Measuring innovation competencies for integrated services in the communications industry

Hsien-Tang Ko (Corresponding Author)
Graduate Institute of Management
National Taiwan University of Science and Technology
No. 43, Sec. 4, Keelung Road, Taipei 106, Taiwan
Tel.:+886 2 2655 8500; Fax: +886 2 2655 8337
Email: D9416942@mail.ntust.edu.tw

Hsien-Tang Ko received a B.S. degree in electrical engineering from the Tamkang University in Taiwan in 1978, an M.S. degree in information engineering from the Tamkang University in Taiwan in 1982, and an MBA degree from the National Taiwan University in Taiwan in 2003. He joined the Institute for Information Industry (III) in Taiwan in 1984. Mr. Ko has hosted the "Telecom Applications Platform Development and Promotion Program" since 2002. Also working as an executive secretary of the "Committee of Communications Industry Development Ministry of Economic Affairs" since 2002, he is responsible for stimulating Taiwan's communications industry via technological development and industrial promotion. Meanwhile, he is also a Ph.D. candidate at the Graduate Institute of Management, National Taiwan University of Science and Technology in Taiwan. His major research interests include technology and innovation management, information management, and innovative application services of the broadband communications industry.

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Hsi-Peng Lu
Department of Information Management
National Taiwan University of Science and Technology
No. 43, Sec. 4, Keelung Road, Taipei 106, Taiwan
Email: lu@mail.ntust.edu.tw

Hsi-Peng Lu is a Professor of MIS at the National Taiwan University of Science and Technology. He received his Ph.D. and M.S. degrees in industrial engineering from the University of Wisconsin-Madison in 1992 and 1991 respectively. Working as a TV program host since 1996, Dr. Lu has interviewed more than 1,000 CEOs in Taiwan. This has helped him become very familiar with development policies on industrial technologies and trends in Taiwan. His research work has appeared in journals such as *Information & Management*, *Omega*, *European Journal of Operation Research*, *International Journal of Information Management*, and *International Journal of Technology Management*.

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Measuring innovation competencies for integrated services in the communications industry

Abstract

Purpose –The purpose of this study is to gain insight into firms' innovation competencies and to develop an instrument to examine the key innovation competencies that contribute to integrated services.

Design/methodology/approach – Data was collected via the initial 80-item questionnaire given to innovation-related key figures within the Taiwanese communications industry. (sample size 500; valid response rate 75.4 percent). The initial 80 items of innovation competencies and development procedures of measurement instrument were explored, exploited, and analyzed. The instrument validity of the multi-aspect innovation competencies measure was evaluated through assessing convergent, discriminant and predictive validity.

Findings – Research results indicate that 5-dimension and 17-item constructs the measurement instrument of innovation competencies for integrated services. An examination of individual dimensions' effect on "Overall innovation competencies" shows that Industry-specific (0.45) is the most important dimension, followed by Market-related (0.23), Technology-related (0.14), Product-related (0.13), and Organization-related (0.13).

Research limitations/implications – This study was conducted in only one industry (communications) and one country (Taiwan).

Practical implications – Integration capabilities of different innovation competencies of a firm is vital for the successful development of integrated services, and out of all the innovation competencies, Industry-specific innovation competencies are the most important. A firm should then indentify potential markets and trends and fully utilize their Human resource capabilities to develop innovative services, along with senior executives' awareness and acceptance of risk.

Originality/value – This paper may be the first to identify the measurement instrument of innovation competencies for integrated services and will expand the scope of service innovation research.

Keywords service innovation, innovation competencies, integrated services, factor analysis, LISREL, communications industry

Paper type Research paper

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1. Introduction

Innovation has become a major focus of attention for business, industry, government, and academia throughout the world and is recognized as a key factor of a firm's success and long term growth (Geroski, 1995, Cre′pon et al., 1998, Roper and Love, 2002). Researchers have examined innovation from different perspectives ranging from product, market, technology organization, etc.

Prahalad and Hamel (1990) introduced the notion of 'core competencies', which influenced management theory in the 1990s. Firms have a need to focus on identifying and developing their own competencies, which would play important roles in the firm's future success. By linking the new concept with the innovation theory, Pavitt (1991) asserted that firms could gain innovative advantage through building up their competencies which are costly and difficult for competitors to imitate.

In recent years, the economies of developed countries have shifted from production oriented to services dominated (Palmer, 2001). The service industry has been gaining a strong connection to GDP (gross domestic product) of industrialized countries (Froehle et al., 2000). Integrated services give value to ICT (information and communications technology), in which Taiwan plays a leading role, and contribute to the growth of the global economy.

The services market in the communications industry is dominated by fast changes as well. For example, global operators are facing declining revenue generated from traditional telephone service. Those revenue are gradually eroded by emerging VoIP (Voice over IP) services, which is offered through multiple devices (PC, mobile phone, etc,.) and multiple networks (Internet network and Mobile network, etc,.), functioning as an integrated service. Apparently, a thorough understanding of innovation competencies for integrated service is necessary and becoming more crucial under this economic change. Furthermore, the

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implication is that customers need to be physically and virtually present throughout the delivery of integrated services in order to receive the desired benefits of such services.

The measurement of innovation competencies for integrated services in the communications industry may bring important theoretical and practical implications, especially when there are very few researchers that have examined this before. Therefore, this paper tries to propose a framework for measuring innovation competencies for integrated services in the communications industry. Based on related literatures on a firm's competencies determining its innovations (e.g., Leonard-Barton, 1992; Tidd, 2000; Souitaris, 2002a; Ritter, 2006), we propose a model for measuring the generic innovation competencies for integrated services. According to Boer and During (2001), the definition of innovation is the creation of a new type of Product-Market-Technology-Organization-combination (PMTO-combination). The dimensions of our proposed model will include Product-related innovation competencies, Market-related innovation competencies, Technology-related innovation competencies, and Organization-related innovation competencies. In addition, our proposed model also includes industry-specific items of innovation competencies for integrated services, which are developed through conducting qualitative in-depth interviews with 10 communications industry experts.

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The main objectives of this paper are:

- To find out suitable ways to develop future integrated services by measuring the perception of innovation-related key figures on innovation competencies.
- To identify the most important innovation competencies by empirically testing the association between innovation activities and the firm's competencies
- Finally, to develop the measurement instrument and examine the structural model of

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innovation competencies as an overall assessment of innovation competencies for integrated services.

In the following paper we started discussing various background topics (section 2). The initial 80-item questionnaire is then formulated to determine the effect of the items on innovation competencies (section 3). The research methods used are then described and investigated in an empirical study (section 4). To be later identified is the measurement instrument. The structural model of innovation competencies as an overall assessment is then examined (section 5). Finally, the conclusions of the study are discussed, including the findings, managerial implications, limitations of the study and suggestions for further researches (section 6).

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2. Background

2.1 Classification of innovation

Various researchers have adopted different ways of classifying innovation. Robbins (1996) noted that organization innovation can be applied to the improvement of products, services and processes; organizational innovation thus encompasses product innovation, the development of new production process technology and the adoption of new management systems. Oldham and Cummings (1996) also held that successful execution in the form of products, processes and services can be considered to constitute organizational innovation.

