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MEASURING IT CORE CAPABILITIES FOR ELECTRONIC COMMERCE: RESULTS FROM A CONFIRMATORY FACTOR ANALYSIS

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Abstract

This paper reports on the theoretical development and empirical validation of a measurement instrument for three IT core capabilities in an electronic commerce context. The instrument is based on the work of Feeny and Willcocks and includes the capabilities “IS/IT governance,” “business system thinking,” and “relationship building.” It was validated using a sample consisting of 179 respondents, all IT managers or CIOs. Results demonstrate that the constructs are reliable (alpha coefficients > 0.8) and valid. A confirmatory factor analysis on the data set yields a moderately acceptable model fit. The model also demonstrates highly significant factor loadings ($p < 0.001$). We show that a respecification of a competing model in which “IS/IT governance” is split into “business IT strategic thinking” and “IT management” provides better measures of fit. The paper concludes that core capabilities of IT departments are useful constructs to incorporate in future research. They are able to successfully predict behaviors that have relatively little overlap. Recommended further research includes the relationship between capabilities and governance structures, as well as further investigation into how IT core capabilities are formed and strengthened in organizations.

Keywords: Measuring IS success, organizing, factor analysis

1. INTRODUCTION

It has frequently been argued that to be successful in IS development and implementation, the relationship of the IT department with the rest of the business is of critical importance. Indeed, IS researchers have focused on numerous facets of this relationship, including the executive relationship with general management (Feeny et al. 1992), the alignment with business strategy (Reich and Benbasat 1996), the IT governance structure to be used (Sambamurthy and Zmud, 2000), and the involvement of users in system development efforts (Ives and Olson 1984).

When IT departments move beyond purely internal applications to incorporate electronic commerce in their service portfolio, the relationship between business and IT is becoming an even more important issue. Indeed, the deployment of e-commerce systems requires the involvement of almost every functional part of the organization (Turban et al. 2000). Cooperation with the marketing department is necessary to develop the commercial features of the front-end. Cooperation with the operations department is required to help fulfil incoming electronic orders. Cooperation with the accounting department is necessary to comply with accounting standards for e-commerce. Effective cooperation with these and other functional units is required to achieve working e-commerce solutions. Because of all this, Earl (2000) has observed that the complexity and status of the CIO’s job have risen with the advent of electronic commerce.

A promising approach to conceptualize the relationship between IT departments and the business environment is based on the core capability view of the firm (Amit and Schoemaker 1993; Penrose 1959; Teece et al. 1997). In line with this perspective, Feeny and Willcocks (1998a) have operationalised three core capabilities that specifically deal with the IT-business relationship. However, no measurement instrument has yet been developed for these capabilities, and consequently their application in empirical work and the advancement of theory is hindered.

This paper extends the work of Feeny and Willcocks by developing measurement instruments for these three capabilities in an electronic commerce context. Specifically, the objectives of the research reported in this paper are threefold. We aim (1) to develop an instrument to measure three core capabilities for electronic commerce, (2) to empirically assess the psychometric features of these measures, and (3) to suggest ways in which the instrument can be used in the future.

The outline of this paper is as follows. The next section of this paper discusses the theoretical antecedents of this study and the conceptual framework. The following section describes the research design. The subsequent section presents the results, and the final sections discuss the implications of our findings and conclusions.

2. THEORETICAL ANTECEDENTS

The core capability perspective on organizations, also associated with the competencies perspective or the resource-based view of the firm (Penrose 1959), is a relatively established approach in the field of strategic management. From the core capabilities point of view, organizations build a number of core capabilities with which future environmental challenges are to be met (Hamel and Prahalad 1994; Prahalad and Hamel 1990). Capabilities include organization-specific routines, processes, skills, and resources. They need to be built, through learning processes, and cannot be readily bought. In the short run, they are not imitable in other settings, nor are they replicable by competitors (Amit and Schoemaker 1993). Through this property, capabilities enable a firm to achieve sustainable competitive advantage in the market (Teece et al. 1997).

