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Abstract

In the literature, the different ways of representing the capabilities initiated by organizational information technologies (IT) have been provided by IS researchers. Since they were developed for specific purposes, most of them are not likely to illustrate the multifarious values of organizational IT-based capabilities. To provide a comprehensive approach for defining IT-based capabilities, this study suggests taxonomy to describe multiple levels in IT-based capability analyses, including technology functionality level and IT strategic capability level for low and high levels of analysis. The two levels are combined through our integrative framework. For this integration, we selected and modified an existing IT typology from each level. Our integrative framework provides a comprehensive understanding of organizational IT-based capabilities by helping people simultaneously take into account IT-based capabilities at multiple levels. In addition, the suggested framework can serve as basis for further discussion on how and why specific IT resources produce certain organizational outcomes.

Keywords: Information Technologies, IT, Resource, Capability, Typology, Framework

1. Introduction

During the past two decades, the value of organizational information technologies (IT) has been intensively studied by investigating their impacts on many aspects of business, such as organizational competitiveness (Wade and Hulland 2004; Zmud 1983), productivity (Brynjolfsson 1993; Drucker 1988), business process (Mooney et al. 1995; Soh and Markus 1995), and organizational dynamic capability (Sambamurthy et al. 2003; Tippins and Shoi 2003). In the investigation of IT value, the resource-based view (Penrose 1959; Selznick 1949) has been widely applied so that IT can be considered as an important resource within an organization (Zmud 1983). Based on this perspective, researchers have highlighted the IT-based capabilities as the source of organizational IT impacts. While some of them focus on individual technologies or application systems (e.g., Davenport and Short 1990; Mulligan 2002; Straub and Wetherbe 1989) in order to avoid the aggregation issue in their impacts (e.g., Barua et al. 1995; Grover et al. 1998), others focus on the integrated form of IT-based capabilities (e.g., Sabherwal and Chan 2001; Sambamurthy et al. 2003; Venkatraman and Henderson 1998). The former approach focuses on detail functionalities of IT resources. The latter approach highlights the strategic value of the integrated IT resources.

Although each approach in defining IT-based capabilities has its own merits, it is not likely that each individual approach can comprehensively explain the role of IT resources in creating certain outcomes because of its limited purpose under specific context. Relating to this issue, we believe that an integrative approach to the multiple levels of IT-based capabilities can provide more benefits in the investigation of the value of organizational IT

resources and their capabilities. However, this integrative approach has seldom been considered in the literature.

Therefore, this study aims (1) to clarify the multiple levels of analysis in defining IT-based capabilities and their purposes, and (2) to develop an integrative framework that enables researchers to simultaneously take into account the different levels of organizational IT-based capabilities. Based on our integrative framework, researchers studying organizational IT impact can further explain how and why different IT-enabled organizational outcomes happen. To achieve our research objectives, the existing IT typologies in the literature are reviewed and categorized based on their analysis level in Section 2. In Section 3, two existing typologies are extended and analyzed to represent each level of IT-based capability. In Section 4, an integrative framework is illustrated by combining the redefined IT-based capabilities at different levels.

2. IT-Based Capabilities in the Literature

2.1 Resource-Based View and IT-Based Capabilities

According to resource-based view (RBV), an organization's success depends on the ability to capitalize on its strategic resources (Wernerfelt 1984) because organizational resources are potential sources of organizational competencies (Penrose 1959; Selznick 1949). By applying this view, many IS researchers proposed the significance of IT in organizational competitiveness. Specifically, they focused on IT-enabled abilities by specific IT resources (Bharadwaj 2000; Davenport and Short 1990; Sambamurthy et al. 2003). These IT-enabled abilities, called IT-based capability in this study, can be defined as *organization's functional capabilities*[1] *to support organizational activities and work processes by utilizing IT resources*.