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Carter and Jennings (2002) defined innovation as technology-based inventions, driven by the emergence of new markets or new service opportunities. Naver and Slater (1990) pointed out the connection between successful innovation and market-oriented behavior. Atuahene-Gima (1996) confirmed that new product innovation was correlated with market-oriented behavior.

Researchers have divided innovation into a wide range of different dimensions, including product innovation, process innovation, technological innovation, organizational innovation, market innovation, and service innovation. The classifications vary depending on the researchers and the fields of research. In other words, an extensive review of the literature shows that significant linkages exist between the various classification schemes. To classify innovations we need to first understand what causes that particular innovation which leads us to the next discussion on determinants of innovation.

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2.2 The conceptual framework for determinants of innovation

Innovation is generally accepted to be one of the main drivers behind business competitive strategy. A wide range of innovation frameworks have been developed in line with firms' strategic objectives. However, they all tend to emphasize certain key determinants. Table 1 presents a comparison of the conceptual framework underlying the key determinants of innovation.

Table 1
A comparison of conceptual framework for determinants of innovation

Authors	Aspects	Determinants
Leonard-Barton (1992)	The author adopts a knowledge-based view of the firm and defines a core capability as the knowledge set that distinguishes and provides a competitive advantage in new	Technical systems Skills & knowledge embodied in people Managerial systems

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Authors	Aspects	Determinants
	product development.	Values & norms
Tidd (2000)	The author classifies the firm's core competencies into three categories. These competencies are used by the firm to develop new or improved products and services.	Technological competencies Organizational competencies Market competencies
Souitaris (2002a)	The author's main contribution is a customized set of firm-specific competencies of determinants of innovation for the Greek manufacturing industry.	Technological competencies Human resource competencies Organizational competencies Market competencies
Ritter (2006)	The author's main contribution is to discuss a model on the development of a firm's capabilities and an understanding of when to use competency-based communication.	Product competencies Process competencies Market competencies Communicating competencies

Leonard-Barton (1992) identified four dimensions of innovation-related core competencies: Technical systems, Skills and knowledge embodied in people, Managerial systems, and Values and norms. Tidd (2000) presented an alternative classification, grouping People's knowledge, Managerial systems and Norms together in a broader "Organizational competencies" dimension. Tidd also added an additional "Market competencies" dimension to cover firm's ability to understand and develop markets. The end result is a three-dimensional framework covering Technological, Market and Organizational competencies, all of which are clearly related to innovation. Souitaris (2002a) used Tidd's Technology – Market – Organization framework, but separated the Human-resource competencies from the organization category to create a fourth grouping. Souitaris thus presents a four-dimensional framework for examining the linkages between Technology, Market, Human resources and Organizational competencies and a firm's innovation activities. Leonard-Barton, Tidd and Souitaris all seek to classify the specific competencies that determine a firm's ability to

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innovate.

Three different areas of competencies: Product, Process, and Market, have been explicitly or implicitly distinguished by many authors (Winter, 2003; Ford and Saren, 2001). The three competencies are undoubtedly interdependent. For example, higher levels of Product competencies may be achieved through better market intelligence and customer feedback by interacting with customers, enabled through Market competencies. Then, Ritter (2006) established another dimension, Communicating competencies, to help firms choose the exact competencies (such as Process, Product or Market) to focus on and translate in different marketing phases. Translations are based on the knowledge and insights of the suppliers, which increase along with the different phases. This means that a supplier has to develop the ability to translate its competencies forward, or to backwards translate a given customer request into its competencies in order to develop and fulfill a relevant promise.

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2.3 Definition and characteristics of integrated services

For the purposes of this present study, "integrated services" is defined as the developments of new equipments/devices (physical products) and the provision of applicable services (virtual services) to consumers and business firms, under communications network environment through a firm's innovative activities and its utilization of competencies. Therefore, the combination of physical products and virtual services are a fundamental characteristic of integrated services.

For example, remote residential surveillance services require customer premises equipments (CPE) such as IP Cameras and Home Gateways, in addition to an advanced communications network, to successfully transmit surveillance videos to the service providers' systems, which will in turn transmit the videos to personalized end-user devices

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(such as mobile phones). Such architecture is essential to enable an anywhere, anytime surveillance service. Therefore, the paper believes that a system that includes products, networks and services is essential to integrated services.

3. The development of an initial set of items

Our review of related literatures and past researches showed a lack of relevant definitions and empirical studies for integrated services in the communications industry. Based on the definition mentioned above, the determinants of integrated services were proposed. The initial set of items of innovation competencies were developed as two categories covering generic items and industry-specific items. The following two sections present an in-depth discussion on the items of firm's innovation competencies selected for inclusion in our analytical model.

3.1. Generic items of innovation competencies for integrated services

Based on related literatures of firms' competencies determining innovation and PMTO-combination, we proposed the generic items for measuring the innovation competencies as an integrated framework covering Product-related, Market-related, Technology-related, and Organization-related innovation competencies.

3.1.1. Items selected for Product-related innovation competency dimension

The provision of integrated services to consumers and business firms is performed through the medium of products. In order to develop new products and to provide integrated services to consumers and firms, it is at first necessary to have a clear understanding of

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consumers' needs. Firms need to have mechanisms in place that will facilitate innovation and the commercialization of new products that are tailor-made to meet customers' needs. To be commercialized, the new products must provide the characteristics of relative advantage, compatibility, and simplicity; consumers and business firms will only be willing to adopt integrated services if they possess these qualities.

The Product-related innovation competency dimension covered in the present study is based on those presented in the literature, and is divided into three sub-dimensions.

- Customization capabilities: Integrated services are ultimately intended to be adopted by the consumer; it is therefore important to know what the consumers' needs are, so that customization capabilities can be developed to meet these needs (Cooper, 1990, 1994; Souitaris, 1999, 2002b; Martin and Horne, 1993; Ottenbacher et al., 2006).

- Human resources capabilities: Human resources represent a clearly definable capability; employees' skills and knowledge constitute one of the key factors affecting the development of innovative new products. Firms can provide incentives to encourage employees to come up with innovative ideas, while the establishment of mechanisms to stimulate innovation can facilitate the leveraging of employee creativity in the design of innovative new products (Souitaris, 1999, 2002a, 2002b).

- Product characteristics: Innovation diffusion theory assumes that diffusion depends on five overall characteristics: relative advantage, compatibility, complexity, observability, and testability (Roger, 1983; Tornatzky and Klein, 1982). A statistical analysis of the research results relating to innovation characteristics and innovation adoption were presented. Their analysis demonstrated the importance of compatibility, complexity, and relative advantage within the overall adoption decision-making process.

