacobson (2003) argue that companies can achieve competitive advantage through value creation or value appropriation. IICT adoption can enhance value creation by enabling business process innovation and providing value-added services. IICT

adoption may mitigate value appropriation by improving operational efficiency, deepening relationships, and erecting entry barriers through virtual integration with exchange partners.

Many companies have had difficulties in measuring the costs, benefits and return on investment (ROI) associated with IICT implementation (Ling and Yen 2001; Hamill 2000). Although returns on IICT investment are often difficult to estimate, staggering ROIs and payback periods have been documented: 1,700 percent ROI within the first year of an intranet implementation; 1,522 percent ROI with annual cost savings of \$33.7 million for a large retail chain that implemented extranets (Anandarajan et al. 1998). However, these results need to be treated with caution because the numbers are largely based on estimation instead of hard financial data. Furthermore, as Anandarajan et al. (1998) note, “Even though the company has implemented an extranet, any improvements in profit cannot be directly attributed to the implementation of the extranet technology. It could be attributed to a wide variety of market factors.” Due to the difficulties in objective IICT performance assessment this research relies on executive (subjective) judgment in identifying and isolating the specific effect of IICT adoption on variety of business activities and outcomes.

Drawing from the Anandarajan et al. (1998) segmentation of Internet technology benefits, this study investigates the business impacts of customer interface IICT adoption in terms of operational (value chain) and tactical (customer relationship) outcomes. The investigation is limited to the effects of IICT implementation in the customer interface. In this study, IICT includes Electronic Data Interchange (EDI), extended mark-up language (XML), extranets, eMarketplaces or other eIntermediaries, and corporate websites.

The overarching goal of is to identify how business-to-business customer interface IICT impacts suppliers’ business activities and outcomes that translate to business performance. We look at the activities and outcomes that are affected, and investigate the direction of impact, i.e. does IICT implementation have a positive/negative impact on business performance. By doing this, this study provides managers and academicians with a framework to examine business impacts from IICT implementation, which could, in turn, be used in setting objectives for customer oriented IICT implementation project management.

The article will go through the following steps. First, a conceptual research framework is presented, discussed, and hypotheses are specified. After the theoretical discussion, an overview of the study methodology is presented, followed by research results. Research results describe respondent characteristics, IICT adoption patterns and objectives and IICT impacts.

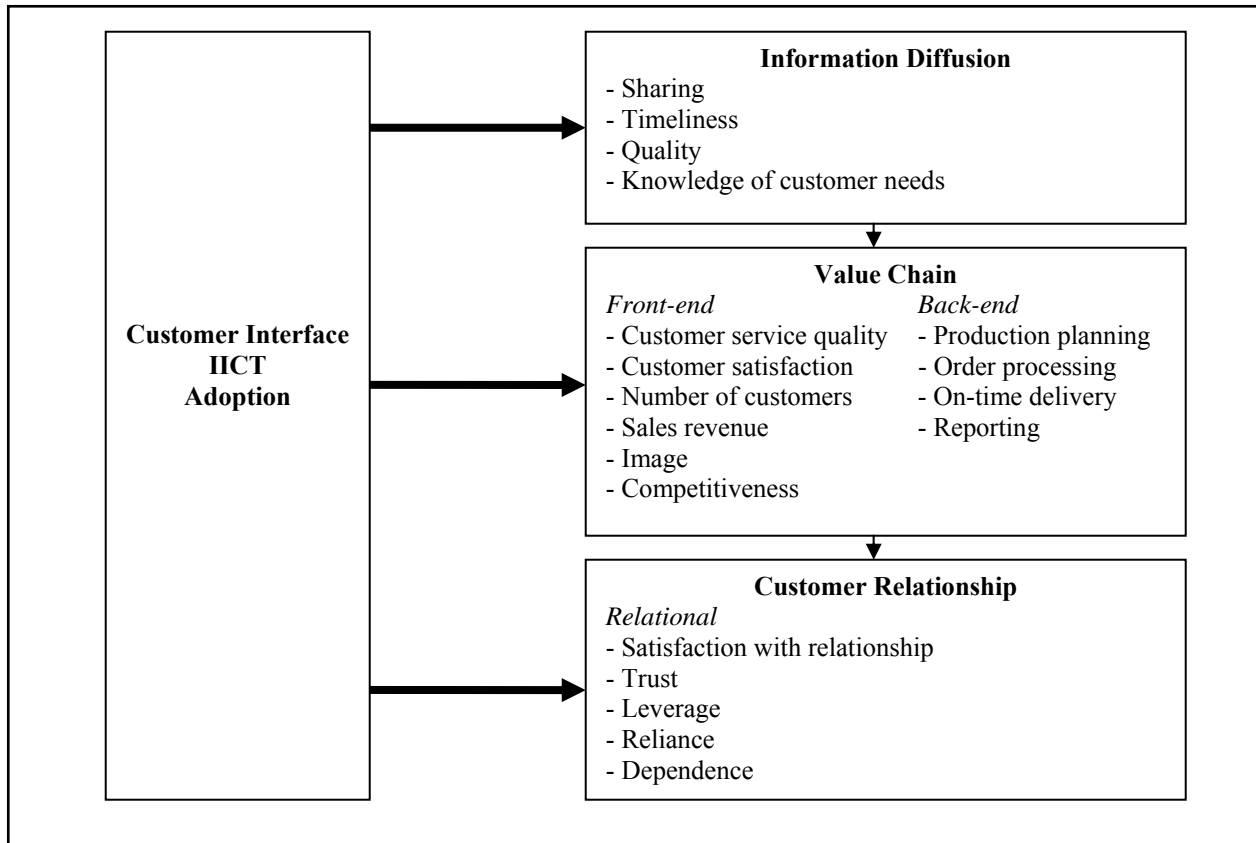
## **A Framework of IICT Business Performance Impacts**