2.2 Multiple Levels in IT-Based Capability Analysis

There have been many typologies (or classifications) for IT-based capabilities, which are varied in terms of the degree of aggregation, or in other words, the level of analysis. Although each has a specific perspective for its classification of IT-based capabilities (see Appendix A), they can be categorized into three groups in terms of their aggregation level (Barua et al. 1995) of IT resources, i.e., low, middle, and high levels. This three-level categorization may not cover all the existing typologies for IT-based capabilities. In addition, it may be difficult to clearly distinguish the three levels because of the continuous nature of the degree of aggregation. Nonetheless, to highlight the different perspectives and merits of the different levels, especially low and high levels, we suggest that the existing IT typologies be classified based on our taxonomy.

The IT typologies that analyze IT-based capabilities at the lower level (e.g. Born 2002; Davenport and Short 1990; Mulligan 2002; Nambisan 2003; Straub and Wetherbe 1989) define IT-based capabilities according to their functional abilities of specific technology components or application features (Lee et al. 2004). Hence, we name this level the *technology functionality level*. According to Barua et al. (1995), the understanding of IT-based capabilities at the technology functionality level would enable researchers to show the distinctive impacts of specific technology components on organizational processes. From this,

[1] To define IT-based capabilities, we adopt Grant's (1996) capability hierarchy view, which considers IT-based capability as one of the functional capabilities within an organization. The functional capabilities are organizational low-level capabilities for specific tasks with corresponding resources (e.g., marketing capability and manufacturing capability).

the technology functionality level approach may be free of the aggregation issue of IT impacts (Barua et al. 1995) that can generate the mismeasurement problem regarding IT productivity paradox (Brynjolfsson 1993).

On the other hand, other typologies that analyzed IT-based capabilities at the higher level (e.g. Keen 1991; Laudon and Laudon 2004; Sabherwal and Chan 2001; Sambamurthy et al. 2003; Sambamurthy and Zmud 2000; Tallon et al. 2000; Wade and Hulland 2004) tend to describe IT-based capabilities according to their strategic values. The main purpose of this level of analysis is to demonstrate IT resources' comprehensive abilities to support specific business goals. Hence, we call this level the *IT strategic capability level* (see Appendix A).

In addition to the two levels mentioned, there are more IT typologies that can be located between the technology functionality level and the IT strategic capability level in terms of the degree of aggregation of IT resources. The components of these IT typologies are usually application systems. Since application systems involve multiple technology functionalities or features (e.g., Born 2002; Watson-Manheim and Belanger 2002), they are higher than the technology functionality level. At the same time, since they can be thought of as the examples of the IT strategic capabilities (e.g., Laudon and Laudon 2004; Sambamurthy et al. 2003), they are lower than IT strategic capability level. Hence, we call this level the *IT application systems level*. This level of IT-based capabilities can provide somewhat clear boundaries of IT resources because they usually exist independently.

While each level of analysis has the merits mentioned above, each of them may not be suitable for holistic demonstrations of the roles of organizational IT-based capabilities. When focusing on the integrated forms of IT as IT strategic capability level does, the impacts of IT-based capabilities are vulnerable to aggregation (Barua et al. 1995). On the other hand, when focusing on the fragmented functionalities of technologies or application systems as technology functionality level does, the strategic values of IT (Sambamurthy et al. 2003) can be ignored. Hence, the understanding of IT-based capabilities from multiple levels, specifically the IT strategic capability level and the technology functionality level, can help people avoid the problems caused by viewing IT-based capabilities at a single level. Also, this integrated view can provide all the benefits of each level of analysis. For further development of our integrative framework, the IT-based capabilities at different analysis levels are explained further with specific examples in the following section.

3. IT-Based Capabilities at Multiple Levels of Analysis

3.1 Technology Functionality Level

Since the existing typologies at the technology functionality level are context-specific, it is difficult to find a typology that can be generally applied to various situations. Therefore, we develop a new typology by adopting Davenport and Short's (1990) IT capabilities for process redesign. We adopt their typology for two reasons. First, since this typology was developed for redesigning the overall process, it is thought to be general rather than specific. Second, their typology can be used to illustrate how the IT-based capabilities can affect business process, thus, making it possible for researchers to explain how certain IT impacts happen (Barua et al. 1995). On the other hand, there is an issue regarding the use of their typology without modification for our research framework development. Since it was developed a long time ago, the existing IT-based capabilities need to be updated as new technologies are continuously invented.