The core capabilities perspective has been very influential in the field of strategic management, although it has been subject to criticism. Williamson (1991, 1999) mentions the obscure and tautological definition of a core capability (“a capability which is core”) and the lack of sufficient operationalization of the concept. To overcome these limitations, more research is needed to further measurement and operationalization of capabilities.

There has been IS research carried out within the capabilities perspective, both conceptual (Clemons 1991; Feeny and Willcocks 1998a) and empirical (Bharadwaj, 2000; Bharadwaj et al. 1999). The present paper builds further upon the work of Feeny and Willcocks (1998a, 1998b). Based on a body of empirical evidence (Feeny et al. 1992), they develop a view of the IS function as a set of core capabilities. The IS function, in their framework, faces challenges in the environments of “business,” “technology,” “service” and “governance.” To deal with the challenges in these environments, nine distinct core capabilities are needed. These are depicted in Table 1.

Three of these capabilities cover the relationship of the IT department with the rest of the business. “IS/IT governance” refers to the executive relationship between IT management and business management. “Business system thinking” is concerned with the business knowledge and understanding of the IT department. “Relationship building” refers to the relationships between business employees and IT employees.

Feeny and Willcocks attach a short list of behaviors to each of the capabilities. *Our measurement instrument is based on the perceived occurrence of these behaviors.* In other words, we propose to measure a capability by asking respondents to what extent the IT department performs the three to four behaviors that are associated with the capability. A strong manifestation of the capability implies substantial occurrence of each of these behaviors.

The behaviors associated with the capabilities will now be discussed in more detail.

2.1 IS/IT Governance

IS/IT governance is “the capability to integrate IS/IT effort with business purpose and activity” (Feeny and Willcocks 1998b). The ability to deal with interdependencies that arise between the business and the IS function falls into this category. Being a management capability, it is typically developed between the IT manager or CIO and the general manager or CEO (Feeny et al. 1992; Jarvenpaa and Ives 1991), but also between the CIO and the management of the other business departments.

Table 1. Nine Core Capabilities of the IS Function (Feeny and Willcocks 1998b)

Nr	Core capability	Description
1	IS/IT Governance	Integrating IS/IT effort with business purpose and activity
2	Business Systems Thinking	Envisioning the business process which technology makes possible
3	Relationship Building	Getting the business constructively engaged in IS/IT issues
4	Designing technical architecture	Creating the coherent blueprint for a technical platform which responds to present and future business needs
5	Making technology work	Rapidly achieving technical progress—by one means or another
6	Informed buying	Managing the IS/IT sourcing strategy which meets the interests of the business
7	Contract facilitation	Ensuring the success of existing contracts for IS/IT services
8	Contract monitoring	Protecting the business's contractual position, current and future
9	Vendor development	Identifying the potential value of IS/IT service suppliers

Four behaviors reflect this capability (Feeny and Willcocks 1998b). The first factor refers to the *quality of the executive relationship (1.1)* between the CIO and the other executives. High performance CIOs build and develop good quality relationships with their peer executives in the firm.

Another behavior associated with this capability is the ability to arrive at *shared objectives (1.2)* and visions. Shared objectives involves the alignment between business objectives and information technology objectives. The alignment can be intellectual, social, or both (Reich and Benbasat 1996). The intellectual dimension refers to the factual similarity between IT plans and business plans. The social dimension refers to whether IS and business executives understand each other's objectives and plans.

Fostering an appropriate *culture (1.3)* in the IT department is a third behavior associated with IS/IT governance. As Ward and Peppard (1996) observe, there is often a cultural gap between IT departments and business departments (Ward and Peppard 1996). This gap is often fostered by “hard” elements (power and control structures), but also by rituals, routines, stories, myths, and symbols that set the IT department apart from the other departments. Therefore, strong IS/IT governance capabilities are associated with cultural alignment between IT and business departments.

Feeny and Willcocks also associate the behavior of incorporating *best practices (1.4)* in management with this capability. Best practices, a broad term originating from the Total Quality Management movement (Camp 1995), is usually defined as the acquisition and implementation of (management) processes with superior performance on a continuous basis. Thus, the search for continuous improvement of processes is associated with strong IS/IT governance capability.

