Towards an Understanding of how Information Technology Enables Innovation – the Innovators' Perceptions

R. Nootjarat, W. Chantatub, and P. Chongstitvatana

Abstract—This research attempts to explore gaps in Information Systems (IS) and innovation literatures by developing a model of Information Technology (IT) capability in enabling innovation. The research was conducted by using semi-structured interview with six innovators in business consulting, financial, healthcare and academic organizations. The interview results suggest four elements of IT-enabled innovation capability which are information (ability to capture ideas and knowledge), connectivity (ability to bridge geographical boundary and mobilize human resources), communication (ability to attain and engage relationships between human resources) and transformation (ability to change the functions and process integrations) in defining IT-enabled innovation platform. The results also suggests innovators' roles and IT capability.

Keywords—Innovation Platform, IT Capability, Innovators, Innovation Delivery

I. INTRODUCTION

THE Information Technology (IT) capability is critical for an organization to realize business value, drive innovation and sustain competitive advantage [1]–[6]. IT is used strategically to support new product development process, team collaboration and knowledge management that are likely to improve an organization's ability to innovate [7]. Even though, many empirical researches in Information Systems (IS) literatures in last decades have studied IT capability and its relationship with organization's competitive advantages and financial performance through business process redesign and transformation [2], [9], [10]. There are still few researches that study the role of IT as one of determinants in delivering innovation [11], [12] which provoke continuing interest among social scientists and practitioners.

IT capability has been defined as the ability to acquire, deploy, combine, and reconfigure IT resources in support and enhancement of business strategies and work processes [13]. While IT being embedded in products and services (so called IT-based innovation) and supported key business activities (so called IT-enabled business processes), this research attempts to study the role of IT in business activities in delivering innovation.

For innovators, a group of people who performed a set of functions or roles to deliver innovation [14], IT provides benefits in connecting innovators across geographical boundary, enabling a platform for codifying, searching, and exchanging ideas and managing the ideas to implementation [11]. Literatures in innovation researches so far have focused on particular IT applications such as idea generation, collaboration tools and knowledge management, and hence centered on 'existing' application functions and limited on a general model in explaining how IT capability enables innovation process which will aid in designing future IT-enabled innovation process platform. This research aims to define IT capability as perceived by innovators whose experiences in using IT in advancing innovation delivery in organizations. Specifically, we investigate two primary research questions: 1) what are IT capabilities that enabling innovation process? 2) how do IT capabilities complement innovators to enhance innovation delivery?

Considering the exploratory nature of the research questions, we adopted a qualitative research methodology [15] and used semi-structured interviews to acquire knowledge from six innovators in business consulting, financial, healthcare and academic organizations. The motivation behind the choice of these particular groups is to obtain a shared perception on IT capability and innovation process in different organizations. The important contribution of this study is twofold. First, this study focuses on the definition of IT capability in the context of how IT enables innovation delivery. Second, findings are valuables to aid both practitioners and academic researchers in examining IT applications as a platform in enabling innovation.

The remainder sections are organized as follows. First, we summarize literature reviews to identify prior studies on IT capability in IS and innovation researches. Next, we address research methodology, data collection and analysis process. Then, the fourth section analyzes interview results on conceptual elements of IT capability and how it enhance innovation delivery. The analysis is in the form of both confirming existing researches and revealing some emerging ideas on IT-enabled innovation platform. The final section concludes research implications, limitations, directions for future research and conclusions.

R. Nootjarat and W. Chantatub are with the IT in business Ph.D. program, Chulalongkorn University, Bangkok, Thailand. (e-mail: Raschada.N@student.chula.ac.th, Wachara.C@chula.ac.th)

P. Chongstitvatana is with department of computer engineering, Chulalongkorn University, Bangkok, Thailand. (e-mail: Prabhas.C@chula.ac.th)

II. LITERATURE REVIEWS

A. IT Capability in the context of IS researches

In IS researches, IT capability is the ability to acquire, deploy, combine, and reconfigure IT resources in support and enhancement of business strategies and work processes [13]. IT capability derives from underlying strengths in IT infrastructure, human IT resources, and IT-enabled intangibles [3]. IT infrastructures such as electronic data interchange, digital technology, and communication and collaboration tools tailored to a business strategy are enablement for process efficiency, cost reduction and business flexibility through business process redesign [16]. Traditional conceptualizations about IT capability have primary focused on enhancing business capability in operational excellence, value-chain extension and solution delivery [13]. The form of IT capability can be broadly classified based on the roles of IT in views of organization resources, business applications and technology functionality as summarized in table I.

TABLE I
FORMS OF IT CAPABILITY IN IS RESEARCHES

IT Capability Views	Roles and Forms of IT Capabilities	References
Resource-based view	IT can be considered as an important resource within an organization. An organization's success depends on the ability to capitalize on IT assets.	[1]–[3]
- IT infrastructure	Physical IT assets comprise the computer and communication technologies, the shareable technical platforms and databases in building an organization's platform for launching business applications.	[3]
- IT human capital	Organizational human resources generally comprise the training, experience, relationships, and insights of its employees. The critical dimensions include technical IT skills and managerial IT skills.	[3]
- IT-enabled intangibles	The enabling role of IT with respect to three key organizational intangibles:- customer orientation, knowledge assets, and synergy.	[3]
Application-based view	IT can be considered as a tool in enabling labor substitution, productivity, information processing and social relations.	[17], [18]
- Business Intelligent (BI) and Business Analytic	BI and Business Analytics enable managers and other decision-makers to interpret organizational data to improve decision-making and optimize business processes.	[19], [20]
- Business Process Integration (BPI)	BPI supports organization to adapt existing business and IT work processes to continually enhance effectiveness and efficiency as well as to leverage the capabilities of emerging information technologies.	[9]
- Collaboration Tool	Collaboration tool supports interaction, information exchanges and communications between team members.	[21]