Originally, Davenport and Short (1990) suggested nine capabilities: analytical, automational, disintermediation, geographical, informational, knowledge management, sequential, tracking, and transactional. To address the above issue of their outdated definitions of IT-based capabilities, we extend and modify the original typology by: (1) adding three new IT capabilities; (2) redefining the names and definitions of two original capabilities; and (3) separating one original capability into three capabilities. Table 1 shows the newly extended IT typology at technology functionality level.

Table 1. IT-Based Capabilities at Technology Functionality Level

IT-Based Capabilities	Organizational Benefits
Analytical	IT can bring complex analytical methods to bear on a process (Davenport and Short 1990) through proper information technologies (Sambamurthy et al. 2003).
Automational	IT can replace or reduce human labor in a process (Davenport and Short 1990) by supporting procedural activities not requiring alternative choices (Zmud 1983).
Collaboration	IT can enable organizational members to engage in collaborative activities (Keen 1991) through the ability to coordinate and support organizational co-works (Watson-Manheim and Belanger 2002).
Communication	IT allows organizational members to communicate with each other via different media, usually computer-mediated communication channels (Born 2002; Daft and Lengel 1986; Watson-Manheim and Belanger 2002).
Control	IT can ensure security of the organization's data (Born 2002) and give the capability for the organization to protect its IT assets as well as information assets from external or internal computer or Internet abuse (Hoffer and Straub 1989; Lee and Lee 2002; Straub and Nance 1990).
Disintermediation	IT can be used to connect two parties within a process that would otherwise be communicated through an intermediary (Davenport and Short 1990).
Geographical	IT can transfer information with rapidity and ease across large distances, making processes independent of geography (Davenport and Short 1990; Keen 1991; Teo et al. 1997).
Informational	IT can bring vast amounts of detailed information into a process (Davenport and Short 1990).
Knowledge Creation	IT can help employees, especially knowledge workers, to create knowledge by analyzing or combining the existing data and information (Alavi and Leidner 2001; Laudon and Laudon 2004).
Knowledge Storing	IT allows the storage of explicit knowledge and expertise through knowledge filtering and codification (Alavi and Leidner 2001; Davenport and Short 1990; O'Dell and Grayson 1998).
Knowledge Distribution	IT allows the dissemination of explicit knowledge and expertise stored in an organization to improve business processes (Alavi and Leidner 2001; Davenport and Short 1990).
Routinizational	IT can transform unstructured processes into routinized transactions (Davenport and Short 1990).
Tracking	IT allows the detailed tracking of task status, inputs, and outputs (Davenport and Short 1990).
Workflow Management	IT can enable management of the sequence of tasks in a process, optimizing process flow by allowing multiple tasks to be worked on simultaneously (Davenport and Short 1990; Nambisan 2003).

** Extended and modified from Davenport and Short's (1990) IT capability typology*

The newly added capabilities are *collaboration capability*, *communication capability*, and *control capability*. Collaboration capability is the ability to coordinate and support organizational co-works by using IT (Keen 1991; Watson-Manheim and Belanger 2002). As Internet technologies spread rapidly over contemporary businesses, the technologies for peer-to-peer connections and collaborations have been developed; for example, application sharing, calendaring, whiteboard, project management, and document co-development technologies (Watson-Manheim and Belanger 2002). Aside from collaboration support, this IT-based capability is also known to support knowledge sharing among people (Laudon and Laudon 2004).

Communication capability is the ability to enable individuals to communicate with each other via interactive media, such as computer-mediated communication (CMC) channels, in organizations (Daft and Lengel 1986; Watson-Manheim and Belanger 2002). In addition to communication support, the possibility and practical benefits of advanced communication systems in tacit knowledge sharing have been proposed as organizational impacts (Hansen et al. 1999; Sambamurthy et al. 2003).