2.2 Business Systems Thinking

Business systems thinking is the capability “to envision the business processes which technology makes possible” (Feeny and Willcocks 1998b). This capability refers to the degree to which the IT department is able to identify itself with the business processes that it is serving. Four behaviors are said to be associated with this capability: involvement in business strategy, occupation with IT implications on processes, new processes made possible by IT, and an eye for dependencies.

The first factor influenced by this capability is the degree to which the IT department is involved in the formulation of *business strategy (2.1)*. Although intended strategies are not realized strategies (Mintzberg 1994; see also Chan et al. 1997), the degree of involvement in the process of business strategy formulation is clearly a sign of participation in the general orientation of the business.

On a more operational level, business systems thinking is exposed by a clear interest of the IT department in the relationship between IT and the business processes. It is useful to distinguish between the capabilities of IT to improve *existing processes* (2.2) and the *new processes* (2.3) made possible by IT (Davenport 1993; Davenport and Short 1990). IT departments demonstrate their business systems thinking capabilities by pro-actively occupying themselves with these themes and, when necessary, acting upon the insights at which they arrive.

Finally, IT departments that endorse business systems thinking monitor *dependencies* (2.4) that arise through business use of IT. For example, one department may be ignorant of useful data captured into an information system by another department. An IT department may be in the best position to signal and reveal such dependencies.

2.3 Building Relationships

Relationship building is the capability concerned with “getting the business constructively engaged in IS/IT issues” (Feeny and Willcocks 1998b). This capability refers to the degree to which the IT department is capable of sustaining effective working relationships with the business employees. The possession of strong capabilities in this area affects the user’s understanding of IT potential, the effectiveness of the cooperation, and the establishment of business ownership for all IT projects.

A first factor that is affected by strong relationship building capabilities is the degree to which the users get an *understanding* (3.1) of the potential of IT. Possession and use of communicative skills determines to a large degree the extent to which this understanding can be achieved.

The building relationships capability also influences the *cooperation* (3.2) of the IT department with the rest of the business in specific projects or task forces, for example, in the context of software development projects. There is empirical evidence that group processes within teams are significant predictors for team performance in requirement determination (Guinan et al. 1998). Promoting user involvement by introducing business people in the software development team is an effective strategy and a sign of strong relationship building capabilities.

A third and final factor associated with strong relationship building capabilities refers to the degree to which the business takes *ownership* (3.3) of the projects that the IT department executes. Ownership is typically facilitated when (1) there are clear benefits of the IT projects for users and (2) these benefits can be clearly communicated to them. For this reason, we expected degree of ownership to be affected by strong relationship building capabilities.

3. RESEARCH DESIGN

3.1 Method

Survey research followed by confirmatory factor analysis (CFA) was adopted to address the behaviors developed in the previous sections. In such an approach, the three capabilities are modeled as latent constructs, and the behaviors that are affected by these capabilities are the manifest measures of the latent constructs (Bollen 1989).

The 11 behaviors discussed above were translated into statements to which the respondent could wholly disagree or wholly agree on a five-point Likert scale. Each statement was then adapted to an electronic commerce context. At the end of the survey, we asked for the organizational position of the respondent, the size of their IT department in terms of headcount, and the sector in which their business was operating. The resulting questionnaire is included as Appendix A of this paper.

For this research project, we cooperated with a commercial company in the Netherlands that developed and maintained an online survey engine. Using this tool the questionnaire was programmed and subsequently published on the Internet. The tool uses a cookie-based approach to prohibit the submission of multiple answers from the same client machine. The tool was developed in such a way that the respondents could view the aggregated results of the survey instantly after submitting their answers. This incentive was communicated in the introductory paragraphs of the questionnaire. We did not include other incentives for participation.

To obtain an adequate sample size for our study, we cooperated with the commercial survey company as well as the local (Dutch) branch of an international IT magazine. Both companies maintained online communities. The first online community consisted of 600 Dutch IS executives. The second community consisted of the online subscribers to the Dutch version of the IT magazine. This community consisted of approximately 10,000 subscribers. We invited both communities to participate in the research

through e-mail messages. In the e-mail, a link was embedded that pointed to the Internet page where the online survey was located. Although technically possible, we did not personalize the e-mail (for example “Dear Mrs. Smith of Company X”) so as to keep in spirit with the anonymity of the research.