TABLE I (CONTINUE)
FORMS OF IT CAPABILITY IN IS RESEARCHES

IT Capability Views	Roles and Forms of IT Capabilities	References
- Computer-aided design and manufacturing (CAD/CAM)	CAD/CAM provides comprehensive information on the sizes, shapes and attributes of products to support digital design methodology and coordination among distributed design team.	[22]
- Customer Relationship Management (CRM)	CRM provides an interface between front office and logistics processes pertaining to customers, more tightly coupling customers with organizational processes and associated information.	[23]
- Enterprise Resource Planning (ERP)	ERP intersects front and back office processes with financial, human resource, manufacturing/services processes being the primary focus.	[23]
- Executive Information System (EIS)	EIS provides a senior manager access to information relevant to management activities. An EIS can be used as an office support system to improve communication and personal efficiency and/or as a monitoring system to improve decision making, planning, and control.	[24], [25]
- Group Decision Support System (GDSS)	GDSS combine computer, communication, and decision support technologies to support problem formulation and solution in group meetings	[26]
- Knowledge Management System (KMS)	KMS supports and enhances the organizational processes of knowledge creation, storage/retrieval, transfer, and application.	[27]
- Supply Chain Management (SCM)	SCM falls between logistics and back office processes and supports procurement, materials requirement planning and production planning.	[23]
- Work-flow Management (WFM)	WFM supports the automation and reengineering of business processes and information processes. It involves a description of processes, controlling and coordination of tasks according to business needs.	[28], [29]
Functionality-based view	IT can be considered as an enablement for business process redesign and transformation.	[30]–[32]
- Automational	Eliminating human labor from a process.	[30]
- Informational	Capturing process information for purposes of understanding.	[30], [32]
- Sequential	Changing process sequence, or enabling parallelism.	[30]
- Tracking	Closely monitoring process status and objects.	[30]
- Analytical	Improving analysis of information and decision making.	[30]
- Geographical Connect	Coordinating processes across distances.	[30], [32]
- Integrative	Coordination between tasks and processes.	[30]
- Intellectual	Capturing and distributing intellectual assets.	[30]

IT Capability Views	Roles and Forms of IT Capabilities	References
- Disintermediate	Eliminating intermediaries from a process.	[30]
- Transactional	Routinizing transactions through standardization.	[31]
- Knowledge Management	Initiate the coding and sharing of best practices, the creation of corporate knowledge directories, and the creation of knowledge networks.	[27]
- Communication	Support human interactions and collaborations.	[33], [34]
- Transformation	Enable changes and controls of practices of functional and general management.	[35], [36]

Analysis of IT capability on each view provides its own benefits even though it is not in a perspective of innovation delivery. The analysis of IT capability in organization resource-based view helps in understanding how to measure the business values of IT as real option values in supporting IT investment decisions [36]–[39]. The analysis of IT capability in business application view helps in understanding how business organization can adopt IT in responding to business's changing demands as well as this view aids significantly in extension of IT-business strategic alignment and IT management theories [40], [41]. As the IT capability is enabled by technology to store and process information, the analysis in technology functionality view helps in exploring how IT supported organizational processes such as a study of how IT enables business process redesign [30].

B. IT Capability in supporting Innovation Delivery

Innovation is defined as "the intentional introduction and application within a job, work team or organization of ideas, processes, products or procedures which are new to that job, work team or organization and which are designed to benefit the job, the work team or the organization" [42, page 357]. Many studies of innovation with IT have been conducted in identifying the determinants of innovation with respect to some particular technology, innovativeness behavior, and theoretical factors [43]. The IT capability has been observed through the uses of IT in supporting set of activities in delivering innovation such as front-end innovation (FEI) [7], new product development (NPD) process [44], [45], innovation process [46], and the uses of IT in new business processes or process innovation [47]. The selected literatures are summarized in table II.

TABLE II
LITERATURES OF IT CAPABILITY IN SUPPORTING INNOVATION DELIVERY

Innovation with IT Contexts	Roles and Forms of IT Capabilities	References
Front-end Innovation	IT capabilities can be classified into six groups in supporting FEI activities: (1) Collaboration (2) Competitive intelligence (3) Knowledge management (4) Data analysis and modeling (5) Visualization (6) Idea generation	[7]
NPD Process	The infusion of IT in NPD can be examined along four dimensions: (1) Process management (2) Project management (3) Information/knowledge management (4) Collaboration and communication	[44]
	IT leveraging competence in NPD in three key dimensions: (1) Project and resource management (2) Knowledge management (3) Cooperative work	[45]
Innovation Process	IT capabilities can help organizations to be more innovative: (1) Business involvement (2) Project management (3) Information/knowledge management (4) Collaboration and communication	[46]
New Business Process	IT capabilities are enhancing: (1) Knowledge management (2) Collaboration (3) Project management (4) Ambidexterity (5) IT/Innovation Governance (6) Business-IS linkages (7) Process Modeling	[47]

Certain IT can enhance organization to be more innovative [46]. Studies on particular IT applications such as idea generation, collaboration tools and knowledge management are favorable for examining the innovativeness behavior of innovators in existing phases or stages of innovation process, but limiting an answer of what is IT-enabled innovation platform. As IT capability can be reflected from innovators' perceive of usefulness and benefit in using IT applications to advance innovation delivery. Hence, there is a need to further explore innovator's view of IT capability in developing a general model of IT capability in enabling innovation.