Control capability is added because IT-enabled control has been an important issue, especially with regard to internal and external abuse of organizational IT resources (Lee and Lee 2002; Straub and Nance 1990). Based on general deterrence theory (GDT), security and monitoring systems have been developed and implemented in organizations to protect organizational IT assets as well as information assets (Hoffer and Straub 1989; Lee and Lee 2002; Straub and Nance 1990).

In addition to defining new IT-based capabilities, two original capabilities – transactional capability and sequential capability – are modified. First, based on the original definition of transactional capability, we modify the original name to routinizational capability to avoid the possible confusion with transactional processing system (TPS). The transactional capability was originally defined as 'the transformation of unstructured process to routinized transaction'. This capability can be understood as the IT support capability for unstructured tasks, not for transactional tasks. Since the transactional tasks are structured rather than unstructured, they can be supported by automational capability. Second, workflow management capability is used instead of sequential capability, because task sequence management enabled by IT has evolved to comprehensively manage the flow of business process (Nambisan 2003).

Finally, knowledge management capability from the original typology is divided into three specific capabilities: knowledge creation capability, knowledge storing capability, and knowledge distribution capability. Since knowledge management consists of multiple processes, such as knowledge creation, storage/retrieval, distribution/sharing, and application (Alavi and Leidner 2001; Pentland 1995), the technology features to support each process can be different. Hence, we define these three capabilities in the context of supporting the specific aspects of knowledge management processes[2]. Knowledge creation capability is increasingly becoming important in the current organizational environment as a method to create or discover new knowledge (Laudon and Laudon 2004). Although this capability is related to analytical capability, it needs to be distinguished because it requires more sophisticated

[2] Knowledge application capability is not considered an IT–based capability because of the lack of technology features to support knowledge application procedure in the literature.

technologies, such as data mining and pattern analysis (Alavi and Leidner 2001). Likewise, knowledge storing capability is important to capture and store organizational knowledge into knowledge repository or organizational memory (Kankanhalli et al. 2005). On the other hand, knowledge distribution capability enables individuals to transfer or share the organizational knowledge that is stored in repository (Hendriks and Vriens 1999). According to Kankanhalli et al. (2005), usually, the possibility of knowledge codification is assumed when organizations focus on system capabilities that support the abovementioned knowledge management processes. IT means that explicit knowledge (Nonaka 1994) can be created, stored, and distributed by these three IT-based capabilities relating to organizational knowledge management.

3.2 IT Strategic Capability Level

To define a higher level typology, we adopt Sambamurthy et al.'s (2003) digital options, which was defined as 'a set of IT-enabled capabilities in the form of digitized enterprise work processes and knowledge systems (p.247)'. Digital options consist of four classifications: digitized process reach, digitized process richness, digitized knowledge reach, and digitized knowledge richness. There are three reasons we select digital options as an example of IT strategic capability level for further integration with the IT-based capabilities at technology functionality level. First, the classification of digitized process capital and digitized knowledge capital can highlight the strategic value of IT-enabled knowledge management. Since the organizational knowledge base and learning knowledge are very important resources for organizational competitiveness in contemporary business environments (Grant 1996; Tippins and Shoi 2003), the strategic importance of the IT-based capabilities for knowledge management should be highlighted. Moreover, this typology describes the IT strategic capabilities for managing organizational tacit knowledge, as well as explicit knowledge as the source of IT-enabled organizational competitiveness (Sambamurthy et al. 2003). Second, this typology is a sufficient frame of reference by distinguishing the reach and richness of organizational IT-based capabilities. This reach and richness can be explained by the quantitative and qualitative nature of IT-based capabilities respectively.