3.2 Results

The study remained online from April 10, 2000, to May 7, 2000. In total, 472 individuals from the communities responded to our survey. Of the total group, 60% responded in the first two days; 95% responded in the first 10 days. We did not send reminder e-mails, because our project partners believed this would have compromised their commercial interests.

We deleted all missing values respondents using list-wise deletion, resulting in a data set of 420 responses, with 179 of the respondents in this set classifying themselves as “IT manager” or “CIO.” In addition, there were 47 general managers, 18 financial managers, 15 marketing managers, and 66 consultants. We decided that only CIOs would be sufficiently qualified to judge their relationship with the rest of the business. Therefore, only the CIO sample of 179 respondents was used for the analysis. Figures 1 and 2 provide details of the respondents, show the size of their IT departments, and the sector they work in respectively.

4. DATA ANALYSIS

4.1 Reliability

Cronbach’s alpha is commonly used as a measure to assess the reliability of the three constructs (Nunnally 1967). “IS/IT governance” has an alpha of 0.81, “business thinking” has an alpha of 0.80, and “relationship building” has an alpha of 0.83. These values are acceptable given the threshold values of 0.60 for exploratory research and 0.80 for confirmatory research (Hair et al. 1998). The implication is that the capabilities are reliably measured with the behaviors put together by Feeny and Willcocks. Considering the fact that these items have little overlap and that alphas tend to be higher when the overlap between items is larger, these high reliability scores are quite impressive.

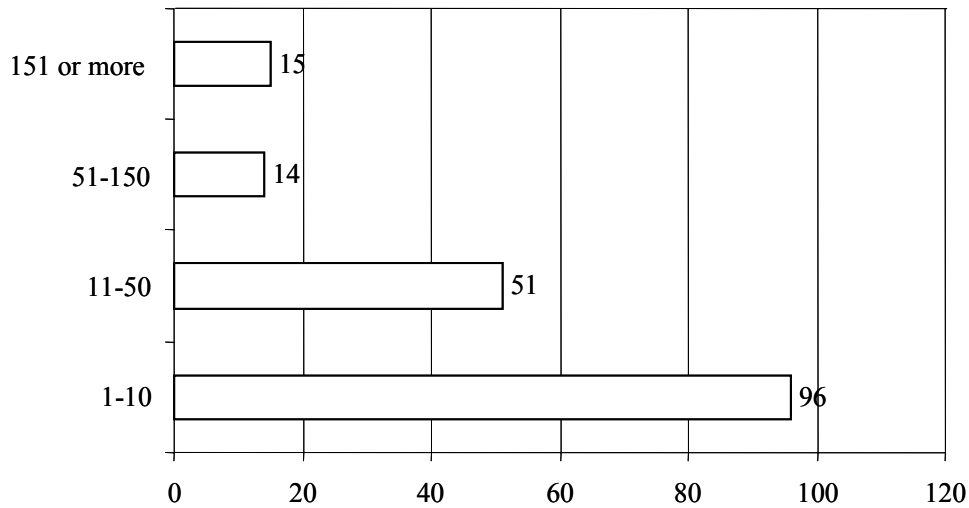


Figure 1. Number of Employees in IT Department
(n = 179, three missing)