III. RESEARCH METHODOLOGY

A. Methodology

Considering the exploratory nature of this research, we adopted a qualitative research methodology [15] and used interview methods to collect data. We used semi-structured interview because in order to understand the perceived of IT capability, we have to follow terms that are described by individual innovator and let the flow of interviews run freely in context of their experiences in IT and innovation. Then we used content analysis as an analysis approach in unitizing, categorizing and inference the emerging elements of IT capability from interview data. Finally, we asked the innovators to review and confirm our analysis results.

B. Innovators

We define an innovator as an individual or a unit of people who performed a set of functions or roles to deliver innovation. We also use the A-to-F roles and the 6 I's of innovation [14] shown in Fig. 1 and the role descriptions in table III as a frame to understand and explore innovators.

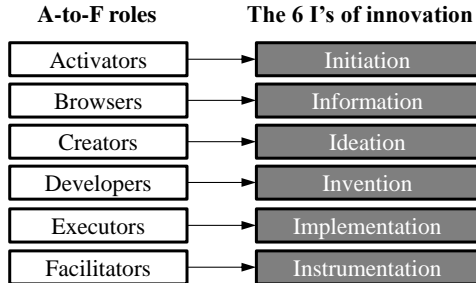| A-to-F roles	The 6 I's of innovation
Activators	→ Initiation
Browsers	→ Information
Creators	→ Ideation
Developers	→ Invention
Executors	→ Implementation
Facilitators	→ Instrumentation

Fig. 1 A-to-F roles and the 6 I's of innovation [14, page 18]

TABLE III
A-TO-F ROLE DESCRIPTIONS [14, PAGE 16-17]

A-to-F roles	Role descriptions
Activators	Initiate the innovation process by raising questions for exploration of innovative ideas. Challenge possibility of new ways in doing things and interesting benefits.
Browsers	Investigate the innovation process and supply information that relevant both to the start of the process and to the application of new ideas.
Creators	Ideate new concepts and possibilities, and search for new solutions at any point in the process.
Developers	Invent ideas into products and services. Creators come up with ideas; developers "tangibilize" ideas into things.
Executors	Implement or bring the innovation under development to the organization and to the market.
Facilitators	Instrument the innovation process; approve the new spending items and investment needed as the innovation process moves forward. Manage the process to prevent it getting stuck.

The interviewees in representing innovators were selected based on their availability to the authors and their experienced in IT and innovation from fifteen to twenty years. Table IV describes the interviewees' background and the mapping roles to innovator.

TABLE IV
INTERVIEWEES' BACKGROUND AND MAPPING TO INNOVATOR' ROLES

	Interviewees' Background	A	B	C	D	E	F
Resp 1	is an IT director in a business consulting company based in Thailand. He has experiences in integrating information from social network to detecting business opportunity.	-	X	X	-	-	-
Resp 2	is a sales and account manager in a global software and systems integration company based in US. He has experiences in implementing IT integrated solutions, web collaborations and cloud technology.	-	-	-	X	X	-
Resp 3	is a vice president in leading financial company in Thailand. He is responsible for initiating and directing all IT projects in aligning IT services with internal core banking processes and external customer service processes.	X	-	-	-	-	X
Resp 4	is a professor in a university in Thailand. His main expertise is in artificial intelligent (AI) and IT infrastructure. He is currently a member in a joint research group between universities in Thailand and Japan in cloud computing, AI and robotics.	-	-	X	X	-	-
Resp 5	is a professor in a university in Thailand. His main expertise is in business strategic planning and innovation management. His research is mainly on corporate strategy, innovation management and IT collaborations.	-	X	X	-	-	-
Resp 6	is a director in a non-profit healthcare organization in Thailand. He is responsible for developing IT governance policy to improve healthcare services provided to all government-owned hospitals. He served as a WHO advisor on several projects in adopting IT for monitoring and controlling diseases.	X	-	-	-	-	X

C. Interview protocol

Interview protocol was created based on the literature review and with objectives to understand "how important the IT is" to the innovator; and to understand "how IT is important to innovation delivery". Table V summarizes protocol components and interview questions. All interviews were recorded and each interview took an average of two hours.

TABLE V
INTERVIEW PROTOCOL

Protocol component	Interview Questions
Innovator characteristics	What is the best description of your work responsibility? How does it relate to innovation?
Innovation enablement	Share an experience in delivering innovation. What make it success or fail?
IT roles	How has IT supported or failed to support the innovation delivery that you have just described?
IT capability	In your opinion, how IT application and technology advance innovation delivery?
IT importance	What types of IT application and technology that your organization should invest to advance the innovation delivery? Why you think it is important?

D. Data Analysis

The interviews were transcribed and unitized based on content relevant to the concept of IT capability in relation to innovation. The analysis results were reviewed and confirmed with each interviewee on the interpretations and agreement in general model in explaining how IT capability enables innovation.