There is empirical evidence to indicate that firms with high IT capability tend to outperform rivals on a variety of profit and cost-based performance measures (Bharadwaj 2000). This study attempts to identify and classify customer interface IICT adoption effects on business activities and outcomes from the supplier’s perspective in business-to-business markets. The potential impact of IICT on business activities and outcomes that contribute to business performance is approached by investigating potential effects on information diffusion, value chain activities between exchange partners and on customer relationships. **Figure 1** describes the conceptual model of customer interface IICT adoption on business activities and outcomes. The model is discussed in detail and hypotheses are presented in following sections.

First, we discuss IICT adoption impact on information dissemination between suppliers and their customers. Second, impacts on internal business operations are examined in the context of Porter’s value chain framework (Porter 1985) and, finally, impacts on customer relationships

are discussed in terms of IICT ability to fortify customer relationships both through increased satisfaction and lowered switching costs.

**Figure 1. Customer interface IICT adoption impact on business activities and outcomes**



### ***IICT Impact on Information Diffusion***

Information has become the unit of exchange, a source of competitive advantage (Vargo and Lusch 2004) and a primary wealth-creating asset (Achrol 1991). Information and information management has become the vehicle for success in business. The Internet and IICT have not only changed the way companies communicate with business partners but, for many, have become a requirement for business survival. In order to be competitive in today's networked business environment, companies must be able to deliver up-to-date information to customers, as well as to others along the supply chain.

Afuah and Tucci (2003) describe the Internet as a mediating technology that facilitates information exchange among parties distributed in time and space; a time moderator that allows instant and 24/7 access to information; and an information asymmetry shrinker that increases overall information access. IICT, typically facilitated by an Internet platform, enables faster preparation, transferring, and processing of order management documents, as well as market information. In a case study by Anandarajan et al. (1998) extranet adoption enhanced customer service through improved access to information that customers need for decision making and planning; decreased lead times and improved operations planning resulted from the extranet

launch and adoption. Additionally, IICT applications provide effective tools to gather and process information about customers, suppliers, and their market behavior.

Information dissemination variables in the model include customer interface IICT impact on: amount of information shared; timeliness of information exchange; quality of information shared; and understanding of customer needs. The following hypothesis was formulated to test the nature of customer interface IICT impact on information dissemination with customers:

H<sub>1</sub>: IICT implementation is perceived to have a positive impact on information diffusion with customers.

### ***IICT Impact on Value Chain Activities***

The potential impact of IICT on business activities and outcomes that contribute to business performance can be approached through Porter's value chain (Porter 1985). Past research has argued numerous benefits and ways IICT may improve business efficiency along the value chain. Primary value chain activities which have been argued to gain from IICT, include: operations, which include activities required transforming inputs into outputs; outbound logistics, which include activities required to collect, store, and distribute the output; marketing and sales, which include activities to inform buyers, induce and facilitate the purchase of products and services; and service, which include activities required to make the product or service work effectively for the buyer during and after it is sold and delivered.

Ling and Yen (2001) argue that implementing IICT in the customer interface can simplify front-end value chain workflows in sales and customer service and support (Ling and Yen 2001). In a case study by Anandarajan et al. (1998), IICT application adoption enhanced customer service through improved access to information. IICT applications can offer important marketing tools and platforms for providing value-added services, such as inventory visibility, delivery tracking, on-line chats, reporting tools, and customized user interfaces. Each purchase event can be customized and every sale standardized (mass customization) through IICT utilization contributing to service quality. Anandarajan et al. (1998) also found that IICT implementation enables organizations to win new business as well as retain existing customers, hence supporting the sales functions. IICT applications can drive down customer related transaction cost by reducing time and effort required to customer transactions, in addition to reducing customer acquisition cost. In another case study documented by Chan and Davis (2000), a large U.S. electronics distributor was able to double their sales and profits by extranet implementation, while the sales staff was reduced by 9 percent.