To achieve the objectives outlined above, the Product-related innovation competency

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dimension related literature sources listed in Table 2 were selected:

Table 2
Summary of items selected for Product-related innovation competency dimension literature review

Items	Sources
Customization capabilities	
Commercialization capabilities of innovative products/services	Kotler (1994); Martinich (2005)
Customer relationship management capabilities	Slater and Mohr (2006)
Flexible customization capabilities of innovative products/services	Alegre-Vidal et al.(2004); Caird (1994); Hipp and Grupp (2005)
Human resources capabilities	
Ways to stimulate innovation creation	Acs and Audretsch (1988); Davenport and Prusak (1998); Handfield et al. (1999)
Mechanisms for inspirational innovation and realization	Gopalakrishnan and Damanpour (1997); Stock et al.(2002)
Ability to systematically build up creativity	Baumol (2002); Drucker (1985)
employee enthusiastically participation in innovation activity	Caird (1994); Lindman (2002)
A number of multi-skilled employees	Caird (1994); Malhotra et al. (1996); Zahra and Bogner (2000)
Ability to accumulate innovation experiences	Abernathy and Utterback (1978); Hall and Bagchi-Sen (2002)
R&D capability of emerging technologies	Baumol (2002); Handfield et al. (1999); Uzun (2001)
Ability to develop new products/services using the firm's existing technical capabilities	Garud and Kumaraswamy (1995)
Ability to speed up new products/services' commercialization	Caird (1994); Martinich (2005)
Ability to attract excellent employees	Ottenbacher et al. (2006)
Product characteristics	
Product originality	Baumol (2002); Lindman (2002)
Capability of innovative product differentiation	Martinich (2005); Suzuki and Kodama (2004)
New products/services with advantage over competitors	Gopalakrishnan and Damanpour (1997); Holak and Lehmann (1990); Nahar et al (2006); Roger (1983); Tornatzky and Klein (1982)
Product compatibility	Nahar et al (2006); Roger (1983); Tornatzky and

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Items	Sources
	Klein (1982); Zahra et al.(1994)
Ability to develop innovative products/services with ease-of-use user interface	Song and Parry (1994); Hipp and Grupp (2005)
Ability to develop products/services with high reliability	Hipp and Grupp (2005)

3.1.2. Items selected for Market-related innovation competency dimension

While assessing integrated services, the ability to commercialize products/services successfully in new markets is vitally important. Firms need to explore the range of potential markets in order to identify market opportunities; firms also need the ability to roll out new services to market in the shortest time.

The Market-related innovation competency dimension covered in the present study is based on those presented in the literature, and is divided into two sub-dimensions:

- Marketing capabilities: A firm needs to be able to identify those market segments that are worth entering, and to be able to appraise the market size. A firm also needs to be able to achieve careful timing in the extension of services innovation into a new market (Cooper, 1990, 1994; Rothwell and Zegveld, 1985; Ottenbacher et al., 2006).

- Time to market capabilities: To take an example, a recent study of strategic perspective is concluded by Coriat and Weinstein (2002), when innovating and developing new products, a firm needs to focus on reducing time-to-market, and on making sure that product characteristics meet customers' needs. Several researchers have noted that successful innovation is often the result of new needs and a solution to those needs appearing at around the same time (Chau and Tam, 2000; Gopalakrishnan and Damanpour, 1997).

To achieve the objectives outlined above, the Market-related innovation competency

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dimension related literature sources listed in Table 3 were selected:

Table 3
Summary of items selected for Market-related innovation competency dimension literature review

Items	Sources
Marketing capabilities	
Ability to identify potential markets of innovative products/services	Brown and Eisenhardt (1995); Kotler (1994) ; Martinich (2005)
Ability to grasp market trends	Caird (1994); Kotler (1994); Stock et al.(2002)
Time to market capabilities	
Ability to familiarize with customer needs	Caird (1994); Keizer et al. (2002); Malhotra et al. (1996)
Ability to develop practical innovative products/services	Barras (1990); Watanabe et al. (2001)
Ability to innovate distribution	Davenport and Prusak (1998)
Ability to globalize its innovative products/services	Watanabe et al. (2001)
Ability to secure first-mover advantage	Alegre-Vidal et al. (2004); Caird (1994); Hall and Bagchi-Sen (2002); Stock et al. (2002)

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3.1.3. Items selected for Technology-related innovation competency dimension

A firm developing integrated services could achieve its goals through the medium of different technologies and products, the accumulation of R&D capabilities is thus of key importance. A firm must possess technological competencies in order to successfully and smoothly develop innovative products/services.

The Technology-related innovation competency dimension covered in the present study is based on those presented in the literature, and is divided into two sub-dimensions:

- R&D activities: An extensive body of empirical research demonstrates that R&D activity is a key factor in firm's innovation performance (Slater and Mohr, 2006; Souitaris, 1999, 2002a, 2002b; Vega-Jurado et.al, 2008). A greater emphasis on R&D within a firm can

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expand the potential for the creation of new knowledge, thereby facilitating the development of new and improved products (Cooper and Kleinschmidt, 1995).

- Technological capabilities: Firms need to build up their specialized technological capabilities (Hoffman et.al 1998), and they should focus on securing a lead over their competitors through the development of cutting-edge technology. Developing the capabilities needed to integrate different technologies can also contribute to the cultivation of the firm's overall technological competencies, thereby establishing a solid foundation for the development of innovative products/services (Leonard-Barton, 1992; Ottenbacher et al., 2006).

To achieve the objectives outlined above, the Technology-related innovation competency dimension related literature sources listed in Table 4 were selected:

Table 4
Summary of items selected for Technology-related innovation competency dimension literature review

Items	Sources
R&D activities	
High R&D expenditure	Pujari et al.(2004)
High fundamental research expenditure	Hall and Bagchi-Sen (2002); Pujari et al. (2004)
Ability to apply for a number of patents	Moser and Morrissey (1984); Uzun (2001)
Ability to acquire and hold a number of patents	Bowman-Upton et al.(1989); Moser and Morrissey (1984); Kumar and Jain (2003)
Technological capabilities	
Progressive capability of innovative technology	Abernathy and Utterback (1978); Moser and Morrissey (1984), Porter (1985)
Technology integration capability	Burgelman et al. (1996); Uzun (2001); Zahra, Sisodia, and Das (1994)
Ability to utilize fundamental technology	Cooper (1994); Stock et al.(2002)
Competitively proprietary technology	Baumol (2002); Cooper (1985)
High number of patents being used by other parties	Acs and Audretsch (1988); Johne and Pavlidis (1995); Stock et al. (2002)

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3.1.4. Items selected for Organization-related innovation competency dimension

Technology-related innovation competencies, Product-related innovation competencies and Market-related innovation competencies are dimensions of innovation competencies for integrated services and cannot operate independently. For a firm to achieve maximum benefit from innovation competencies, these dimensions must be integrated with the organization's goals, strategies, managerial capabilities, organizational structure and corporate culture.

The Organization-related innovation competency dimension covered in the present study is based on those presented in the literature, and is divided into six sub-dimensions:

- Operation management: Innovative firms tend to emphasize quality and flexibility. The correspondence between operational capabilities and product innovation strategy has been shown to be one of the most significant characteristics of those firms that have a clear direction towards the development of innovative products/services (Alegre-Vidal et. al, 2004).

- Supply chain management: Integrated services must take the form of products with the aim of achieving the ultimate goal of providing services to the customers. A firm needs to allocate and use its resources effectively and efficiently to ensure a stable supply of raw materials (Tan, 2001).