In context of innovation delivery, interview results reveal four elements of IT capability in enabling innovation which are information, connectivity, communication and transformation, as summarized in Fig 2.
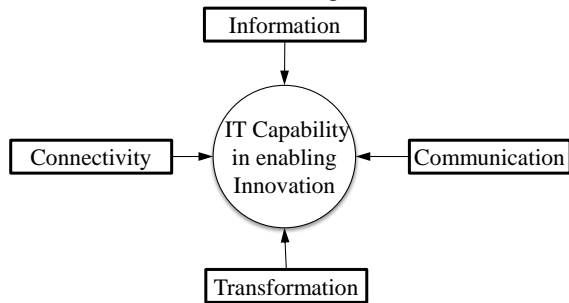

Fig. 2 IT Capability in Enabling Innovation – General Model

A. Information

Information is an element in IT capability to capture both explicit data such as 'patient records' and implicit data such as 'idea', 'knowledge', 'social relationships' in a digital format, and process it to information for exchanges of a particular fact or circumstance. This element supports organizations' members to create, store, analyze and disseminate explicit knowledge to improve routing works as well as to generate implicit knowledge by using complex analytical methods.

This element was illustrated from what Resp1 and Resp6 mentioned about their experiences in using IT for improving work processes in their organizations. Resp1 told to us that IT supports processes in capturing implicit data such as personal relationship in social network for analyzing customer behaviors which is more in-depth comparing to the past. In Resp6's view, the information capability is important in healthcare services that the research on customized drugs is moving forward by using IT to capture individual genetic data and integrate healthcare systems for supporting a case data for future researches. The ability to capture and process implicit data in digital format to create useful results enables their works that were not possible in the past.

| Resp 1 | *I think people start with apply everything into IT.. first..people* **put data into computerized.. and second..it's faster..so it's allow data finding quicker..** *we have theory on this detecting before.but it's not possible to make it happened..***integrating with new systems like social network for detecting new customer behavior information that is in depth than the past.** *has already happened in other countries..like in US..they are doing this..* |

Bold face added by author.

| Resp 6 | *with the IT..of course they are improving..***they have electronic medical records..electronic tape records so you can access the patient data quite easily....** *rather than doctor have to memorize everythings including the pharmacist's..you can check for drug to drug intereaction that can be helpful if you want to have experts opinion..* **if they have the digitized format..they can send those to the experts in order to interpret those films..and with digitalize of course you can create some software tool to help detect on some types of the troubles..** *so they think* **having the genetic data banks** *for example...that people can do research* **in the future if you may have the customized drugs that is based on their genes individual..** *this area that the pharmacy is moving forward..this trend..I think the* **IT has a role in term of the data collection in advancing researches.. you cannot run research without computerize format..** |

Bold face added by author.

Information is a source and a mean of innovative idea. Resp2 suggested that IT supports sharing, using and reusing innovative ideas to create innovations. Resp5 also suggested that drawing new ideas needs information provided by IT such as product innovation especially product design needs computer-aided-design (CAD) application to support the flow of idea from product designer to product developer to implement innovation. This is supported by experiment studies that found number of ideas increases when changing from pen and pencil to idea generation tool and to creativity support systems (CSS) [48].

| Resp 2 | **first..about how do we create innovation..I think first..the question is how we can record idea..** *I think that..if you want to record in A4 paper..it could be possible..but difficult* **to continue the process on the ideas..** *so in my view..***web portal..or sharepoint like Microsoft Sharepoint Server and Workspace allow you to capture and submit the ideas..exchange the ideas..and connecting the ideas..this is how we started..** |
| Resp 5 | **I believe that the innovation needs design and to design will not be only just the pencil and paper..the design that you can collaborate and coordinate between the organizations..should be the design in the electronic form..** *once I get the design of any new products..I can seperate it for partner 'A' to develop this component..partner 'B' to develop another component and then come back to integrate together..this kind of assembling and dismantling..will not be able to do without IT..* also **IT will help you in doing some the prototype..the technology like the CAD and CAM in the past help you develop some prototype..and this process is critical in product innovation..** |

Bold face added by author.

B. Connectivity

Connectivity is an element in IT capability to allow organizations' members to participate, to transfer information and to establish communications seamlessly and transparently. Connectivity allows the organization to mobilize and use its resources freely beyond its geographical boundary. Connectivity is seen as a foundation for organization to transfer information rapidly.

This element was illustrated from the use of Internet technology in view of Resp3 and Resp4. People use Internet technology to connect to their organization infrastructure and to send and transfer information. In Resp3's view, Internet represents the connectivity of people and allowing them to

access and execute information across physical locations. In Resp4's view, connectivity provided by Internet allows organizations' members, i.e. instructor and students, to join a distance learning class in transferring knowledge that captured in electronic format.

Resp 3	*most of the business now you cannot strict to your own office..your own physical location..because you tend to travel..and the world become more norrow..because it's like connected..***this IT technology is like connect the whole world..to become small like..as small as Internet is....so mobility is one of the important factor to allow the business to continue and extend and be efficient***..and productive..because with mobility..***you don't have to stay at one physical location to do thing***..you can do something else while you are in travelling..*
Resp 4	***now we have distance learning..the students who take course stay here in Thailand but we have teacher..instructor..do the lecture in Japan..and send information here using video conference systems***..but in this case..IT helped improve our daily life..so the lecturer doesn't need to fly here in order to teach..*

Bold face added by author.