Anandarajan et al. (1998) argue that employing IICT may also lead directly or indirectly to an enhanced corporate image. In support of this argument, Vlosky et al. (2000) conclude that extranet partners are perceived to be more "cutting edge", customer orientated, and more committed to long-term relationships. IICT adoption has the potential to improve market and customer knowledge through open and timely shared information, which not only can reduce marketing costs but can greatly improve back-end operations and outbound logistics along in the value chain.

"The focus in supply chain management has shifted from engineering efficient manufacturing processes to the coordination of activities in supply chain networks through knowledge management" (Tan et al. 2000). In the past, manufacturers often estimated future demand based on previous consumption. However, fluctuating order patterns made this method inaccurate and resulted in operational inefficiencies and high stock-levels. Virtual integration

facilitated by IICT allows for incorporation of timely and accurate data into the production planning and control systems (Anandarajan et al. 1998; Vlosky et al. 2000). By sharing manufacturing schedules, production capacity information, and consumer demand information, companies are better able to coordinate and streamline production, logistics, and other operations in the value chain (Tan et al. 2000). Thus, IICT integration has potential to reduce the excess inventory building bullwhip effect caused by lack of accurate upstream demand information.

Implementing IICT in the customer interface can simplify workflows and lead to significant reduction in costs related to production scheduling, material handling, inventory management, and order processing (Ling and Yen 2001; Anandarajan et al. 1998). Programs such as just-in-time delivery (JIT) and continuous replenishment (CRP) rely on the dissemination of scheduling, production, and shipment information between business partners (Tan et al. 2000; Vlosky et al. 2000).

The impact of IICT adoption in the customer interface is explored in terms of following front-end and back-end value chain activity outcomes: sales revenue, number of customers, customer service quality, customer satisfaction, image, company competitiveness, production planning efficiency, order processing efficiency, on-time delivery, and timely management reporting. The following hypothesis was formulated to test the nature of customer interface IICT adoption business impact on organization's value chain activities and activity outcomes:

H<sub>2</sub>: IICT implementation is perceived to have a positive impact on value chain activities and outcomes.

### ***IICT in Exchange Relationships***

In the 21<sup>st</sup> century "Network Economy", business relationships are often facilitated by IICT, hence IICT plays an important role in supplier-customer relationships. IICT adoption may mitigate value appropriation by deepening relationships and erecting entry barriers through virtual integration with exchange partners. Since the 1980's, relational marketing exchange has evolved to be a dominant paradigm in the marketing literature. Relational exchange develops over time; considers both history and future; is based on assumptions on expected behavior; builds on trust, commitment, and joint effort; and includes both economical and social satisfaction (Dwyer et al. 1987). There is wide consensus that relationship strength is a driver to increase customer satisfaction, erect market barriers, lower transaction and operations costs, and earn higher returns both for suppliers and buyers (Gundlach and Murphy 1993; Narayandas and Rangan 2004). According to Arndt (1979) reduced uncertainty and transaction costs, synergies of integrating operations, and opportunities in political economies of scale to shape and control the market motivate relational market structures. The value of a relational exchange hinges on ex ante coordination and information management. Consequently, the role of information and information processing capabilities has increased its importance. As a supplier's information system becomes integrated with a customer's information system, or even when a customer learns to use and utilize the IICT application provided by a supplier, it becomes more difficult and expensive for the customer to change suppliers due to switching costs and asset specificity.

Anandarajan et al. (1998) argue that IICT can increase an organization's ability to win and retain customers as well as deepen business partnerships and collaboration. IICT enables efficient and effective market monitoring, faster reaction time, or even a proactive approach to change in customer demands or markets. In a study by Cannon and Homburg (2001), the authors hypothesized that open information sharing between supplier and customer in the business-to-

business context would lead, via decreased acquisition and operation costs, to increased customer intention to expand purchases from the supplier. Internet-based technologies provide excellent tools for the relationship management function to gather information about customers and their exchange behavior. This enables opportunities for targeting in terms of products, services, and prices. Further, sales representatives are able to move from routinized work to establishing closer customer relationships (Vlosky et al. 2000).