According to Sambamurthy et al. (2003, p.20), digitized process reach refers to 'the extent to which a firm deploys common, integrated, and connected IT-enabled processes that tie activity and information flows across departmental units, functional units, geographical regions, and value network partners'. Digitized process richness refers to 'the quality of information collected about transactions in the processes and transparency of that information to other processes and systems that are linked to it, and the ability to use that information to reengineer the process'. Digitized knowledge reach is defined as 'the comprehensiveness and accessibility of codified knowledge in a firm's knowledge base and the interconnected networks and systems for enhancing interactions among individuals for knowledge transfer and sharing'. Digitized knowledge richness is defined as 'the systems of interactions among organizational members to support sense-making, perspective sharing and development of tacit knowledge'. Since this typology puts a stress on the contemporary business environments and is general in terms of the scope of consideration rather than specific, we adopt the classifications and definitions above without modification for our integrative framework development.

4. An Integrative Framework

To provide an integrative framework, we map technology functionalities and IT strategic capabilities. For this, in addition to comparing the definitions of the IT-based capability of

each level, we use the IT application systems level, the middle level of analysis to bridge the two levels - technology functionality level and IT strategic level.

Application systems in IT application systems level can be analyzed by their core features - technology functionalities. At the same time, the application systems can be defined as example systems of specific IT strategic capabilities from the literature. By reviewing the core features of specific application systems discussed in the literature, we can map each specific application system into the technology functionalities. The mapping results are listed in Table 2.

Table 2. Application Systems for Technology Functionalities

Technology Functionalities	Example Application Systems of Each Technology Functionality
Analytical	Customer Relationship Management (CRM), Decision Support Systems (DSS), Executive Support Systems (ESS), Programmed Decision Systems (PDS) (Laudon and Laudon 2004; Zmud 1983)
Automational	Accounting Systems, Inventory Management Systems, Office Automation (OA), Transaction Processing Systems (TPS) (Laudon and Laudon 2004; Zmud 1983)
Collaboration	Application Sharing Systems, Electronic Document Management Systems, Group Decision Support Systems (GDSS), Virtual Learning Systems, Whiteboard (Born 2002; Laudon and Laudon 2004; Malhotra and Majchrzak 2004; Nambisan 2003; Watson-Manheim and Belanger 2002)
Communication	E-Mail, Internet Chatting Systems, Group Support Systems (GSS), Video Conference Systems, Voice Mail (Born 2002; Huber 1984; Laudon and Laudon 2004; Shirani et al. 1999; Watson-Manheim and Belanger 2002)
Control	DB Security Systems, Firewall, Monitoring Systems, Network Security Systems (Born 2002; Lee and Lee 2002; Urbaczewski and Jessup 2002)
Disintermediation	CRM, Electronic Data Interchange (EDI), Enterprise Resource Planning (ERP), Product Data Management (PDM), Supply Chain Management (SCM), TPS (Laudon and Laudon 2004; Zmud 1983)
Geographical	Automatic Tele Machine (ATM), EDI, File Transfer Systems, Networking Systems, Point of Sales (POS) (Broadbent et al. 1999; Huber 1984)
Informational	Database (DB), Data Warehouse Systems (DWS), DSS, ESS, File Server Systems, Intranet (Born 2002; Laudon and Laudon 2004)
Knowledge Creation	AI Systems, Data Mining Systems (DMS), DSS, Expert Systems, Market Analysis & Sales Forecasting Systems, Text Mining Systems (Alavi and Leidner 2001; Hendriks and Vriens 1999; Laudon and Laudon 2004)
Knowledge Storing	Enterprise Knowledge Repository (EKR), Knowledge Retrieval System, Knowledge Worker Systems (KWS) (Alavi and Leidner 2001; Kankanhalli et al. 2005; Laudon and Laudon 2004; Lawton 2001)
Knowledge Distribution	EKR, Intranet, Office Systems, KWS (Alavi and Leidner 2001; Kankanhalli et al. 2005; Laudon and Laudon 2004; Lawton 2001)
Routinizational	DSS, Information Reporting Systems (IRS), Management Information Systems (MIS), Production Planning Systems, Use-Case Tools (Laudon and Laudon 2004; Zmud 1983)
Tracking	ERP, MIS, Monitoring Systems, Production Management Systems (PMS), Source Safe (Laudon and Laudon 2004)
Work Flow Management	Electronic Signature Systems, Groupware, Workflow & Scheduling Systems (Nambisan 2003)

The four digital options as IT strategic capabilities are analyzed in terms of application systems. For this, we analyze the four IT strategic capabilities by input, processing, and output-based on their definitions and the example systems given by Sambamurthy et al. (2003). Since they are the highly aggregated forms of technology functionalities, we decompose them by applying Laudon and Laudon's (2004, p.41) analysis method and their analysis results. The results of the four IT strategic capabilities are summarized in Table 3.