Connectivity draws boundary in transferring and implementing innovation. In views of our interviewees, the information element is necessary for capturing innovative idea while the connectivity element plays important role in mobilizing human resources necessary in creating and implementing innovative idea to innovation. In Resp4's view, IT supports an expansion of innovative classes beyond physical location. While, Resp5 believed that social network is a sample of connectivity that enables organizations to be a real-time enterprise in reaching and executing innovative ideas to response to changing markets.

Resp 4	*best top university in the world..they still improve themselves..like stanford or MIT..***this year Stanford provide AI class for everyone on the Internet via YouTube***.with the Chris..***fifty thousand people registered to this course to study***..this is kind of innovation...allowing..***people just stay their home, access to the server..to see the lectures..and study on their own..at anytime***.. I think that it is a kind of innovation..that IT provide connection to human around the globe..*
Resp 5	***I think social network is the key infrastructure for the change in the information management***..like facebook..when someone post something or message something to you..you can response instantly.. and this concept is support to the next generation business flow..the ***RTE..real-time enterprise..the RTE will be enabled by the social network..once information is changed..and the executive can know instantly***..and they can rely on this information also..because this information is not just from someone outside the community..but from ***someone inside your work group to confirm this information***..***I think this is really powerful***..if you can apply social network in the enterprise like the realtime enterprise to create innovations...*

Bold face added by author.

C. Communication

Communication is an element in IT capability to support an exchange of information through a common system of symbols and signs in representing meanings between organizations' members. The ability is demonstrated through the use of different media, usually computer-mediated communication channels, within and across the organizations' boundary. Communication relates to how emotions, i.e. feeling,

experiences, and behavior, are conveyed in a message to encourage or discourage trusts and collaborations.

This element was illustrated from what Resp2 and Resp5 mentioned about collaboration and social network applications. They believe that it is a sample on how IT is a platform for communication that is not just to send and receive message but to attain and engage relationships.

Resp 2	*I believe that social network is a way in ***using technology to support in touching or engaging our customers to stay with us longer***..because the cost in inquirying new customers is more than the cost in maintaining existing customers..*
Resp 5	***let's say..the very first steps of creating innovation is to get inside into your customer and the market***..you can use the IT to gather knowlege and product bugs or new product features that customer want it into the system..***IT can gather the VOC..the voice of customer for you to enhance your product development..to me the social network can engage customer experiences and induce trust to our brand***..*

Bold face added by author.

Communication supports growing and cultivating on innovative ideas. Resp2, Resp5 and Resp6 suggest that it is necessary to encourage people to have new ideas and promote teamwork to enable flow of ideas. Collaboration between persons is necessary to empower individual in acquiring new ideas from others and extending the ideas to be more innovative.

Resp 2	***I think IT benefits coorperation..the collaboration between person whom have ideas..to extend and connect idea to be more completeness..and I believe that..many major ideas are the inputs of new methods and new innovation***..here we used IT to engage our people to create more ideas to help us doing our works better..that is how our company success in innovation..*
Resp 5	*Technology advancement..in the new application..***I think all applications should embrace the feature of the social networking such as the CRM or SCM or even BI.. all the new applications in IT would embrace this kind of features and empower to the individual level***..not just the organizational level..empower people..with the tool to let them collaborate and innovate.. as I said earlier..***IT would play role in the collaboration..collaborate between your lead users and collaborate between your creative strategists***..*
Resp 6	*in the past..the research center..they also worked with one and another..but they may used other media..of course they used mail..they may used telephone..they may used skype for that to communication.. for collaboration..***advance in IT just helped facilitate this process to be much easier***..so rather than the people just send messages..***they can use media like video conferences..to communicate online..see faces..get the feeling..and sense what others think..which are important for collaborations..exploring other ideas to create our own new ideas***..it won't enable in the past..*

Bold face added by author.

D. Transformation

Transformation is an element in IT capability to standardize unstructured processes into routinized tasks. Transformation enables flexibility in managing task sequences, optimizing process flow by executing multiple tasks simultaneously, and improving the process flows by changing the functions and its integrations. This element allows the organizations to adapt for future changes.

This element was illustrated from Resp2 and Resp6 mentioned that IT provides flexibility in retooling and reintegrating the work processes to support new requirements and changes.

Resp 2	*the change paradigm from the Internet is 'cloud' not the 'virtualization'.. the thing that 'cloud' provided is the flexiblity that you can use information on premise or on cloud..or hybrid..I believe this is a sample..that IT enables ability to changes..*
Resp 6	*with IT we can build things above and beyond what are people cannot do...for example adaptability..we ever spent times for days in servicing long list of patients..but the retooling of the work flow and work process..including plug in some new processes in diagnostic patient conditions from their health records..the process times was shorten up..to less than a 5-minutes..in my experience here..we already saved tons of times with error prone process..efficiency..we used IT to structure and restructure everything..and with inter-operable computerize systems including hospital information systems in integrating data..we can get things done with more accuracy..*

Bold face added by author.

Transformation supports flexibility in implementing innovative idea to innovation. Considered inputs from Resp3 and Resp5, they suggested that besides ability to obtain innovative ideas, the application of IT in supporting organization for adapting and implementing innovative ideas to innovation is necessary for successes of innovations.