Not all IICT-facilitated business relationship outcomes are positive. For example, as business partners' information systems are integrated, it becomes more difficult and expensive to lose customer accounts, consequently increasing dependence. In addition, IICT can diminish information asymmetry between suppliers and buyers, generally shifting power from suppliers to customers (Porter 2001). Suppliers are facing a more knowledgeable customer base than ever before due to increased information availability and reduced information search costs.

Supplier satisfaction with customer relationships, trust in customers, reliance and dependence on long-term customer relationship, and supplier leverage in the relationship are the relationship variables investigated in this research. The following hypothesis was formulated to test the nature of customer interface IICT adoption impact on customer relationships:

H<sub>3</sub>: IICT implementation is perceived to have a positive impact on customer relationships.

## **Research Methodology**

This study, conducted in spring 2006 investigates IICT impacts on four U.S. manufacturing sectors; two sectors were identified as having well established IICT capabilities and two sectors are considered to be laggards. The intent is to represent average IICT adoption effectiveness. The sample frames for the study were the 250 largest U.S. companies (by 2005 sales) from the following manufacturing sectors: Leaders-chemicals (NAICS 325) and food (NAICS 311), and Laggards-paper (NAICS 322) and wood products (NAICS 321). Percentage of shipments by industry sector conducted using eCommerce was used as a proxy as an indicator of IICT participation.

Chemical and food manufacturing ranked 2<sup>nd</sup> and 4<sup>th</sup>, respectively, with regard to share of eCommerce shipments across 21 U.S. manufacturing sectors (U.S. Census Bureau 2005). Chemical industry eCommerce represented 10 percent of total sector shipments and for the food sector, seven percent of shipments were facilitated using eCommerce. Conversely, the paper industry was ranked 11<sup>th</sup> and the wood products industry was ranked last with two percent and 0.7 percent of total shipments using eCommerce, respectively.

Marketing executives were identified by Srinivasan et al. (2004) as frequently being responsible for eBusiness implementation decisions. Due to their responsibilities, they were presumed to possess the most accurate assessment of IICT impact on business activities and outcomes. Accordingly, marketing executives were selected as the informants in this study.

The research was conducted using mail surveys. In general, survey procedures, follow up efforts, and data analysis were conducted in accordance with the Tailored Design method developed by Dillman (2000). In order to ensure that the questionnaire was appropriately designed to collect the desired information, it was pre-tested with a selected convenience sample of 20 marketing research and industry experts. Face validity of the questionnaire constructs were assessed by establishing consensus among the experts that the survey instrument completely and comprehensively covered the concepts that it intended to measure.



## Results

Accounting for undeliverables and inappropriate companies, the adjusted survey sample size of 886 yielded a 12 percent adjusted response rate, i.e. 106 usable returns were received. Given that typical response rates for industrial studies range from 15 to 30 percent (Adams 1986; Donald 1960) the response rate is somewhat low, but is deemed acceptable considering the often lower response rates in studies investigating eBusiness in the business-to-business context (e.g. Chuang and Shaw 2005; O'Leary 2003; Kallioranta 2003; Vlosky and Pitis 1999).

Overall, missing data was infrequent and random throughout the questionnaire, thus mean replacement was chosen as the imputation option (Hair et al. 1998). The test statistics did not indicate significant group mean differences between the early and late respondents at  $\alpha=0.05$  level. Hence, no evidence of non-response bias was found and the research results are considered to be generalizable to the sample frames.

### ***Respondent Characteristics***

Of the 106 respondents, 49 percent were in paper and wood products manufacturing sectors and 51 percent were chemical and food manufacturing respondents. A majority of respondent companies were medium-size companies with 2005 corporate sales revenue between ten and five-hundred million dollars (65 percent). Smaller companies with 2005 revenue less than \$10 million (16 percent) and large corporations with corporate revenue more than \$500 million (19 percent) were also represented.

Overall, 90 percent of respondents said they had implemented the IICT applications of interest in this study (website, extranets, eMarketplaces or eExchanges, or direct virtual integration) in customer interface. Allowing for multiple responses, the most widely used IICT application was company website (85 percent of respondents), followed by extranets (43 percent), peer-to-peer (P2P) integration with customer information systems (35 percent), and use of eIntermediaries to transact with customers (15 percent).