Table 3. Analysis of Four Digital Options

IT Strategic Capabilities	Application Systems	Input	Processing	Output
Digitized Process Reach	ERP	Transactions	Processing, Planning, Tracking	Regular Reports, Summary
	CRM	Transactions	Data gathering, Low-level analysis	Summary
	SCM	Transactions, Events	Connection, Transition	Transaction Data, Lists
	Product Data Management	Production data	Listing, Merging, Updating	Detailed Reports, Lists, Summary
Digitized Process Richness	DSS	Low-volume data or Massive	Interactive, Simulation, Analysis, Decision model	Specific reports, Decision analysis, Response to queries
	Analytic	Aggregate data, Internal	Analysis, Graphics, Simulations	Specific reports, Decision analysis, Projections
	Tracking Technology	Transactions, Events, Exceptions	Tracking	Progress reports, Projections
Digitized Knowledge Reach	Intranet	Information, Opinion, Knowledge	Posting, Transferring, Archiving	Information, Knowledge
	DB	Text, Multimedia	Repository, Indexing, Retrieval	Data, Information
	Knowledge Repository	Information, Knowledge	Repository, Hyper-linking, Retrieval	Explicit knowledge
Digitized Knowledge Richness	Advanced Communication Tech.	Information, Knowledge	Sharing, Interactive communication, Sense-making,	Explicit & Tacit knowledge
	Video Conference	Information, Knowledge	Sharing, Face-to-face communication	Explicit & Tacit knowledge
	Collaborative Tools	Information, Knowledge	Sharing, Interactive communication, Knowledge development	Explicit & Tacit knowledge

Also, based on the analyses above on input, processing, and output, we define the core tasks that are preceded or supported by each IT strategic capability. By considering the analysis results and the core tasks involved in each capability, we develop an expanded list of application systems for each IT strategic capability as shown in Table 4.

By comparing the core characteristics and the example application systems in Tables 1, 2, 3, and 4, we match the low-level IT-based capabilities at technology functionality level and the high-level IT-based capabilities, four digital options at IT strategic capability level. First, since digitized process reach supports a firm's deployment of the IT-enabled processes

integrating the information flow among functional units (Sambamurthy et al. 2003), this high-level IT-based capability is likely to consist of automational, geographical, disintermediation, and workflow management capability at technology functionality level. In addition, control capability may belong to digitized process reach because the systematic control of data flow and system access is a supportive mechanism of IT-enabled business process. This analysis can be supported by the example application systems in Tables 2 and 4.

Table 4. Application Systems for IT Strategic Capabilities

IT Strategic Capabilities	Core Tasks Involved	Expanded List of Example Application Systems for Each Capability
Digitized Process Reach	Transaction processing, Networking or connecting, Operational process management	CRM, ERP, Networking System, PDM, SCM, TPS (Broadbent et al. 1999; Laudon and Laudon 2004; Sambamurthy et al. 2003; Zmud 1983)
Digitized Process Richness	Analytical, Decision making support, Information processing and tracking	Analytic Systems, DSS, ESS, IRS, MIS, PDS, Tracking System (Laudon and Laudon 2004; Sambamurthy et al. 2003; Zmud 1983)
Digitized Knowledge Reach	Information / knowledge uploading, Packing, Storing, Transferring	DB, Intranet, Knowledge Repository System (EKR), Office Systems (Alavi and Leidner 2001; Kankanhalli et al. 2005; Nambisan 2003; Sambamurthy et al. 2003)
Digitized Knowledge Richness	High-level analysis, Knowledge sharing, Interactive communication, Collaboration	Advanced Communication Technology, Collaboration Tool, Knowledge Sharing System, KWS, Video Conference Systems (Born 2002; Sambamurthy et al. 2003; Watson-Manheim and Belanger 2002)