- Organizational structure: Centralized control, complexity, formalization, scale, strategy and goals are among the most common organizational features affecting innovation (Souitaris, 1999, 2002b).

- Management attitude: The senior executives had a demonstrative and risk-taking attitude towards innovations in order to achieve best results. (Khan and Manopichetwattana, 1989; Souitaris, 1999, 2002b; Martin and Horne, 1993); they also tend to assume that the

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costs of introducing new technology can be recouped more quickly than is generally believed to be the case.

- Business strategy: A firm's development of services innovation needs to be based on its core competencies. In the process of developing integrated services, a firm must take into consideration their market potential, the size of the investment required, and price competitiveness, so as to create value through brand development. (Hipp and Grupp, 2005). Research has shown that firms with high rates of innovation tend to be characterized by the adoption of well-defined business strategies and comprehensive integrated services development plans (Rothwell, 1992; Souitaris, 1999, 2002b).

- External resource management: When developing integrated services, a firm needs to be able to make effective use of external resources in combination with the firm's own core competencies, so as to gain maximum benefit from the resources utilized (Souitaris, 1999, 2002b).

To achieve the objectives outlined above, the Organization-related innovation competency dimension related literature sources listed in Table 5 were selected:

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Table 5
Summary of items selected for Organization-related innovation competency dimension literature review

Items	Sources
Operation management capabilities	
Mass production capability	Alegre-Vidal et al. (2004)
Flexible production capability	Hall and Bagchi-Sen (2002); Hart and Simmie (1997)
Quality assurance capability	Calantone et al. (1999); Driva et al. (2001); Hart et al. (2003); Kim and Lim (1988); Lin and Chen (2004); Tatikonda and Montoya-Weiss (2001); Zirger and Maidique (1990)

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Items	Sources
Supply chain management capabilities	
Ability to efficiently deliver raw material and products/services	Slater and Mohr (2006); Pujari et al. (2004)
Ability to stably obtain raw materials	Kanji (1996); Slater and Mohr (2006); Tan (2001)
Ability to utilize resources effectively and balance their allocation	Dougherty and Bowman (1996)
Organizational structure	
High interaction between marketing and R&D departments	Keizer et al. (2002); Rafiq and Saxon(2000)
Formal and informal network relationships	Robbins (1994)
Efficiency of information exchange and communication	Brown and Duguid (1991)
Formal and informal R&D-related activities	Zahra et al. (1994)
Management attitude	
High risk acceptance by senior managers in innovative products/services development	Danneels and Kleinschmidt (2001)
High risk acceptance by senior managers in innovative products/services commercialization	Cooper and Kleinschmidt (1995); Gopalakrishnan and Damanpour (1997); Lindman (2002); Pujari et al. (2004)
High commitment in resources allocation to innovation activity by senior managers	Cooper and Kleinschmidt (1995); Hoffman et al. (1998); Malhotra et al. (1996)
Business strategy	
Horizontal integration capability within the industry	Doeringer and Terkla (1995)
High investment in innovation	Baumol (2002); Cooper and Kleinschmidt (1995); Gopalakrishnan and Damanpour (1997)
Ability to provide business services center	Caird (1994); Dougherty and Bowman (1996); Prahalad and Hamel (1990)
Ability to create brand awareness	Caird (1994); Keller (1993)
Price competitiveness	Monroe and Lee (1999)
Cost-down capability	Alegre-Vidal et al.(2004); Stock et al. (2002)
Accurate market surveys and sales forecasts	Mansfield (1974); Pujari et al. (2004)
Sound management capabilities	Keizer et al. (2002); Tidd (2001)
Ability to resolve customer complaints and problems efficiently	Ottenbacher et al. (2006)
External resource management capabilities	
Ability to use external resources	Martinich (2005); Robbins (1994)

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Items	Sources
Co-operation capability with external parties	Cooper and Kleinschmidt (1995); Souitaris (1999, 2002b)
Ability to gain supports from government	Duncan (1972)

3.2. Industry-specific items of innovation competencies for integrated services

In order to be more applicable and useful in measuring innovation competencies in the communications industry, it is necessary to develop industry-specific items. To generate items that comprise the domain of innovation competencies in the communications industry, a team of interviewers conducted one-on-one interviews with a sample of 10 communications industry experts. In these interviews, based on their experiences in developing innovative services, participants were asked to talk about their perception on the necessary innovation competencies.

To code the qualitative data thus obtained, a content analytic approach was conducted through three independent coders. First, three coders agreed on 20 industry-specific items. Secondly, three coders were asked to categorize the 20 items into four sub-dimensions based on similarities of items. Transcripts and items in each sub-dimension were further examined by panel discussion (with a panel consisting of two academics, two employees of the Committee of Communications Industry Development, Ministry of Economic Affairs, and two senior managers working in the communications industry) to assign names to each sub-dimension. This exercise led to the identification and labeling of the following four sub-dimensions of innovation competencies: System integration capabilities (5 items), Special process capabilities (4 items), Special function capabilities (5 items), and Special operation capabilities (6 items).

- System integration capabilities: The combination of physical products and virtual services are a fundamental characteristic of integrated services, which heavily based on

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the ICT environment. In order to develop integrated services, along with synergy from other industries, (e.g. cultural creativeness, security) and use software and hardware as a means of integration, a firm should have System integration capabilities including the following innovation competency items: Ability to integrate physical products and virtual services; Ability to instill cultural creativeness into integrated services; Ability to blend different industries for integrated services; Ability to renovate and redesign its previous works; Ability to evaluate software/hardware integration.

- Special process capabilities: The development process of integrated services requires a project team which should compose of members possessing a diverse range of domain knowledge, a standard procedure of process for members, and test planning and system validation abilities. In order to insure the quality development of integrated services, a firm should have Special process capabilities including the following innovation competency items: Ability to design and execute SOP (Standard of Process); Full support from a consulting team with proper domain know-how; Domain adaptive capability of project communication, coordination, and management; Ability to build up a proper testing plan and to ensure outcomes through established verification platform.

- Special function capabilities: In order to take the advantage of diverse broadband access technologies, follow multimedia trend , provide customized services, a firm should have Special function capabilities including the following innovation competency items: Multimedia human-machine interface of integrated services; Ability to mobilize integrated services through mobile or wireless network; Interactive visual-audio platform for integrated service; Ability to modulize and re-configurate integrated services; Ability to provide personalized integrated services.

- Special operation capabilities: Under customer-first strategy and in order to provide an

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on-line customer service system, transaction security mechanism, and automatic update and protection mechanisms for integrated services, a firm should have Special operation capabilities including the following innovation competency items: A system or mechanism for on-line help and interactive customer services; A system or mechanism for transaction security; A system or mechanism for the digital rights management (DRM); Flexible capability to accommodate changes; A system or mechanism to upgrade integrated services automatically; A system or mechanism for anti-hacking, prompt recovery and periodic backup for its integrated services.

4. Research methods

The framework for the initial 80 items of firm's innovation competencies was settled up and detailed analyzed, as shown in section 3. The design of a questionnaire was based on the initial 80 items consisting of generic 60 items and industry-specific 20 items. The initial 80 items were transformed into Liker-scales and the respondents were asked to indicate their perceptions of a firm's innovation competencies for integrated services as shown in Appendix A. A 5-point Likert-type scale was used where 1 = strongly disagree and 5 = strongly agree.