Respondents who had implemented IICT were asked which business objectives were the primary motivators for IICT implementation. Improvement in customer service (78 percent) and deepening existing customer relationships (60 percent) were the most cited motivators for customer interface IICT adoption (**Table 1**). Both of these objectives are aligned with the general objective of Porter's (1985) differentiation business strategy to provide unique and superior value to customers. Sources of value may include product quality, special features, distribution, and service. Differentiation strategy emphasizes innovation, brands, marketing, and new product development (Grant 1991). The next three most cited IICT adoption objectives; reach new customers (54 percent of respondents), reduce transaction cost (38 percent), and improve operational efficiency (38 percent), are closely aligned with the criteria of Porter's (1985) cost leader strategy. Cost leadership stresses scale, low cost inputs, and improving efficiency in the production process (Grant 1991). Typically, businesses with a cost leader strategy avoid expenditures that are not directly associated with the production and distribution of a competitive product or service. Only 7 percent of respondents had adopted IICT with the objective to cut out middlemen from their existing distribution channels. The desire to reduce employee count was mentioned as a motivator for IICT utilization for 15 percent of respondents. Five percent of respondents said that no clear objectives were established for IICT adoption or that they were not aware of them.

Overall, results indicate that IICT adoption is strongly driven by a customer orientation. Customers, as opposed to manufacturing processes, are the focus of all top three IICT objectives (improve customer service, deepen relationships, reach new customers).

**Table 1. IICT implementation objectives and associated strategy type (n=95)**

IICT implementation objective	% of respondents <sup>mr</sup>	Strategy type association
Improve customer service	78%	Differentiation
Deepen existing customer relationships	60%	Differentiation
Reach new customers	54%	Cost leader
Reduce transaction costs with customers (e.g. sales, service, negotiation cost)	38%	Cost leader
Improve operational efficiency (e.g. better forecasting, production planning)	38%	Cost leader
Improve brand image	37%	Differentiation
Faster inventory turns	16%	Cost leader
Reduce employee count	15%	Cost leader
Joint product development	14%	Differentiation
Cut out middlemen	7%	Differentiation
No objectives were set or I don't know	5%	“Stuck in the middle”
<sup>mr</sup> Multiple responses possible		

### ***Customer Interface IICT Adoption Impact***

Respondents were asked to express their perception of customer interface IICT implementation impact on a set of business activity outcome variables. **Table 2** lists the business activity outcome variables presented in the questionnaire and the mean perceived impact of IICT implementation for each variable. The response scale was anchored by 1= highly decreased, 2= somewhat decreased, 3= no effect, 4= somewhat increased, 5= highly increased. Respondents who indicated that no IICT applications were adopted were omitted from the analysis resulting in a sample size of 95.

One-sample two tailed *t*-tests were conducted to investigate IICT adoption impact on business outcomes by comparing the variable mean to the scale midpoint value (3= no effect). All variables were significantly ( $p < 0.01$ ) above the midpoint scale test value of “no effect”. This indicates positive business impact from customer interface IICT across all business activity outcome variables.

**Table 2. Descriptive statistics: IICT impact on business outcomes (n=95)**

Business Activity Outcome Variable		Mean IICT impact	Std. Dev.
1	Information sharing with customers	4.0 **	0.6
2	Timeliness of information supplied to customers	4.0 **	0.7
3	Company image	3.8 **	0.5
4	Quality of information supplied to customers	3.8 **	0.7
5	Quality of customer service	3.7 **	0.6
6	Customer satisfaction	3.5 **	0.5
7	Order processing efficiency	3.5 **	0.6
8	Sales revenue	3.5 **	0.6
9	Company competitiveness	3.5 **	0.5
10	Timely reporting to management	3.4 **	0.6
11	Number of customers	3.4 **	0.5
12	Production planning efficiency	3.4 **	0.6
13	Ability to meet on-time delivery commitments	3.4 **	0.5
14	Understanding of customer needs	3.3 **	0.5
15	Our reliance on long-term customer relationships	3.3 **	0.5
16	Our satisfaction with long-term customer relationships	3.2 **	0.5
17	Our trust of our customers	3.1 *	0.4
18	Our leverage over customers	3.1 *	0.4
19	Our dependence on customers	3.1 *	0.4
* Significantly different from 3 (“no effect”) at $\alpha=0.01$			
** Significantly different from 3 (“no effect”) at $\alpha=0.001$			

Instead of merely looking at the perceived IICT impact at the item level, the goal of this research was to describe IICT impacts on business performance on a higher conceptual level. Accordingly, principal component factor analysis, with varimax rotation, was conducted to identify underlying dimensions of perceived customer interface IICT impact on business activity outcomes. Several preliminary factor analysis solutions were examined before the final factor analysis solution was found. Four variables were withdrawn from the final factor solution: “number of customers” was omitted due to low sampling adequacy ( $.434 < .50$ ); “sales revenue” and “understanding of customer needs” were omitted due to low communalities (0.299 and 0.352 respectively); and “customer satisfaction” was omitted due to low ( $<.50$ ) factor loading. The sample size ( $n=95$ ) for the remaining 15 variables exceeds the minimum required number of 5 observations (6.3) per variable required for factor analysis (Hair et al. 1998). The Kaiser-Meyer-Olkin overall Measure of Sampling Adequacy<sup>1</sup> (.793), Bartlett test<sup>2</sup> of non-zero correlations (.000), Measures of Sampling Adequacy (range from .729 to .879) on the anti-image correlation matrix, and small partial correlations all indicate that the data set is suitable for factor analysis.

