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Conceptual Model of Innovation Capability in Industrial and Academic Research Centers: A Systematic Review

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Abstract

Innovation capability has a multi-dimensional structure and the aggregate resultant performance of these dimensions would bring about the organizational success. The main aim of this study is to introduce a conceptual model of innovation capability in industrial and academic research centers. This paper is a systematic review of the papers published in the field of innovation capability dimension in industrial and academic R&D centers (especially medical sciences universities). The authors have used the standard guideline of systematic review (PRISMA). For this paper, more than 200 full-text articles published between 2000 and 2016 in valid scientific research journals were studied. Based on the conducted study, the innovation capability dimensions and their relationships in two internal and external dimensions were plotted in a conceptual model framework. On the basis of the reviewed studies, six intra-organizational capacities, the management and leadership, organizational resources, knowledge and information management, R&D, organizational culture and the organizational intangible aspects capacity, and two extra-organizational capacities, the environmental capacity of the organization and the extra-organizational relationships and interactions, effective in organization's innovation capability have been determined.

Keywords

Innovation Capability, Innovation Orientation, Innovativeness, Research Centers, R&D.

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Introduction

Research and Development (R&D) is the only path towards the production and knowledge acquisition and is the basis for the innovation, greater productivity, and sustainable and pervasive excellence (Paolillo & Brown, 1978; Brouwer & Kleinknecht, 1997; Ulku, 2007). Nowadays, it is the scientific research indices that determine a country's status and ranks amongst others. In developed countries, the investment on research and development is regarded as something self-evident; something that determines the budget allocation, financial issues and future conditions of the organizations (Rabiey, 2008).

The companies use the research and development for leading and support of the innovation (Edwin, 1991; Hall & Bagchi-Sen, 2002; Daniel Amrik, 2006). A history of the research and development in the developed countries especially Japan, United States, and China (over 60% of R&D costs spent worldwide) suggests their increased focus on innovation and entrepreneurship in the research and development issue (Yadollahi Farsi et al., 2012; Momaezi, 2013). The Chinese push ahead with the growth of science and technology through adopting the thinking "Science and technology is the first productive force". One of China's strategic policies for national development is encouraging the researchers to create innovations and to find ways for their application in industry (Xin, 2002). Long-term vision, the focus on human resources, intra-organizational growth, and accelerated innovation are among the most important features of management in the R&D section of Japan. The governing principle in Japanese research institutes is warmly welcoming and rapid circulation of new thoughts which causes the growth of innovation (Salehi & Banisi, 1996). In the United States, the commercialization of research results plays a major role in development and economic growth of the country (Karlsson, 2004). Self-entrepreneurship training in the universities and investment in innovation sector are considered as commercialization of research results in the United States (Jamaly & Shafizada, 2012). Iran’s 20-year vision plan considers 6 axes

aiming at technological development: "Conducting and leadership, research and development, budget allocation for research and development, human resource development, circulation of technology, and promotion of technological entrepreneurship" (SCCR, 2011).

The development and innovation plan of medical education and research has been arranged in line with moving towards the third university generation and empowerment of the medical sciences universities which is of top priorities of Iran's health system comprehensive plan of higher education (HBI, 2015).

World Health Organization defines the innovation in health system as identification of policies, systems, products and technologies, services, and new transportation methods or their improvement for the people's health and welfare (WHO, 2017). In fact, health innovation will be responsible for meeting the unmet needs of public health by developing new thought and work methods through focusing on the needs of vulnerable groups (WHO, 2017).

Innovation in any organization is vital for individuals, groups, and organizations (West & Altink, 1996). As a comprehensive definition, the innovation is defined as the organizational potential for rehabilitation of products, services, strategies, and new managerial activities (Kianto, 2008; Baregheh et al., 2009; Rosenblatt, 2011) applicable anywhere in the organization especially in the R&D unit.

The innovation capability means the capability, talent, potential, and ability to achieve innovation in the future (Cristina & Benavides-Velasco, 2004; Saunila & Ukko, 2012; Saunila, 2014; Aryanto et al., 2015). A set of skills and skill patterns used by the organizations for compilation and implementation of an innovative strategy that includes the creation, development, and optimization of resource for the innovation (Helfat & Peteraf, 2009; Malek Akhlagh et al., 2013), that can provide for the innovation probability in the future and continuity as well as the duration of existing innovation in the organization is called the organizational innovation capability (Dehqan et al., 2012). Numerous factors affect the organizational innovation capability; as an example, the knowledge and skills brought by an employee into the organization have a direct

relationship with the innovation capability of the organization (Raffai, 2014). The innovation capability assigns widespread spectrum dimensions and components to itself in the literature. In a study, the learning ability, research and development capability, marketing ability, ability of resources, and the organizational strategy have been introduced as the organizational innovation capability (Teece, 2009; Kindström et al., 2013). Also, the organizational structure and culture, type of strategy, knowledge process, market strategy, human resources management, legal and political framework, and the economic environment have been referred to as the organizational innovation capability (Pierce & Delbecq, 1977; Smith et al., 2008; Zurina et al., 2011; Verma et al., 2014). The results of several studies indicate the possibility of developing innovation capability (Kessler & Chakrabarti, 1996; Lawson & Samon, 2001; Martensen et al., 2007; Teece, 2009; Giannopoulou et al., 2011; Kindström et al., 2013). Smith et al. (2008) introduces nine key factors effective in organizational capability for innovation management.