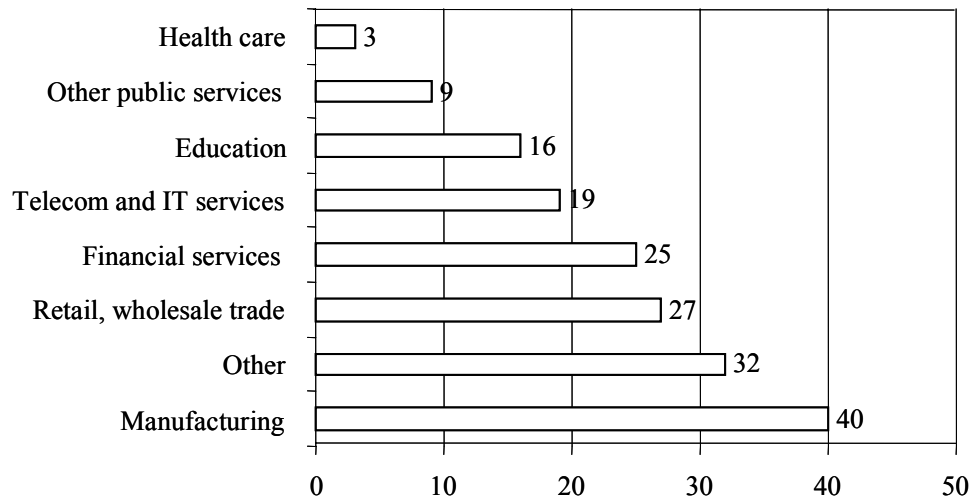


Figure 2. Sector of Respondent's Business
(n = 179, eight missing)

4.2 Validity

To examine the validity of the constructs, we examined the fit measures of a confirmatory factor analysis (CFA) with maximum likelihood estimation using Amos 4.01 (Arbuckle and Wothke 1999). For replication purposes, the covariance matrix of the latent variables is shown in Appendix B.

The values on generally accepted measures of fit are presented in Table 2.

Table 2. Fit Statistics and Recommended Values for Original Model

Fit statistics	Recommended values (Hair et al. 1998)	Value
χ^2 (df)	Non significant	114.14 (41) ***
χ^2 / df	Between 1 and 2/3	2.87
Goodness-of-fit index (GFI)	Close to 1	0.89
Adjusted goodness-of-fit index (AGFI)	> 0.80	0.83
Root-mean-square error of approximation (RMSEA)	< 0.08	0.10 (+/- 0.02)
Normed fit index (NFI)	> 0.90	0.90
Tucker-Lewis index (or non- normed fit index, NNFI)	> 0.90	0.91

Note: *** $p < .001$

The chi-square test is highly significant at $p < 0.001$. However, chi-square tests are sample size dependent and favor complex models over simpler ones (Hair et al. 1998; Long 1983). When adjusted for degrees of freedom, these and other measures of fit are acceptable. The exception is the RMSEA, whose lower bound 90% confidence interval is just above the threshold level of 0.08 (Browne and Cudeck 1993). For these reasons, we conclude with some reservation that the original model is a plausible representation of the data.

To test for discriminant validity of the three capabilities, we used the chi-square difference test. This test compares the chi-square statistic of the original model to one of a model in which the latent constructs are perfectly correlated (e.g., set to a fixed value of 1.0). The perfectly correlated model, which reflects that there are no distinct capabilities but instead one single capability, yielded a chi-square of 131.85 (d.f. 44). The difference between the statistics (17.71) exceeds the critical chi-square of 7.82 (d.f. 3, $p = 0.05$). Thus, the perfectly correlated model is rejected when compared to the original model and this suggests discriminant validity of the three capabilities.

Figure 3 shows the standardized factor loadings. All of them are highly significant at $p < 0.001$.