The principal component factor analysis identified strong intercorrelations among the business activity outcome items and identified four unique dimensions that could be used to

<sup>1</sup> Proportion of variance that might be caused by the underlying factors; Guidelines for interpretation: .90 or above is marvelous, .80 is meritorious, .70 is middling, .60 is mediocre, .50 is unacceptable (Hair et al. 1998)

<sup>2</sup> Presence of correlations among at least some of the variables in the correlation matrix (Hair et al. 1998)

address different facets of perceived customer interface IICT adoption on business performance. The latent root criterion (eigenvalue  $\geq 1$ ) was used in extracting the factors. The four factors explain 67.7 percent of the total variance of the 15 variables (**Table 3**). Orthogonal varimax rotation was used to disperse the factor loadings<sup>3</sup> within the factors to achieve a more interpretable solution (Field 2000).

**Table 3. Variance explained by the factor solution**

Total Variance Explained						
Factor	Extraction Sum of Squared Loadings			Rotation Sums of Squared Loadings		
	Eigenvalue	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	4.55	30.31	30.31	2.99	19.93	19.93
2	2.53	16.85	47.16	2.97	19.81	39.74
3	1.99	13.24	60.40	2.49	16.58	56.32
4	1.10	7.31	67.70	1.71	11.39	<b>67.70</b>

Extraction Method: Principal Component Analysis. (n=95)

The cut-off point for interpretation of the loadings was  $\pm .60$  (Hair et al. 1998; Field 2000). In naming the four factors, all significant factor loadings were used in the process, but variables with higher loadings had greater influence on the factor name (**Table 4**).

- Factor 1 has four significantly high loadings (.803-.850), which are all related to perceived IICT impact on fulfillment or internal process efficiency in the value chain, thus the factor was named “*Internal Business Process Efficiency*”.
- Factor 2 loads the highest (.833-.674) on variables associated with the depth and satisfaction with customer relationships. Accordingly, the factor was named “*Customer Relationship*”.
- Factor 3 has significantly high loadings (.759-.645) on variables linked with sharing information with customers. Hence, the factor was named “*Information Diffusion*”.
- Factor 4 has two significant loadings “Company competitiveness” (.786) and “Company image” (.694). Both items describe competitive position of the company, thus the factor was named “*Competitive Position*”.

Validity refers to the extent the measures correctly represent the concept or construct intended and how well the concept is defined by the measures (Hair et al. 1998). The factor solution demonstrated good convergent validity, where items measure their intended concept and no other, by having the items load strongly ( $\geq .60$ ) on one factor. With respect to discriminant validity, which refers to does a concept differ from other concepts, the items loaded high on their corresponding factor construct, not on their cross-loadings. All internal consistency (Cronbach’s  $\alpha$ ) measures are above the recommended level of .60 for the identified factors and hence were

<sup>3</sup> Correlation between the original variable and the factor; the squared loading is the amount of the variable’s total variance accounted for by the factor (Hair et al. 1998).

satisfactory, indicating that the measures are reliable and would yield consistent values in multiple measurements (Table 5).