Resp 3	*The most important thing to introduce or to deliver the innovation is the ability to understand the current situation..first we must have whole this infrastructure ready..by whenever the business users would like to have this innovation deliver to the market..we just put together assemble all the jigsaw..and give them as fast as possible..because..whenever someone thinks of these new things..I believe our other competitors may also thinking of something similar...there is no secret in this business.. not only banking, but IT business as well.. there are many ways to make innovation success..but you have to do it fast.. you need a platform that is expandable easily...this is the time when IT come in the picture.. like..I just want to show one example..it's the other bank in Thailand.. they just want to expand their business faster without spending times on branch locations and people stuffs..so they just writing a small web application..to open a personal banking..bookless..branchless..and tellerless..and a week later they extending it to mobile..this is the flexibility that IT make innovation success....*
Resp 5	*IT is the key for the process innovation..the process innovation is you develop something more quickly and more with the lower cost..and with IT.IT can help you optimize..do something like the multiple optimization..especially in the production process..is important for continuous innovation..*

Bold face added by author.

E. IT Capability in Enabling Innovation

While "Innovation is restricted to *intentional* attempts to bring about benefits from new changes" [42, page 357], IT capability in enabling innovation is an ability of IT to support innovators in capturing ideas and knowledge, bridging boundaries and encouraging the idea into refined results, and implementing changes that is intended as benefits.

The integration of four elements was illustrated from Resp1, Resp2, Resp3 and Resp6 mentioned that while ideas and knowledge as well as creativity are coming from people, IT is enhancing the way they capture and develop the idea to innovation.

Resp 1	*Our success is to have a good network and sources of information..the worlds keep changing rapidly..we cannot work alone..and think alone...have you ever heard about the hub firms..knowledge brokers?..this is not new..but it is what I see IT..social network..wiki..is..a platform of knowledge..that we must invest..to tap into opportunities and get values from it..social network is a source of business opportunities..ideas..and solutions..but it's depend on how you use it..let's me give a sample..for customer analysis..in the past..we did market survey, selection and analysis by human..now..everything come right to my mobile..we have an intelligent software..to help us search..analyze and explore new ideas..and even test the ideas..our software helped us analyze customer behavior..feedbacks..communications..to see the trend..and integrate all channels we have..*
Resp 2	*In my view..I believe that in any organization..people have ideas..people tends to generate ideas while they are engaging with their organization..during working or travelling..all you have to do is to create an environment that allow people to throw their ideas out..anytimes..comfortable..and challenges...In my company..we used IT to encourage people to talk and walk the ideas..no positions and distances here..we have idea drop boxes to capture ideas..comments..chats..feedbacks..the tool is running mobile..so we can used it as another social network..to move the ideas from employees to management..everyone can win the idea competitions..and once approved..we used IT to help us implemented it quickly..what make us success? I think…we have creative people..and IT to capture..connect.cultivate..and communicate our successes with them and to the clients..we shared future together...that's our ingredients..*
Resp 3	*I think Banking business is moving fast..we are providing services which mean quality..times..and most important..trust..to our customers..and that's IT come into play..service innovation has to be built on top of quality and accuracy providing by IT and flexibility in changing and rewiring our processes to the need of individual customer..my sample on that bank will explain this..*
Resp 6	*Innovation..what I would say is now that in healthcare there probably quite a big..if you heard about the Avian Influenza or the disease outbreaks that coming in..the innovation in IT is..how you can implement..the system that can monitor this outbreak..can early detect..early predict all these outcomes and manage them effectively..I think I have a good example..the center of diseases control and prevention, CDC, in the US..of course..they are traced more on the flu trend in the states..they have a weekly report coming out on all of the diseases..may be it's in 2009 or something..but along those lines..google..actually rather than depending on the report on the diseases from their government part..they have unique idea of how many people actually search for information about flu..about the drugs for flu..you know..based on those information they created a trend to predict what gonna be a flu outbreak..or what's happening..and actually based on those data..I couldn't remember exact data but it can actually predict the flu outbreak even before the government repeating the reports for a couple weeks..so in the innovation in IT in the public health or health care.. usually you have an early warning..that is something you should have..*
Resp 6	*in term of creating innovation..I would say that IT has help significantly...because the improvement in the technology..including Internets..social networks..even..the mobile technology..that integrate information directly from the sources..to use and reuse..to get knowledge and new ideas..almost anytimes..and that tremendously speeding up the way we create innovation and..IT..it comes as a new type of innovation in the market as well..in my organization..IT helped streamline and transform the processes a lot..we see many continuous innovation by using IT in medical researches and healthcare services…*

Bold face added by author.

Interview results also illustrated elements in IT capability that considered important to innovators' views, as summarized in table VI. For innovators, information is important in providing them to see opportunities, search and test ideas. Connectivity, communication and transformation are important for implementing the ideas to innovation. This is supported by experiment studies on the capability of Internet in improving R&D efficiency and new product development as well as role of IT as an enabler for information efficiency, continuous process improvement and business process redesign [16], [36], [49]-[51].