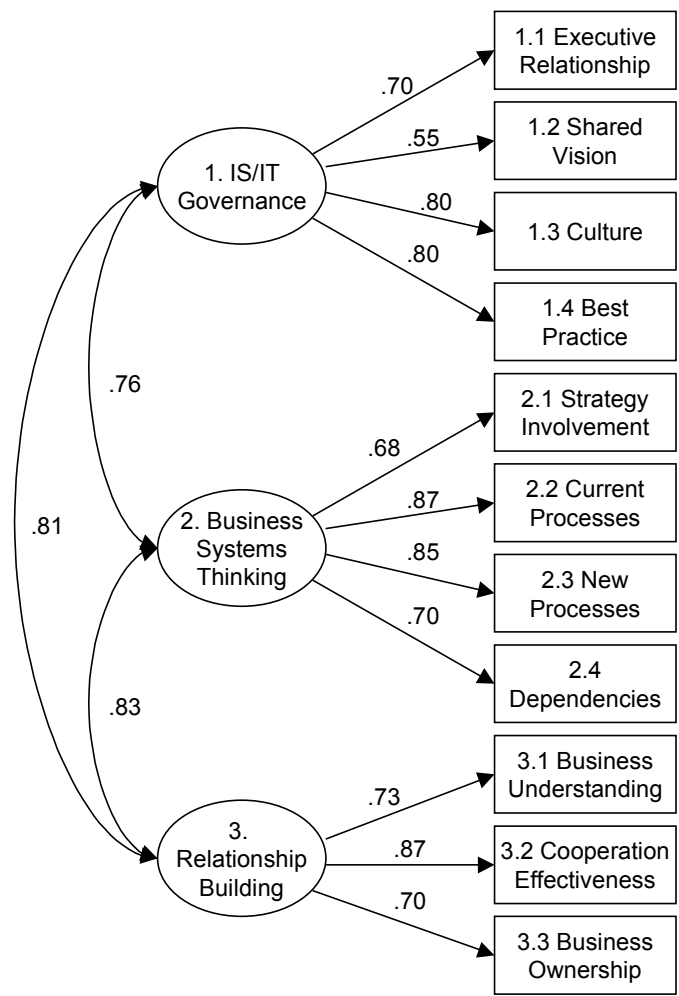


Figure 3. Standardized Coefficients for the Original Model
(Latent constructs are shown in ellipses, and observed variables are shown in rectangles. All coefficients are significant at $p < 0.001$)

4.3 Respecifications of Competing Models

Because the possibility exists that the original model is a misspecification, we specified two competing models to represent the data and examined their psychometric properties. The models are discussed below.

- Model 2. It can be argued that “IS/IT governance” is a capability that reflects the IT performance on the *managerial* level, while “business systems thinking” and “relationship building” reflect the IT performance on the *operational* level. In other words, the first capability is developed by the management of the IT department, whereas the other two are developed by the IT department as a whole. Following this line of argument, behavior 2.1 (strategy involvement) is misplaced in the original model, because it is a management activity, not an operational one. It is defensible to argue that only the IT management is closely involved in the formulation of the organizational strategy. Therefore, a competing model is suggested that moves behavior 2.1 to capability 1.
- Model 3. It can also be argued that “IS/IT governance” is both concerned with *outward* managerial skills (building executive relationships, shared objectives, and strategy involvement) and *inward* management skills (developing culture and processes). In a similar fashion, Bharadwaj et al. (1999) identified the capabilities “business IT strategic thinking” and “IT management.”¹ To test the argument that “IS/IT governance” reflected two capabilities, we specified a third model that distinguished between “business IT strategic thinking” and “IT management.” The former included the behaviors 1.1, 1.2, and 2.1. The latter included the behaviors 1.3 and 1.4.

Table 3 provides the measures of fit for the competing three models.

Table 3. Goodness-of-Fit Indicators of Three Models for Measuring IT Capabilities (m = 179)

Model	df	χ^2	χ^2/df	GFI	AGFI	RMSEA	NFI	NNFI
Original model	41	114.14***	2.78	.89	.83	.10	.90	.91
Model 2	41	116.45***	2.84	.89	.82	.10	.90	.90
Model 3	38	71.92**	1.89	.94	.89	.07	.94	.95

Note. GFI = goodness-of-fit index; AGFI = adjusted goodness-of-fit index; RMSEA = root-mean-square error of approximation; NFI = normed fit index; NNFI = non-normed fit index. ** $p < 0.01$, *** $p < 0.001$

Clearly, Model 2 does not fit the data better. Compared to the original model, Model 2 performs slightly worse on the overall fit indexes. Model 3, on the other hand, performs much better than our original model. The chi-square statistics are more acceptable. Furthermore, the goodness of fit indices (GFI and AGFI) rise to more acceptable levels. Finally, the RMSEA point estimate decreases to the more acceptable level of 0.07, i.e., below the generally established tolerance level of 0.08. These results support the argument that the “IS/IT governance” capability is in fact an aggregation of two capabilities.