The survey was first applied to 120 individuals who attended a forum of innovative services. Those individuals worked in communications-related companies in Taiwan and were fully, or partially, responsible for developing innovative services. After the forum, we further asked them to collect more information from innovation-related employees in their organizations and a total of 500 questionnaires were then distributed.. After removing invalid questionnaires (missing and invalid answers, uncompleted, and left blank), 377 valid responses were collected, with a valid response rate of 75.4%.

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5. Instrument development

5.1. Sampling profile

The demographic information of respondents is described in Table 6. Of those who participated in the survey, 65.6% were male and 34.4% female. Individuals aged between 31 and 39 years is the largest group within the survey sample, or 55.5% of the total. The next largest groups were those aged 21 to 30 and 41 to 50, making up 22.0% and 19.6% of the total respectively. 94.7% of the respondents were at least a college degree. The largest group of respondents was comprised of non-management personnel (67.7%). Other interviewees included lower, middle and senior management personnel (19.0%, 9.5%, and 3.9% respectively). R&D accounted for the largest group, at 30.3%, while sales accounted and marketing personnel for 28.2% and 10.1% respectively. Among the respondents, ones that work in a system integrated company makes up the largest group of 29.4%, while application services software developer and services/contents provider are 12.2% and 7.4% respectively. Companies that employ more than one hundred employees accounted for 45.7% of all businesses in this paper.

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Table 6
Demographic information of the respondents

Demographic profile		Frequency	Percent (%)
Gender	Male	221	65.6
	Female	116	34.4
	Total	337	100.0
Age	Under 21	0	0.0
	21~29	74	22.0
	30-39	187	55.5
	40-49	66	19.6

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Demographic profile		Frequency	Percent (%)
	Over 50	10	0.3
	Total	337	100.0
Department	Human resource	20	5.9
	Marketing	34	10.1
	Sales account	95	28.2
	Production	28	8.3
	Research and Development	102	30.3
	Financial	16	4.7
	Others	42	12.5
	Total	337	100.0
Position	General staff	228	67.7
	Lower management	64	19.0
	Middle management	32	9.5
	Senior management	13	3.9
	Total	337	100.0
Major business	Equipment vendor	53	15.7
	Component vendor	67	19.9
	Mobile handheld vendor	10	3.0
	Software developer	41	12.2
	System integrator vendor	99	29.4
	Services/Contents provider	25	7.4
	Telecom operator	29	8.6
	Others	13	3.9
	Total	337	100.0
Company's scale (employees)	1-49	102	30.3
	49-100	81	24.0
	101-300	81	24.0
	301-500	36	10.7
	501-1000	8	2.4
	Over 1000	29	8.6
	Total	337	100.0

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5.2. Item reduction and exploratory investigation of dimensionality

This paper is based on the suggestion of Churchill (1979), that the purification of an instrument first carry out reliability analysis and items analysis to increase the reliability of the measurement instrument. This study assumed single construct of the measurement instrument of innovation competencies before using exploratory factor analysis in order to discover important dimensions. Based on this assumption, the reliability of the items at the start was 0.941. The items analysis in this study uses the item-to-total method to conduct item reduction. If an item's item-to-total value is below 0.45 this item would be removed.

Following reliability analysis, exploratory factor analysis (principal components with varimax rotation) was applied to identify critical dimensions and items for measuring innovation competencies. The analysis was conducted using SPSS (13.0). Item analysis was also used to ensure that each item was assigned to its proper dimension. Each of the extracted items was presented in the rotated component matrix (see Table 7). According to the guidelines by Hair et al. (1998), to obtain a power level of 80% at a 0.05 significance level with 337 responses, a factor loading of 0.50 is required. We applied two criteria to decide the number of dimensions that can be identified: eigenvalues greater than 1.0 (Hair et. al,1998) and an item was assigned to a given dimension if it had a factor loading of at least 0.50 on the dimension, as well as low cross-loadings on all other dimensions (Edvardsson et. al,1997). After dropping low-loading items, we derived 5 dimensions (see Table 7).

Items within each dimension were carefully examined through a panel discussion to give each dimension an appropriate name. Finally, we recommend the measurement instrument to be constructed by 5-dimension and 17-item shown in Table 7, which could reflect and explain 63.493% of the information in all variables.

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Table 7

Rotated component matrix [a, b]

Items	Factor loadings				
	F1	F2	F3	F4	F5
S1: Integrate physical products and virtual services	0.654				
S2: Domain adaptive capability of project communication, coordination, and management	0.649				
S3: Multimedia human-machine interface of integrated services	0.629				
S4: A system or mechanism for transaction security	0.747				
S5: A system or mechanism for the digital rights management (DRM)	0.684				
P1: Ways to stimulate innovation creation		0.710			
P2: Mechanisms for inspirational innovation and realization		0.760			
P3: Systematically build up creativity		0.734			
P4: Employee enthusiastically participating in innovation activity		0.636			
O1: High risk acceptance by senior managers in innovative products/services development			0.736		
O2: High risk acceptance by senior managers in innovative products/services commercialization			0.837		
O3: High commitment in resources allocation to innovation activity by senior managers			0.728		
M1: Develop products/services with high reliability				0.665	
M2: Identify potential markets of innovative products/services				0.765	
M3: Grasp market trends				0.792	
T1: High R&D expenditure					0.812
T2: High fundamental research expenditure					0.830
Eigenvalue	2.682	2.355	2.121	2.005	1.630
% of variance explained	15.775	13.855	12.475	11.797	9.591
Cronbach's alpha	0.781	0.751	0.801	0.731	0.743

[a] The factor loadings less 0.30 are not shown.

[b] F1: Industry-specific, F2: Product-related, F3: Organization-related, F4: Market-related, F5: Technology-related.

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5.3. Assessment of measurement instrument

Confirmatory factor analysis (CFA) using LISREL (Joreskog and Sorbom, 1996) was then applied to the five-factor measurement model to further test dimensionality as well as convergent and discriminant validity. The measures chosen to estimate the model fit are chi-square/degree of freedom (χ^2/d.f.), the goodness-of-fit index (GFI), the AGFI (adjusted GFI), the normed fit index (NFI), the non-normed fit index (NNFI), the comparative fit index (CFI), the incremental fit index (IFI), the standardized root mean square residual (SRMR), and the root mean square error of approximation (RMSEA). The results are shown in Table 8. For all cases, the indices met their respective common acceptance levels suggested by previous literatures (Bentler and Bonett, 1980; Hair et al., 1998; Scott, 1994; Seyal et al., 2002).

The reliability and validity of the measurement instrument were also tested. Results are shown in Tables 8 and 9. For all dimensions, the standardized factor loadings all reached a significant level, and the composite reliability (CR) were all above 0.6, showing good reliability on all measures (Bagozzi and Yi, 1988; Hair et al., 1998). Validity was assessed in terms of content, convergent, and discriminant validity. Content validity was qualitatively evaluated by examining the data collection and processing method to ensure that the innovation competencies affect the development of integrated services. In addition, Convergent validity was assessed by Garbarino and Johnson (1999). If the validity test of each dimension or item is significant (t-value > 2) at the 5% level (two-tailed) that means the study is satisfactory for convergent validity. Results are shown in Table 8. Hence it satisfied the criterion of convergent validity. Finally discriminant validity was also tested, and results

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suggested that each dimension was much more closely related to itself than other dimensions (see Table 9), indicating support for discriminant validity (Fornell and Larcker, 1981).