TABLE VI
INNOVATOR' VIEWS ON IT CAPABILITY

	A	B	C	D	E	F	IT Capability
Resp 1	-	X	X	-	-	-	Information
Resp 2	-	-	-	X	X	-	Information, Connectivity and Communication
Resp 3	X	-	-	-	-	X	Transformation
Resp 6	X	-	-	-	-	X	Information, Transformation

V. CONCLUSION

This research explored a definition of IT capability and how it enables innovation delivery in views of innovators. The interview results suggest four elements in defining how IT enable innovation delivery which are information (ability to capture ideas and knowledge), connectivity (ability to bridge geographical boundary and mobilize human resources), communication (ability to attain and engage relationships between human resources) and transformation (ability to change the functions and process integrations).

This research adds knowledge to IS and innovation fields by proposing a model in elaborating IT capability in enabling innovation. The model extends a functionality-based view and aids in explaining the role of IT applications such as idea generation, collaboration tools and knowledge management in supporting innovation process in other studies. The answer on what is IT-enabled innovation platform indicates contributions for future empirical researches on social networks and developments of assessment scale for evaluating IT-enabled innovation applications.

REFERENCES

[1] F. J. Mata, W. L. Fuerst and J. B. Barney, "Information technology and sustained competitive advantage: A resource-based analysis," *MIS Quarterly*, vol.19, no.4, pp.487-505, 1995.

[2] J. W. Ross, C. M. Beath and D. L. Goodhue, "Develop long-term competitiveness through IT assets," *Sloan Management Review*, vol.38, no.1, pp.31-42, 1996.

[3] A. S. Bharadwaj, "A resource-based perspective on information technology capability and firm performance: An empirical investigation," *MIS Quarterly*, vol.24, no.1, pp.169-196, 2000.

[4] G. D. Bhatt and V. Grover, "Types of information technology capabilities and their role in competitive advantage: An empirical

study," *Journal of Management Information Systems*, vol.22, no.2, pp.253-277, 2005.

[5] R. Kohli and N. P. Melville, "Learning to Build an IT Innovation Platform," *Communications of the ACM*, vol.52, no.8, pp.122-126, 2009.

[6] Y. Lu and K. Ramamurthy, "Understanding the Link between Information Technology Capability and Organizational Agility: An Empirical Examination," *MIS Quarterly*, vol.35, no.4, pp.931-954, 2011.

[7] S. Gordon, M. Tarafdar, R. Cook, R. Maksimoski and B. Rogowitz, "Improving the front end of innovation with information technology," *Research-Technology Management*, vol.51, no.3, pp.50-58, 2008.

[8] S. Aral and P. Weill, "IT assets, organizational capabilities, and firm performance: How resource allocations and organizational differences explain performance variation," *Organization Science*, vol.18, no.5, pp.763-780, 2007.

[9] A. S. Bharadwaj, V. Sambamurthy and R. W. Zmud, "IT capabilities: theoretical perspectives and empirical operationalization," *Paper presented at the Proceedings of the 20th international conference on Information Systems,* Charlotte, North Carolina, United States, 1999.

[10] M. D. Stoel and W. A. Muhanna, "IT capabilities and firm performance: A contingency analysis of the role of industry and IT capability type," *Information and Management*, vol.46, no.3, pp.181-189, 2009.

[11] T. Dewett, "Understanding the relationship between information technology and creativity in organizations," *Creativity Research Journal*, vol.15, no.2, pp.167-182, 2003.

[12] L. Kleis, P. Chwelos, R. V. Ramirez and I. Cockburn, "Information Technology and Intangible Output: The Impact of IT Investment on Innovation Productivity," *Information Systems Research*, vol.23, no.1, pp. 42-59, 2012.

[13] V. Sambamurthy and R. W. Zmud, "Research commentary: The organizing logic for an enterprise's IT activities in the digital era - A prognosis of practice and a call for research," *Information Systems Research*, vol.11, no.2, pp.105-114, 2000.

[14] F.T.de Bes and P.Kotler, "Winning at Innovation: The A-to-F Model," *Palgrave Macmillan*, 2011.

[15] B.L.Berg, "Qualitative Research Methods for the Social Sciences," *Allyn & Bacon, Boston, MA,* 1989

[16] M. Attaran, "Information technology and business-process redesign," *Business Process Management Journal*, vol.9, no.4, pp.440-458, 2003.

[17] E. Brynjolfsson and L. M. Hitt, "Beyond computation: Information technology, organizational transformation and business performance," *The Journal of Economic Perspectives*, vol.14, no.4, pp.23-48, 2000.

[18] W. J. Orlikowski and C. S. Iacono, "Research commentary: Desperately seeking the "IT" in IT research - A call to theorizing the IT artifact," *Information Systems Research*, vol.12, no.2, pp.121-134, 2001.

[19] T. H. Davenport, "Competing on analytics," *Harvard Business Review*, vol.84, no.1, pp.98-107, 2006.

[20] H. J. Watson and B. H. Wixom, "The Current State of Business Intelligence," *Computer*, vol.40, no.9, pp.96-99, 2007.

[21] R. D. Banker, I. Bardhan and O. Asdemir, "Understanding the impact of collaboration software on product design and development," *Information Systems Research*, vol.17, no.4, pp.352-373, 2006.

[22] N. S. Argyres, "The impact of information technology on coordination: Evidence from the B-2 "Stealth" bomber," *Organization Science*, vol.10, no.2, pp.162-180, 1999.

[23] P. J. Brews and C. L. Tucci, "The structural and performance effects of internetworking," *Long Range Planning*, vol.40, no.2, pp.223-243, 2007.