**Table 4. Factor analysis solution matrix for IICT impact on business activity outcomes**

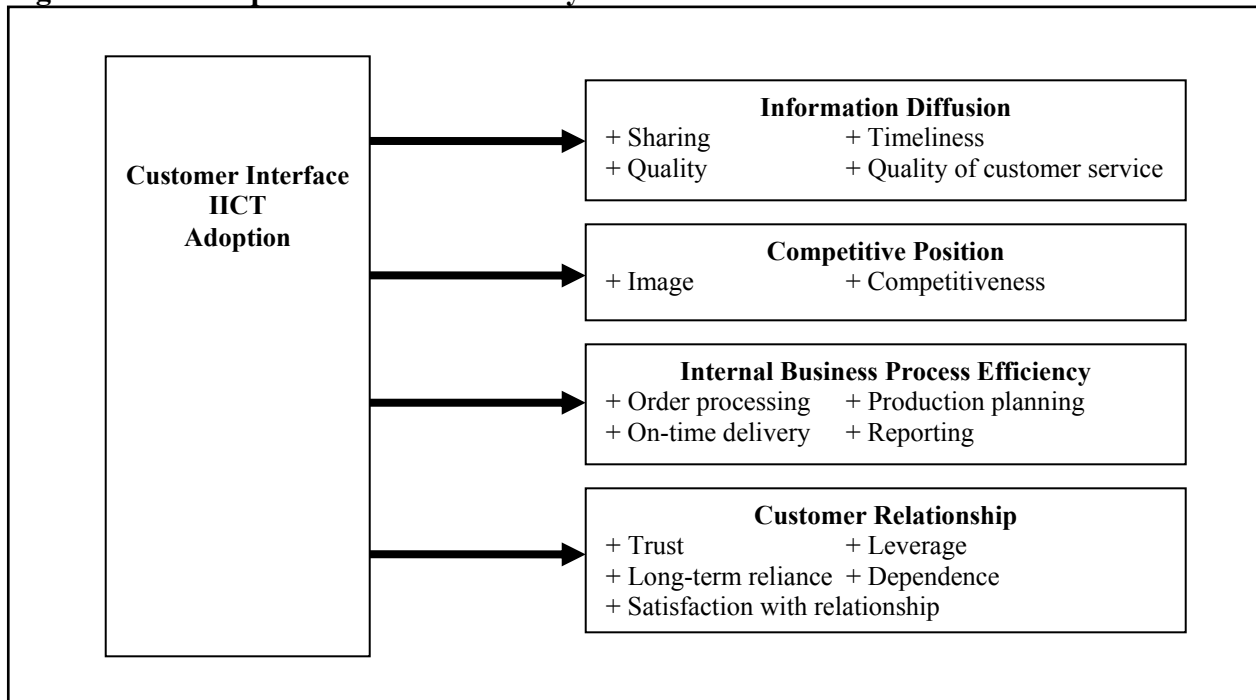
	“Internal Business Process Efficiency”	“Customer Relationship”	“Information Diffusion”	“Competitive Position”	Communality
Ability to meet on-time delivery commitments	0.850				0.565
Order processing efficiency	0.841				0.586
Production planning efficiency	0.832				0.674
Timely reporting to management	0.803				0.651
Our reliance on long-term customer relationships		0.833			0.670
Our dependence on customers		0.777			0.644
Our satisfaction with long-term customer relationships		0.763			0.709
Our trust of our customers		0.711			0.603
Our leverage over customers		0.674			0.622
Timeliness of information supplied to customers			0.759		0.740
Information sharing with customers			0.753		0.653
Quality of customer service			0.711		0.728
Quality of information supplied to customers			0.645	0.453	0.774
Company competitiveness				0.786	0.794
Company image				0.694	0.742
Extraction Method: Principal Component Analysis Rotation Method: Varimax with Kaiser Normalization Loadings <.40 not shown; (n=95)					

**Table 5. IICT impact composite scale reliability analysis (Cronbach’s  $\alpha$ )**

	Internal Business Process Efficiency	Customer Relationship	Information Diffusion	Competitive Position
<b>Cronbach’s <math>\alpha</math></b>	<b>0.88</b>	<b>0.82</b>	<b>0.79</b>	<b>0.60</b>
n	88	89	89	89
Number of variables	4	5	4	2
Scale min/max	4/20	5/25	4/20	2/8
Scale mean	13.7	15.9	15.4	7.3
Scale std.dev.	2.1	1.8	2.1	0.9
Item mean	3.4	3.2	3.8	3.7

The factor analysis revealed four different facets of perceived business impact from adopting customer interface IICT: 1) impact on internal business process efficiency; 2) impact on customer relationships; 3) impact on information diffusion with customers and; 4) impact on competitive position. Hence, the results provide support for the hypotheses that customer interface IICT implementation impacts value chain activities, customer relationships, and information diffusion. In addition IICT adoption had a positive impact on respondents' perception of their organizations' competitive position. Further, the test statistics indicate the impact of IICT to be positive, as hypothesized, across all identified business activity outcomes and thus, all positively contribute to business performance. **Figure 2** displays the empirically tested and revised theoretical model.

**Figure 2. IICT impact on business activity outcomes**



### ***The Order of Impact***

In order to determine the business activity outcome factor most likely to benefit from IICT adoption and the order of relative impacts on business impact factors, paired sample one-way *t*-tests were performed between the different impact factors (**Table 6**). IICT adoption had the greatest impact on information diffusion with customers (scale item mean 3.8). Respondents indicated that their ability to provide customers with up-to-date and accurate information had improved since IICT adoption. They also perceived an increase in the amount of information shared with customers. Respondents perceived the second highest impact from IICT adoption on their company's competitive position (scale item mean 3.7). Respondents felt that company image had improved from IICT adoption and enabled them to be more competitive. IICT adoption also had a positive effect on respondents' business process efficiency (scale item mean 3.4). Respondents indicated that their ability to meet on-time delivery commitments improved with IICT adoption, as had order processing and production planning efficiency and provided

better opportunities for timely management reporting. IICT implementation in the customer interface had the least effect on customer relationships (scale item mean 3.2).