5. DISCUSSION OF FINDINGS AND RESEARCH IMPLICATIONS

In this research project, our goal was to empirically assess the measurement of three e-commerce capabilities of IT departments in relation to their business environment. We have done so by treating capabilities as latent, unobserved constructs that manifest themselves through their influence on directly observable variables. A confirmatory factor analysis on the data indicated moderately acceptable fit and significant loadings. A *post hoc* respecification, in which we respecified “IS/IT governance” into “business IT strategic thinking” and “IT management” (cf. Bharadwaj et al. 1999), revealed a more acceptable fit to the data.

We believe this work contributes to the body of knowledge in IS research. We have extended work on IS core capabilities by developing and testing a measurement instrument for three e-commerce capabilities. The validation of the instrument suggests

¹Bharadwaj et al. identified five dimensions of IT capabilities. “IT business partnerships” is roughly similar to “relationship building.” “IT business process integration” is similar to “business systems thinking.” “Business IT strategic thinking” and “IT management” would constitute “IS/IT governance.” Finally, “IT infrastructure” would be in the technical domain and “external IT linkages” in the service domain.

that two capabilities, “business systems thinking” and “relationship building,” are reliable and valid measures. Other researchers are encouraged to use these measures in their own research.

The “IS/IT governance” capability appears to be an aggregation of two capabilities, “business IT strategic thinking” and “IT management.” These measures require further validation with an independent data set. We suggest the inclusion of additional measurement items related to outward executive relationship building and inward IT management to reduce measurement error and avoid identification issues in subsequent research.

Feeny and Willcocks derive six other capabilities, three related to vendor management and three related to technical management. These capabilities await further operationalisation, and future research could be directed toward the development of measurement instruments for these capabilities. Our field would then have a portfolio of measurable capabilities for IT departments on which to base further research.

This work is subject to a number of limitations. In the first place, respecification of theoretical models to improve the fit to data should be appreciated in the context of theory building, not theory testing. We cannot test the revised model with our data set. We can only suggest the new model to further stronger theory in this area. Future research would have to develop and validate the measurement of the newly formed capabilities. In particular, the number of items for the new capabilities is too small at this stage. Besides identification issues in structural equation models, measurement error may occur.

In the second place, we have specifically asked the respondents for the performance of their IT departments in the area of e-commerce. E-commerce is a broad term, and activities that are considered e-commerce by some IT managers are not considered e-commerce by others. Also, the study was carried out with Dutch respondents. It is possible that the results cannot be transported well to other socio-cultural contexts such as those found in North American or Australasian countries. Therefore, we recommend this study be replicated in other culture settings and with more specific application foci. This would improve both the generalizability and the precision of the model.

In the third place, the data collected through an online survey engine may not be as reliable as, for instance, similar data collected using postal mail. On the Internet, people are better positioned to masquerade their true profiles and “cheat” on their answers than in postal surveys: no cross-checks or validations are typically in place to ensure that people are indeed what they say they are. We do not believe that this is a strong limitation in this particular case, however. First of all, the communities did check the quality of their user profiles periodically by contacting the community members by phone. Second, there was no real incentive to cheat, as the survey was anonymous and voluntary. Nevertheless, we did not control for non-respondent bias and self-selection bias in the sample, and these biases might reasonably have occurred. Therefore, interpretations should be read with these limitations in mind.

6. CONCLUSIONS

Our research has confirmed that core capabilities influence a variety of behaviors of IT departments. Although these behaviors have little overlap at first sight, they share common, “core” capabilities. In other words, perceived exposed behaviors of an IT department can be successfully “imploded” into a reduced set of variables. Therefore, capabilities present themselves as a suitable unit of analysis to synthesize work on the behavior of IT departments. Prior studies on the behavior and performance of IT departments are somewhat fragmented, and a unifying unit of analysis may provide an opportunity for stronger theory based on cumulative empirical results.