[24] J. J. Elam and D. G. Leidner, "EIS adoption, use, and impact: the executive perspective," *Decision Support Systems*, vol.14, no.2, pp.89-103, 1995.

[25] A. Rai and D. S. Bajwa, "An empirical investigation into factors relating to the adoption of Executive Information Systems: An analysis of EIS for collaboration and decision support," *Decision Sciences*, vol.28, no.4, pp.939-974, 1997.

[26] R. T. Watson, G. DeSanctis and M. S. Poole, "Using a GDSS to Facilitate Group Consensus: Some Intended and Unintended Consequences," *MIS Quarterly*, vol.12, no.3, pp.463-478, 1988.

[27] M. Alavi and D. E. Leidner, "Review: Knowledge management and knowledge management systems: Conceptual foundations and research issues," *MIS Quarterly*, vol.25, no.1, pp.107-136, 2001.

[28] D. Georgakopoulos, M. Hornick and A. Sheth, "An overview of workflow management: From process modeling to workflow automation infrastructure," *Distributed and Parallel Databases*, vol.3, no.2, pp.119-153, 1995.

[29] U. von Christoph and M. Speck, "Internet technology to run workflows," *Internet Research*, vol.8, no.5, pp.414-424. 1998.

[30] T. H. Davenport, "Process Innovation: Reengineering Work Through Information Technology," *Harvard Business School Press*, 1993.

[31] P. Mulligan, "Specification of a capability-based IT classification framework," *Information and Management*, vol.39, no.8, pp.647-658, 2002.

[32] P. C. W. Keen, "Shaping the Future: Business design through information technology," *Harvard Business School Press*, 1991.

[33] R. E. Rice, "Computer-Mediated Communication and Organizational Innovation," *Journal of Communication*, vol.37, no.4, pp.65-94, 1987.

[34] W. J. Orlikowski, J. Yates, K. Okamura, and M. Fujimoto, "Shaping Electronic Communication - the Metastructuring of Technology in the Context of Use," *Organization Science*, vol.6, no.4, pp.423-444, 1995.

[35] D. W. Straub and J. C. Wetherbe, "Information technologies for the 1990s: an organizational impact perspective," *Communications of the ACM*, vol.32, no.11, pp.1328-1339, 1989.

[36] M. J. Earl, "The new and the old of business process redesign," *The Journal of Strategic Information Systems*, vol.3, no.1, pp.5-22, 1994.

[37] A. Barua, C. H. Kriebel and T. Mukhopadhyay, "Information Technologies and Business Value - an Analytic and Empirical-Investigation," *Information Systems Research*, vol.6, no.1, pp.3-23, 1995.

[38] R. G. Fichman, "Real options and IT platform adoption: Implications for theory and practice," *Information Systems Research*, vol.15, no.2, pp.132-154, 2004.

[39] N. Melville, K. Kraemer and V. Gurbaxani, "Review: Information technology and organizational performance: An integrative model of IT business value," *MIS Quarterly*, vol.28, no.2, pp.283-322, 2004.

[40] J. C. Henderson and N. Venkatraman, "Strategic alignment: Leveraging information technology for transforming organizations," *IBM Systems Journal*, vol.38, no.2, pp.472-484, 1993, 1999.

[41] N. Venkatraman, "IT-enabled Business Transformation: From Automation to Business Scope Redefinition," *Sloan Management Review*, vol.35, no.2, pp.73-87, 1994.

[42] M. A. West, "Sparkling fountains or stagnant ponds: An integrative model of creativity and innovation implementation in work groups," *Applied Psychology-an International Review*, vol.51, no.3, pp.355-387, 2002.

[43] R. G. Fichman, "The role of aggregation in the measurement of IT-related organizational innovation," *MIS Quarterly*, vol.25, no.4, pp.427-455, 2001.

[44] S. Nambisan, "Information systems as a reference discipline for new product development," *MIS Quarterly*, vol.27, no.1, pp.1-18, 2003.

[45] P. A. Pavlou and O. A. El Sawy, "From IT leveraging competence to competitive advantage in turbulent environments: The case of new product development," *Information Systems Research*, vol.17, no.3, pp.198-227, 2006.

[46] S. Gordon and M. Tarafdar, "How do a company's information technology competences influence its ability to innovate?," *Journal of Enterprise Information Management*, vol.20, no.3, pp.271-290, 2007.

[47] M. Tarafdar and S. Gordon, "Understanding the influence of information systems competencies on process innovation: A resource-based view," *Journal of Strategic Information Systems*, vol.16, no.4, pp.353-392, 2007.

[48] B. Wierenga and G. H. van Bruggen, "The dependent variable in research into the effects of creativity support systems: Quality and quantity of ideas," *MIS Quarterly*, vol.22, no.1, pp.81-87, 1998.

[49] T.Dewett and G.R.Jones, "The role of information technology in the organization: a review, model, and assessment," *Journal of Management*, vol.27, no.3, pp.313-346, 2001.

[50] M.I.Kafouros, "The impact of the Internet on R&D efficiency: theory and evidence," *Technovation*, vol.26, no.7, pp.827-835, 2006.

[51] D. De Grosbois, U. Kumar and V. Kumar, "Internet-based technology use and new product time-to-market: The moderating effect of product innovativeness," *International Journal of Innovation Management*, vol.14, no.5, pp.915-946, 2010.