**Table 6. Paired samples *t*-test results for differences between IICT impact constructs**

			Paired differences				
Scale		Mean	Std.Dev.	Mean difference	<i>t</i> -value	d.f.	Sig. <sup>+</sup>
1	Information diffusion	3.8	0.5	0.2	3.40	87	0.001**
	Competitive position	3.7	0.5				
2	Competitive position	3.7	0.5	0.2	3.24	87	0.002*
	Internal business process efficiency	3.4	0.5				
3	Internal business process efficiency	3.4	0.5	0.3	4.21	87	0.000**
	Customer relationship	3.2	0.4				
* Significant at $\alpha=0.01$ ; ** Significant at $\alpha=0.001$							
<sup>+</sup> p-value of 1-tail <i>t</i> -test							

## Conclusions

Research results show that IICT has gained a foothold in the business-to-business supplier-customer dyad, with ninety percent of respondents having implemented IICT applications in their customer interface. Overall, results suggest that IICT adoption is strongly driven by the desire to strengthen companies' customer orientation. Customers, as opposed to an emphasis on manufacturing processes, are the focus of all top three ranked IICT implementation objectives, which include improving customer service, deepening customer relationships, and reaching new customers.

The research located four different facets of perceived business impact from IICT on respondents' business: 1) internal business process efficiency, 2) customer relationships, 3) information diffusion with customers, and 4) competitive position. In addition, this research provides empirical evidence on the positive business impacts of customer interface IICT adoption. IICT adoption had the greatest positive impact on information diffusion. Respondents indicated that in their opinion, their organizations ability to provide customers with up-to-date and accurate information had improved since IICT adoption. Respondents perceived the second highest positive impact of IICT adoption to be on their company's competitiveness in terms of improved image and competitiveness. Respondents perceived that their order processing and production planning efficiency and ability to meet on-time delivery commitments had improved since IICT implementation. Respondents found smallest relative positive change in their customer relationships after IICT was adopted in customer interface. The identified overall positive impact across the different facets of business activities and outcomes warrants the argument that based on business executives opinion customer IICT is a solid investment.

In general, this research offers a framework for business executives to consider areas of potential impact from customer interface IICT adoption. Access and management of information have become crucial to business success in today's dynamic market environment. The findings indicate that customer interface IICT can significantly increase the amount, but most importantly the quality, of information flow between suppliers and customers, providing organizations the opportunity to tailor up-to-bar operations, fulfillment execution, and customer service. The results suggest that IICT adoption can be used as a tool to gain both operational efficiencies along the value chain and solidify customer relationships. Further, the results empirically support

arguments presented in previous research that IICT adoption may elevate organization's overall image, hence suggesting that effectively communicated IICT strategy and efficiently publicized IICT operations can support corporate brand equity. In addition, this research aids business executives in setting objectives and building performance metrics for customer interface IICT implementation and management. The identified facets of IICT impact can be used as before and after implementation benchmark-points for IICT implementation success tracking, as well as starting point in designing effective IICT strategy around the identified opportunities of IICT impact on business activities and outcomes.

## **Limitations and Future Research**

The findings of this study need to be viewed in light of its limitations. However, these limitations provide a platform for future research. IICT impact was measured perceptually using Likert-type scales rather than through objective, quantifiable measurements (e.g. revenue, stock market value). As such, results must be treated as respondents' subjective opinions without a guarantee of underlying objective measurement of IICT impact. It is very likely that most of the respondent organizations lack an objective performance measurement system for customer IICT implementation. Potential future research could investigate what kind of metrics companies use in evaluating IICT success. In addition, this research was limited to customer interface IICT. Future research could consider a broader set of applications in a broader business context. Future research could also investigate the relationships between the identified IICT impact factors. It might be that the level of information dissemination moderates the impact on operational efficiency and customer relationships, which in turn might mediate the relationship to competitive position.

Three limitations pertain to the sample frame. First, only four industry sectors were investigated. Second, the results were obtained from a small sample of companies operating in the U.S. Third, despite previous research findings that marketing executives are often responsible for eBusiness implementation in the customer interface (Srinivasan et al. 2002), future research could consider other informants. If objective measures for IICT success are not available, Chief Executive Officers (CEO) could be argued to possess the most comprehensive picture of firm's resources effect on overall performance, whereas Chief Information Officer (CIO) could be argued to have most familiarity with IICT project performance metrics tracking.



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