Theory development based on capabilities could proceed in at least two directions. In the first place, the manifestations of certain capabilities could be theoretically associated with established dependent variables in IS research. This would generate predictive validity for the capabilities. Candidates include IS effectiveness variables, such as user information satisfaction (Bailey and Pearson 1983; Ives and Olson 1984), strategic impact (Chan et al. 1997) and SERVQUAL applied to IT (Pitt et al. 1995).

Particularly fruitful may be the relationship between capabilities and the governance structure of the IT department: fully centralized, fully decentralized, or a hybrid form. The literature suggests that organizational context variables such as size and type of strategy predict the IS governance solution (Sambamurthy and Zmud, 2000). Recent findings support the theory that perceived IT capabilities on the business unit level matter, and indeed may generate “deviant” governance structures (Brown 1997). We would suggest that decentralized IT functions are associated with stronger “business thinking” capabilities: centralized IT functions with weaker capabilities.

A second area of future research is the way in which capabilities are created and developed. Capabilities are argued to arise dynamically (Teece et al. 1997), following organizational learning processes. Qualitative research could investigate how the capabilities of IT departments are formed and strengthened. Since core capabilities that provide competitive advantage are (1) scarcely available in the market and (2) not readily redeployable in other organizational settings, these characteristics of capabilities are particularly worth investigating.

Acknowledgments

This paper benefitted from the comments of my colleague, Maarten Gelderman, and the anonymous ICIS reviewers. I would like to thank Mark Smeekes, Jac Gianotten, and Marco Gianotten from Giarte Media Group and ITsurvey.com for their participation in this study.

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Appendix A. Survey

The survey below is a translation from the original in Dutch. The original survey instrument is available from the author.

Respondents were asked to express their opinion on 11 statements using a five-point Likert scale (wholly disagree... wholly agree).

1. IS/IT Governance capability

1. In the context of e-commerce, the IT department of our organization maintains close relationships with business management.
2. The vision of our IT management on the role of e-commerce is similar to the vision of business management.
3. The IT department actively develops a culture in which e-commerce skills are stimulated.
4. The IT department is actively occupied with the implementation of *best practices* in the area of e-commerce.

2. Business systems thinking capability

1. With respect to e-commerce, our IT department is closely involved in the formulation of the organizational strategy.
2. Our IT department is actively engaged in the impact of e-commerce on our business processes.
3. Our IT department is actively occupied with new business processes made possible by e-commerce.
4. Our IT department guards the dependencies that arise because multiple departments are affected by e-commerce.

3. Relationship building capability

1. Our IT department ensures that the business has a good understanding of the possibilities of e-commerce.
2. With respect to e-commerce, our IT department ensures that IT employees and the business cooperate effectively.
3. Our IT department ensures ownership of the business with respect to e-commerce activities.

About the respondent:

1. Which position do you fulfil?
IT manager or CIO / Financial manager / Marketing manager / General manager or CEO / Consultant / Something else:
[textbox]
2. How many people (internal and external) are located in your IT department?
No IT department / 1-10 / 11-50 / 50-150 / 150 or more
3. In what sector do you operate?
Financial services / Telecom and IT services / Manufacturing / Retail, Wholesale trade / Education / Health care / Other public services / Other, [text field]

Appendix B. Covariance Matrix Used for Analysis

	v1.1	v1.2	v1.3	v1.4	v2.1	v2.2	v2.3	v2.4	v3.1	v3.2	v3.3
v1.1	1.384										
v1.2	0.678	1.185									
v1.3	0.673	0.509	1.345								
v1.4	0.703	0.501	0.977	1.39							
v2.1	0.847	0.733	0.646	0.674	1.671						
v2.2	0.842	0.448	0.696	0.724	0.973	1.559					
v2.3	0.642	0.418	0.713	0.714	0.858	1.182	1.509				
v2.4	0.523	0.349	0.568	0.628	0.608	0.809	0.828	1.282			
v3.1	0.534	0.351	0.684	0.572	0.574	0.607	0.612	0.56	1.101		
v3.2	0.674	0.472	0.642	0.659	0.693	0.793	0.742	0.75	0.715	1.106	
v3.3	0.584	0.364	0.601	0.617	0.591	0.758	0.694	0.698	0.582	0.739	1.342