Table 8
Scale items, standardized factor loadings, t-value, CR [a]

Items	Factor loadings	t-value	CR
Industry-specific dimension			0.782
S1: Integrate physical products and virtual services	0.70	13.57	
S2: Domain adaptive capability of project communication, coordination, management	0.70	13.50	
S3: Multimedia human-machine interface of integrated services	0.62	11.59	
S4: A system or mechanism for transaction security	0.60	11.14	
S5: A system or mechanism for the digital rights management (DRM)	0.61	11.25	
Product-related dimension			0.755
P1: Ways to stimulate innovation creation	0.62	11.37	
P2: Mechanisms for inspirational innovation and realization	0.70	12.98	
P3: Systematically build up creativity	0.73	13.78	
P4: Employee enthusiastically participating in innovation activity	0.58	10.39	
Market-related dimension			0.735
M1: Develop products/services with high reliability	0.65	11.68	
M2: Identify potential markets of innovative products/services	0.73	13.41	
M3: Grasp market trends	0.70	12.76	
Technology-related dimension			0.745
T1: High R&D expenditure	0.77	13.18	
T2: High fundamental research expenditure	0.77	13.31	
Organization-related dimension			0.809
O1: High risk acceptance by senior managers in	0.74	14.50	

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Items	Factor loadings	t-value	CR
innovative products/services development			
O2: High risk acceptance by senior managers in innovative products/services commercialization	0.84	17.09	
O3: High commitment in resources allocation to innovation activity by senior managers	0.72	13.99	
Model fit statistics	χ^2 = 183.09, df = 109, GFI = 0.94, AGFI = 0.92, NFI = 0.96, NNFI = 0.98, CFI = 0.98, IFI = 0.98, SRMR = 0.04, RMSEA = 0.045.		

[a] CR = composite reliability

Table 9
Standardized correlation matrix of dimensions [a]

Dimensions	1	2	3	4	5
Industry-related (1)	**0.663**				
Product-related (2)	0.580	**0.663**			
Market-related (3)	0.660	0.550	**0.693**		
Technology-related (4)	0.580	0.490	0.510	**0.771**	
Organization-related (5)	0.640	0.580	0.540	0.530	**0.764**

[a] Diagonal elements (in bold) are the square root of the average variance extracted.

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5.4. Predictive validity

We now examine predictive validity as a type of criterion-related validity, checking if the set of indicators called 'the test' is used to predict the outcome. The correlation between the test result and the criteria is the most important indicator of criteria-related validity (Pagani, 2007). In this paper, the set of indicators is related to the 5-dimension and 17-item measurement instrument; outcome is related to performance of innovation competencies. Performance is related to customer satisfaction/dissatisfaction and loyalty (e.g. Patterson, 1993; Cronin and Taylor, 1992; Van Riel et al., 2004), commercial success (e.g. Van Riel et al., 2004), firm's competitive position (e.g. Van Riel et al., 2004), and financial success (e.g. Van

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Riel et al., 2004). The predictive validity of the innovation competency measure was further evaluated by regressing performance on the 5-dimension (Sharma and OJHA, 2004). The performance measure was obtained by averaging the scores of the five items in the survey instrument (see Appendix B) namely, "Innovation competencies will contribute to a firm's development success of integrated services", "Innovation competencies will contribute to a firm's commercial success of integrated services", "Innovation competencies will contribute to a firm's market position of integrated services", "Innovation competencies will contribute to increase customer satisfaction and loyalty of integrated services", and "Innovation competencies will contribute to a firm's return on investment (ROI) of integrated services". The individual dimensions of innovation competencies significantly correlated with the performance (r was 0.588 with industry-specific dimension, 0.493 with Product-related dimension, 0.503 with Market-related dimension, 0.462 with Technology-related dimension, and 0.514 with Organization). The standardized regression coefficients for Industry-specific dimension, Product-related dimension, Market-related dimension, Technology-related, and Organization-related were 0.283, 0.170, 0.167, 0.148 and 0.152 respectively, and p was less than 0.01 for all cases as shown in Table 10. This confirms the predictive validity of the innovation competency measure.

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Table 10
The effects of the innovation competency dimensions on performance: the results of regression analysis [a]

Dimensions	Standardized beta coefficient	t-value	Significance
Industry-related	0.283	5.467	0.000
Product-related	0.170	3.561	0.000
Market-related	0.167	3.454	0.001
Technology-related	0.148	3.184	0.002
Organization-related	0.152	3.032	0.003

[a] $R^2 = 0.481$, Adjusted $R^2 = 0.473$, F = 61.248, significance = 0.000.

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5.5 Tests of the structural model for innovation competencies

The structural model of innovation competencies that this study suggested as an overall assessment is based on the 5-dimension and 17-item measurement instrument, "Overall innovation competencies", and "Performance". "Overall innovation competencies" mentioned above comprises of two items which are "Generally, a firm should have generic innovation competencies for integrated services" and "Generally, a firm should have industry-specific innovation competencies for integrated services", specifically developed for this research and included in the survey instrument (see Appendix B).

The results in Fig. 1 show that the model fits the data rather well (χ^2 = 430.71, df = 236, SRMR= 0.044, GFI = 0.90, AGFI = 0.88, NFI = 0.96, NNFI = 0.98, CFI = 0.98, RMSEA = 0.050). The direct effects of individual dimensions on "Overall innovation competencies" and the direct effects of "Overall innovation competencies" on "Performance" are significant. That is, the standardized regression coefficients from: (1) Industry-specific dimension to "Overall innovation competencies" (γ= 0.45; t = 4.84); (2) Product-related dimension to "Overall innovation competencies" (γ= 0.13; t = 1.75); (3) Market- related dimension to "Overall innovation competencies" (γ= 0.23; t = 2.82); (4) Technology-related dimension to "Performance" (γ= 0.14; t = 2.09); (5) Organization- related dimension to "Overall innovation competencies" (γ= 0.13; t = 1.80); and (6) "Overall innovation competencies" to "Performance" ($\beta 1$ = 0.91; t = 9.63) are all significant. In addition, 82 percent of the variance in "Overall innovation competencies" is explained by the 5-dimension and 83 percent of the variance in "Performance" is explained by "Overall innovation competencies".