Second, since digitized process richness is related to the information quality and the transparency for information processing in business analysis and decision, this high-level IT-based capability may include analytical, informational, and routinizational capability at technology functionality level. In addition, digitized process richness requires a capability to manage the progress of specific business processes, such as project and production schedules. Since tracking capability at technology functionality level can be thought of as information-level tracking rather than just data tracking, the tracking capability can also be viewed as a part of digitized process richness. This matching is consistent with the comparison of example application systems between Tables 2 and 4.

Third, digitized knowledge reach can be understood as the organizational IT-enabled capability to manage organizational knowledge and to enhance organizational interactions for knowledge transfer. Since this high-level IT-based capability focuses on codified knowledge (Sambamurthy et al. 2003), we clarify the knowledge storing capability and knowledge distribution capability into this high-level IT-based capability. Moreover, since codified knowledge can be a source of new knowledge discovery or creation (Hendriks and Vriens 1999), knowledge creation capability should also be a part of digitized knowledge reach. In addition, this high-level IT-based capability requires communication capability to leverage knowledge transfer within an organization. This matching is also supported by the comparison between the example application systems in Tables 2 and Table 4.

Finally, digitized knowledge richness capability supports the interactions among organizational members for sharing tacit knowledge and sense-making. Therefore, the

interactive capability for communication and collaboration can be thought of as the technology functionalities of this high-level IT-based capability. It is supported by the example application systems in Tables 2 and 4. The results of the matching analyses are summarized in Table 5.

Table 5. The Integration of the IT-Based Capabilities at Two Levels

Technology Functionalities \ IT Strategic Capabilities	Digitized Process Reach	Digitized Process Richness	Digitized Knowledge Reach	Digitized Knowledge Richness
Automational	√			
Control	√			
Disintermediation	√			
Geographical	√			
Workflow Management	√			
Analytical		√		
Informational		√		
Routinizational		√		
Tracking		√		
Knowledge Creation			√	
Knowledge Distribution			√	
Knowledge Storing			√	
Communication			√	√
Collaboration				√

In Table 5, the communication capability is duplicated by matching two IT strategic capabilities: digitized knowledge reach and digitized knowledge richness. This duplication is caused by the different supporting goals in which communication capability is involved. According to the definition and the analysis outcomes in Table 3, while digitized knowledge reach supports the interactions among individuals for explicit knowledge transfer and sharing, digitized process richness is more related to the sharing of tacit knowledge (Sambamurthy et al. 2003). For both the IT strategic capabilities, therefore, communication capability is a critical functionality that shares something. However, digitized knowledge richness seems to require more interactive capability to arrive at a consensus and to create new knowledge among people (Malhotra and Majchrzak 2004; Sambamurthy et al. 2003). Therefore, the communications capability under digitized knowledge richness is likely to be more interactive than digitized knowledge reach (Malhotra and Majchrzak 2004). In this case, knowledge creation through individual knowledge sharing and interactions can be thought of as a result of the utilization of communication capability, above and beyond system capability itself.

5. Discussion & Conclusion

Overall, this research has extended the literature in four significant ways. First, we have delineated different levels for IT-based capability analysis through an extensive literature review. Second, the IT-based capabilities at technology functionality level were redefined by considering up-to-date capabilities in contemporary business environments. Third, we provided a systematic method to match the IT-based capabilities at different levels through the analyses of core tasks involved and the example application systems. Finally, by showing the possibility of integrating the technology functionalities and the IT strategic capabilities, this research may enable researchers to investigate and interpret the roles of organizational IT-based capabilities from their strategic value (based on IT strategic capability perspective)

as well as from their operational value in process supports (based on technology functionality perspective). Therefore, the matching results can help researchers explain certain organizational IT impacts in terms of the use process of IT resources (Markus and Soh 1993) as well as in terms of the strategic management of IT resources (Sambamurthy et al. 2003).