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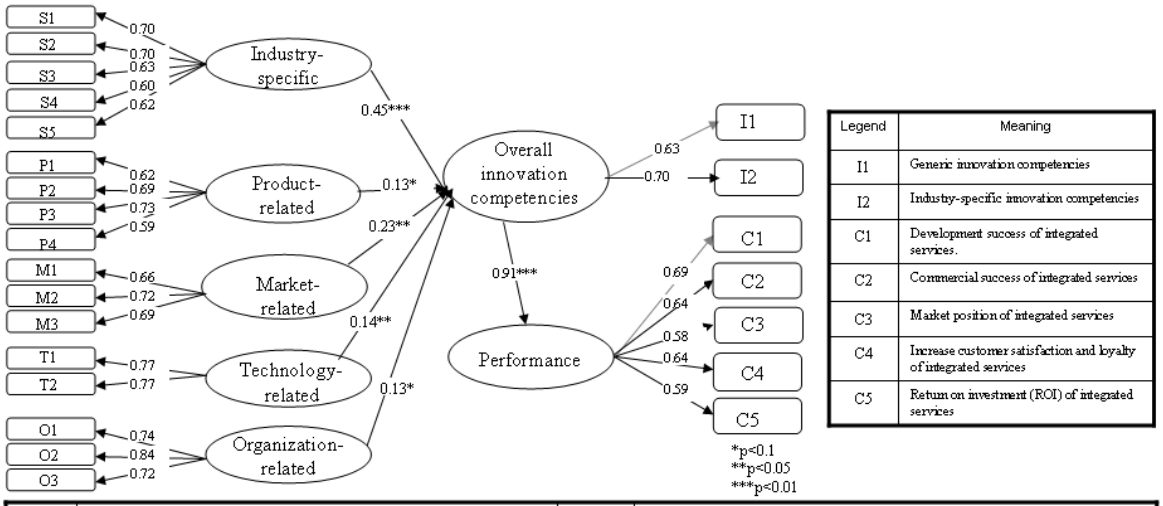

Legend	Meaning
I1	Generic innovation competencies
I2	Industry-specific innovation competencies
C1	Development success of integrated services.
C2	Commercial success of integrated services
C3	Market position of integrated services
C4	Increase customer satisfaction and loyalty of integrated services
C5	Return on investment (ROI) of integrated services

Legend	Meaning	Legend	Meaning
S1	Integrate physical products and virtual services	M1	Develop products/services with high reliability
S2	Domain adaptive capability of project communication, coordination, and management	M2	Identify potential markets of innovative products/services
S3	Multimedia human-machine interface of integrated services	M3	Grasp market trends
S4	A system or mechanism for transaction security	T1	High R&D expenditure
S5	A system or mechanism for the digital rights management (DRM)	T2	High fundamental research expenditure
P1	Ways to stimulate innovation creation	O1	High risk acceptance by senior managers in innovative products/services development
P2	Mechanisms for inspirational innovation and realization	O2	High risk acceptance by senior managers in innovative products/services commercialization
P3	Systematically build up creativity	O3	High commitment in resources allocation to innovation activity by senior managers
P4	Employee enthusiastically participating in innovation activity		

Chi-Square=430.71, df= 236, P-value=0.00, SRMR= 0.044, GFI =0.90, AGFI = 0.88, NFI = 0.96, NNFI = 0.98, CFI = 0.98, RMSEA = 0.050
Proportion of variance explained (R^2) in Overall innovation competencies = 0.82, Proportion of variance explained (R^2) in Performance = 0.83

Fig. 1. The structural model of innovation competencies for integrated services development

6. Conclusions

In the past, most researches on the innovation of the ICT industry were concentrated on the manufacturing aspect, mostly on technology and product innovations, while very few literatures were focused on integrated services. Therefore, this paper might be the first to identify the innovation competencies for integrated services, through combining literatures, in-depth interviews, surveys, and empirical studies.

6.1 Findings

This study identified the 17-item survey instrument to measure innovation competencies in the communications industry. The results showed that innovation competencies could be

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conceptualized and measured as a 5-dimensional construct consisting of Industry-specific, Product-related, Market-related, Technology-related, and Organization-related. The measurement instrument exhibited high internal consistency reliability and met rigorous conceptual and empirical criteria for instrument validity including content, convergent, discriminant, and predictive validity. Results may be regarded as an initial checklist in an attempt to quantitatively measure the coefficient between innovation competencies and important dimensions.

An examination of the standardized regression coefficients between individual dimensions and "Overall innovation competencies" in Fig. 1 shows that Industry-specific (0.45) is the most important dimension followed by Market-related (0.23), Technology-related (0.14), Product-related (0.13), and Organization-related (0.13).The implication of standardized loadings for each dimension and performance is shown as below:

Firstly, the two items with the highest loading value in Industry-specific dimension are "Integrate physical products and virtual services" (0.70), and "Domain adaptive capability of project communication, coordination, and management" (0.70). It can thus be seen that, a firm should have System integration capabilities when developing integrated services.

Secondly, the two items with the highest loading value in Product-related dimension are "Systematically build up creativity" (0.73), and "Mechanisms for inspirational innovation and realization" (0.69). It can thus be seen that, the human resources and the establishment of mechanisms stimulating innovation represent a clearly definable capability to develop innovative products/services.

Thirdly, the two items with the highest loading value in Market-related dimension are "Identify potential markets of innovative products/services" (0.72) and "Grasp market trends" (0.69). It can thus be seen that management should pay more attention to the potential markets

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and trends.

Fourthly, the two items with the highest loading value in Technology-related dimension are “High R&D expenditure” (0.77) and “High fundamental research expenditure” (0.77). When developing innovative products/services, it appears that a firm should increase budgets on R&D and fundamental research expenditure.

Fifthly, the two items with the highest loading value in Organization-related dimension are “High risk acceptance by senior managers in innovative products/services commercialization” (0.84), and “High risk acceptance by senior managers in innovative products/services development” (0.74). It appears that, when a firm seeks to develop innovative services, its chances of success depend on the managers’ willingness to accept risk.

Sixthly, the item with the highest loading value in “Overall innovation competencies” is “Generally, a firm should have industry-specific innovation competencies”(0.70). When developing integrated services, it appears a firm should pay more attention on industry-specific innovation competencies.

Finally, the three items with the highest loading value in “Performance” of innovation competencies are “Innovation competencies will contribute to a firm’s development success of integrated services” (0.69), “Innovation competencies will contribute to a firm’s commercial success of integrated services” (0.64), and “Innovation competencies will contribute to increase customer satisfaction and loyalty of integrated services” (0.64). It appears that, the integration capabilities of different innovation competencies of a firm are vital and these competencies will contribute to the increase of development success, commercial success, and customer satisfaction and loyalty.

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6.2 Managerial implications

In this paper, we identified the 5-dimension and 17-item measurement instrument and examined their respective weights of innovation competencies. Through our empirical results, we found out that the integration capabilities of different innovation competencies in a firm are vital for the development of integrated services innovation. Out of all the innovation competencies, Industry-specific innovation competencies are the most important and following would be the Market-related innovation competencies.

When developing integrated services in communications industry, it is the upmost priority that firms possess industry-specific innovation competencies. The "Integrate physical products and virtual services" is the most important item of System integration capabilities, "Domain adaptive capability of project communication, coordination, and management" is the most important item of Special process capabilities, "Multimedia human-machine interface of integrated services" is the most important item of Special function capabilities, and "A system or mechanism for transaction security" and "A system or mechanism for the digital rights management (DRM)" both are the most important items of Special operation capabilities.

Innovativeness can increase competitiveness and differentiation in products and services; however it could simultaneously increase consumer unfamiliarity, which might decrease the possibility of acceptance. Therefore, firms have to seize the market trend, understand the potential market segmentation, and recognize the consumers' needs before firms develop any kinds of innovative services. Only by doing this can firms fully make use of their R&D activities (e.g. high R&D expenditure) and Human resource capabilities to truly develop integrated services. In addition, developing an innovative products or services is a highly risky investment. Therefore, senior executives have to fully understand the risks involved and

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agree on devoting any needed resources in integrated services' development.

6.3 Limitations

The present study has several limitations. Firstly, it is based on testing performed within a single culture and a single market. The results obtained using a sample drawn from the Taiwanese communications industry may be considered too Taiwan-specific.

Secondly, the research is to some extent based on a "snapshot" of innovation competencies at a given point in time; it does not take into consideration the changing environment within which integrated services are developed. Ideally, a longitudinal study should be performed to follow up the development of integrated services over an extended time frame.

Thirdly, as "integrated services" constitutes a relatively new concept, some of those actually involved in its innovation might adopt different interpretations of its significance. Given the considerable time and effort needed for the literature review, and the impact of prejudices and received views on the small-group discussion, there may have been some room for improvement in the 80-item of a firm's innovation competencies used in forming the questionnaire.

Fourthly, to apply this study to other countries or regions, an additional research covering a wider area would be needed to verify the measurement instrument used through more precise evaluation and comparison because of the local cultural attitudes and the special characteristics of domestic firms.

6.4 Future research

It is hoped that the 5-dimension and 17-item construct can be used by the

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communications field as the measurement instrument while developing integrated services innovation. For this reason, it is hoped that this paper will be useful to the industry, government and academia in future research and business developments. However, the major limitation of this study is that although the results unveiled the initial measurement instrument, it is still necessary to develop a valid process and procedure for integrated services continuously to ascertain the execution.

Lastly, the following two suggestions for future research are proposed:

- Research on innovative competencies for integrated services in different countries and in different industries: the 5-dimension and 17-item obtained in this paper can also be applied to the successful development of integrated services in other industries as well as in other countries.
- Research on different service innovation types: new measurement instrument could be examined for particular categories of integrated services (e.g. services targeting residential customers, "on the go" services, etc.).

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Appendix A. 80 questionnaire items of innovation competencies for integrated services

Product-related innovation competency dimension

A firm should have commercialization capabilities of innovative products/services.

A firm should have customer relationship management capabilities.

A firm should have flexible customization capabilities of innovative products/services.

A firm should have ways to stimulate innovation creation.

A firm should have mechanisms for inspirational innovation and realization.

A firm should have ability to systematically build up creativity.

A firm should have employee enthusiastically participating in innovation activity.

A firm should have a number of multi-skilled employees.

A firm should have ability to accumulate innovation experiences.

A firm should have R&D capability of emerging technologies.

A firm should have ability to develop new products/services using the firm's existing technical capabilities.

A firm should have ability to speed up new products/services' commercialization.

A firm should have ability to attract excellent employees.

A firm should have product originality.

A firm should have capability of innovative product differentiation.

A firm should have new products/services with advantage over competitors.

A firm should have product compatibility.

A firm should have ability to develop innovative products/services with ease-of-use user interface.

A firm should have ability to develop products/services with high reliability.

Market-related innovation competency dimension

A firm should have ability to identify potential markets of innovative products/services.

A firm should have ability to grasp market trends.

A firm should have ability to familiarize with customer needs.

A firm should have ability to develop practical innovative products/services.

A firm should have ability to innovate distribution.

A firm should have ability to globalize its innovative products/services.

A firm should have ability to secure first-mover advantage.

Technology-related innovation competency dimension

A firm should have high R&D expenditure.

A firm should have high fundamental research expenditure.

A firm should have ability to apply for a number of patents.

A firm should have ability to acquire and hold a number of patents.

A firm should have progressive capability of innovative technology.

A firm should have technology integration capability.

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A firm should have ability to utilize fundamental technology.

A firm should have competitively proprietary technology.

A firm should have high number of patents being used by other parties.

Organization-related innovation competency dimension

A firm should have mass production capability.

A firm should have flexible production capability.

A firm should have quality assurance capability.

A firm should have ability to efficiently deliver raw material and products/services.

A firm should have ability to stably obtain raw materials.

A firm should have ability to utilize resources effectively and balance their allocation.

A firm should have high interaction between marketing and R&D departments.

A firm should have formal and informal network relationships.

A firm should have efficiency of information exchange and communication.

A firm should have formal and informal R&D-related activities.

A firm should have high risk acceptance by senior managers in innovative products/services development.

A firm should have high risk acceptance by senior managers in innovative products/services commercialization.

A firm should have high commitment in resources allocation to innovation activity by senior managers.

A firm should have horizontal integration capability within the industry.

A firm should have high investment in innovation.

A firm should have ability to provide business services center.

A firm should have ability to create brand awareness.

A firm should have price competitiveness.

A firm should have cost-down capability.

A firm should have accurate market surveys and sales forecasts.

A firm should have sound management capabilities.

A firm should have ability to resolve customer complaints and problems efficiently.

A firm should have ability to use external resources.

A firm should have co-operation capability with external parties.

A firm should have ability to gain supports from government.

Industry-specific innovation competency dimension

A firm should have ability to integrate physical products and virtual services.

A firm should have ability to instill cultural creativeness into integrated services.

A firm should have ability to blend different industries for integrated services.

A firm should have ability to renovate and redesign its previous works.

A firm should have ability to evaluate software/hardware integration.

A firm should have ability to design and execute SOP (Standard of Process).

A firm should have full support from a consulting team with proper domain know-how.

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A firm should have domain adaptive capability of project communication, coordination, and management.

A firm should have ability to build up a proper testing plan and to ensure outcomes through established verification platform.

A firm should have multimedia human-machine interface of integrated services.

A firm should have ability to mobilize integrated services through mobile or wireless network.

A firm should have interactive visual-audio platform for integrated service.

A firm should have ability to modulize and re-configurate integrated services.

A firm should have ability to provide personalized integrated services.

A firm should have a system or mechanism for on-line help and interactive customer services.

A firm should have a system or mechanism for transaction security.

A firm should have a system or mechanism for the digital rights management (DRM).

A firm should have flexible capability to accommodate changes.

A firm should have a system or mechanism to upgrade integrated services automatically.

A firm should have a system or mechanism for anti-hacking, prompt recovery and periodic backup for its integrated services.

Appendix B. Overall-related and Performance-related questionnaire items of innovation competencies for integrated services

Overall-related dimension (developed for this research)

Generally, a firm should have generic innovation competencies for integrated services development.

Generally, a firm should have industry specific innovation competencies for integrated services development.

Performance-related dimension

Innovation competencies will contribute to a firm's development success of integrated services.

Innovation competencies will contribute to a firm's commercial success of integrated services.

Innovation competencies will contribute to a firm's market position of integrated services.

Innovation competencies will contribute to increase customer satisfaction and loyalty of integrated services.

Innovation competencies will contribute to a firm's return on investment (ROI) of integrated services.

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