Practitioners can also find benefits from this research. They can use the newly suggested typology as an index to assess their IT-based capabilities. Our framework can help them decompose their overall IT-based capacity based on the technology functionalities. This decomposition will be helpful in evaluating their weaknesses and strengths in their IT-relevant capacity. Also, our framework can be helpful in evaluating the overall capacity of IT-based strategic capabilities by using the mapping table between technology functionalities and IT strategic capabilities. By comparing the current situations of IT strategic capability and their business strategies, organizations can evaluate whether or not the current IT portfolios fit their strategic directions.

However, this research may have some limitations. First, the generalization of our integrative framework might be arguable, because we assumed that there would be deterministic relationships in matching the IT-based capabilities at multiple levels. The matching can be dynamic according to varying situations. In spite of the limitation of the current deterministic view, the matching mechanisms and their results are likely to provide intuitive understanding about the relationships between the technology functionalities and the IT strategic capabilities. Another limitation is related to the dynamic nature of IT capabilities. As we extended the Davenport and Short's (1990) typology in order to include some up-to-date IT-based capabilities, the suggested IT-based capabilities must be continuously updated as new technologies emerge.

This research can serve as a basis for further studies. But more importantly, this research may guide future IT impact study on using newly developed IT typology and the matching outcomes to demonstrate how certain organizational IT impacts happen. The detailed investigations of the IT use process at the technology functionality level may enable researchers to open the blackbox of IT-enabled business processes which lead to organizational competitiveness. At the same time, the understanding of the strategic value of certain IT resource investment may explain why an organization needs to adopt new IT-based capabilities or to utilize the existing IT resources to generate new capabilities.

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Appendix A.

Example Typologies for Organizational IT-Based Capabilities		
Level	**Perspective**	**IT-Based Capability Components**
Technology Functionality Level	IT Capabilities for Process Redesign	Transactional, geographical, automational, analytical, informational, sequential, knowledge management, tracking, disintermediation (Davenport and Short 1990)
	Technological Capability	Application development, communication technology, database and security, technical support services, web technology (Born 2002)
	IT Infusion in NPD	Process management, project management, information / knowledge management, collaboration and communication (Nambisan 2003)
	Capability-based IT Classification	Integration (intra- and inter-departmental), scale (transaction flow and storage), technology focus (production, work flow, management and communication), accessibility (owners, participants and open) (Mulligan 2002)
	Technology Components and Impacts	Human interface technologies (voice interface, natural language interface, windows, executive information system, etc.), communication technologies (e-mail, voice-mail, EDI, ISDN, LAN, etc.), system support technologies (CASE, 4GL, hypertext/hypermedia, etc.), other technologies (AI, DSS, data extraction, PBX, on-line data searching, etc.) (Straub and Wetherbe 1989)
IT Strategic Capability Level	Business Design	Competitive positioning, geographic positioning, redesigning organization, redeploying human capital (Keen 1991)
	Supporting Level of Organization	Operational-level, knowledge-level, management-level, strategic-level systems (Laudon and Laudon 2004)
	IT Business Value	Customer relations, supplier relations, sales and marketing support, production and operations, product and service enhancement, process planning and support (Tallon et al. 2000)
	Digital Options	Digitized Process Capital (Process Reach and Richness), Digitized Knowledge Capital (Knowledge Reach and Richness) (Sambamurthy et al. 2003)
	IT for Organizational Design	Value innovation, knowledge work leverage, IT-enabled business platform, operational excellence, value-chain extension, solutions delivery (Sambamurthy and Zmud 2000)
	IS Strategy Attributes	Operational support, Market information, and Strategic decision support, Interorganizational information systems (Sabherwal and Chan 2001)
	IS Resource	Outside-In (Manage external relationships, market responsiveness), Spanning (IS-business partnership, IS planning and change management), Inside-Out (IS infrastructure, IS technical skill, IS development, cost effective IS operation) (Wade and Hulland 2004)

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