Considering the responsibility of academic research centers for production of science for further authority and sustainable development of the country (Yaghoubi et al., 2017), this paper was first designed for identifying the components and dimensions of innovation capability in academic research institutes; However, due to the limited number of published articles on the innovation capability in academic research centers, and considering that the objectives and activities of all R&D research centers are moving towards the innovation and development of the organization, thus having the relatively identical identity, the authors added the studies on the industrial research centers. This study, therefore, was designed aiming at identifying and designing a conceptual model of innovation capability in industrial and academic research centers, especially in medical sciences universities, through the application of the systematic review method.

The study has been conducted to find answers for the following two questions:

1. What are the industrial and academic research centers'

innovation capabilities (especially the medical sciences universities)?

2. What are the relationships between the dimensions and components of industrial and academic research centers innovation capabilities (especially the medical sciences universities)?

Materials and Methods

This is a systematic review of the papers published in the field of innovation capability dimension in industrial and academic research centers, especially medical sciences universities. The authors have used the standard guideline of systematic review (PRISMA) that includes 27 items (Liberati et al., 2009), to review 342 articles on the strategic management of innovation published in seven journals from 1992 to 2010.

These studies have been undertaken through searching in Iranian electronic data banks including the Scientific Islamic Database (SID), Scientific Medical Papers' Database (IranMedex), Iranian Research Institute for Science and Technology (IranDoc), Iranian Journals Databank, and foreign scientific databases like Medline, Science Direct, Web of Science, Embase, Scopus, Cochrane Library, and Google Scholar. The main study search phrases included the innovation capability, capability in innovation, innovation ability, innovation possibility, innovation in the universities, innovation in research and development (R&D) institutes, and the similar keywords in journals.

Searching was limited to all the Persian language papers published in scientific research journals of the country and the English papers pertaining to the subject of the study published inside and outside of the country during the years 2000-2016 time span. (No innovation capability related paper was found in Iranian journals published before the year 2009).

Selection criteria

The entry criteria of papers included the publication of the papers in

credible scientific research journals, language of the paper (Persian or English), and full text of the paper. The exclusion criteria of papers included inaccessibility to the full text of the paper, letter to the editor or the papers published in non-credible journals; also the papers with shared subjects published in Persian and English language journals were considered as identical.

Data extraction, variables and data analysis

Researcher-made data extraction form based on the study objective was used for analysis of the papers. This form included parts of the article details including the author's name, publication year, paper's objective, article type, study methodology, and the information relevant to the innovation capability, the dimensions and the innovation capability components, and the papers' final results. Two researchers were involved in the selection process and data extraction activities. In this study, based on the existing studies, the innovation capability dimensions are classified into two intra and extra-organizational dimensions.

- **Intra-organizational dimension.** The potential and actual intra-organizational capacities that the organization has the power of controlling and organizing, and are considered as the strength points of the organization for innovation.
- **Extra-organizational dimension.** The opportunities through which the organization can take steps towards the organizational innovation, mostly having supportive and facilitating roles.

The main characteristics of these selected articles, based on the aim and variables of this study, are presented in Table 1.

The main features of the studies and their results have been summarized considering the following variables:

- **Type of study.** Considering the research design, the study classification included the sectional studies, correlational-descriptive studies, descriptive-analytical studies, qualitative studies, and review studies.
- **Target population.** Target population constituted from 5 categories based on the participants' role in the study that

included research and development (R&D) centers, faculty members, researchers and employees, senior managers and data reviewers.

- **Study approach.** This variable shows the conducted studies approach in line with the description of innovation capability, identifying innovative capability dimensions, factors affecting the innovation capability and the relationships between innovation capability dimensions.
- **Study language.** This variable indicated the language into which the study or article was published, that is Persian or English.
- **Presentation year.** Included the two publication year classifications of 2000-9 and 2010-16 AD.

Table 1. Characteristics of selected articles classified by aim and variables

Variables		Capability innovation			Total	
		Internal	External	Internal & External	N=40	100%
Study design	- Review	5	1	2	8	20
	- Descriptive	2	0	1	3	7.5
	- Qualitative	5	0	2	7	17.5
	- Descriptive correlation	9	3	3	15	37.5
	- Descriptive-analytical	2	4	1	7	17.5
Target population	- Faculty members	1	1	1	3	7.5
	- Staff and researchers	9	2	3	14	35
	- Senior managers	2	2	4	8	20
	- Data reviewers	5	1	2	8	20
	- R&D centers	4	1	2	7	17.5
Approach	- Identify dimensions of innovation capability	5	1	3	9	22.5
	- Describe the dimensions of innovation capability	3	1	2	6	15
	- Factors affecting the innovation capability	2	0	1	3	7.5
	- Relationship between dimensions of innovation capability	12	5	5	22	55
Language	Persian	9	6	1	16	40
	English	14	2	8	24	60
Year of publication	2000-2009	3	2	3	8	20
	2010-2016	18	6	8	32	80

Results

Searching the data sources was performed for two month based on the keywords and searching strategies until January 4, 2017, and 43 Persian and 169 English papers were selected from among 173 and 879 Persian and English articles respectively. The title and abstract of all papers in indices were considered systematically by the author based on the relevancy to the study subject as well as the inclusion and exclusion criteria. In this step, 109 papers (21 Persian and 88 English papers) were entered into the study, as 11 papers with no access to the full texts, and 4 duplicates (Persian and English) were excluded from the study and 94 papers remained. After exclusion of the papers lacking the inclusion criteria, those papers with more comprehensive information and more relevancy to the study objective were selected and their text were assessed by two independent judges and experts in innovation management. In this step, 32 papers were selected and 8 papers were also selected from those referred to in the reference section of the above papers and finally 40 papers were selected. The flow chart of the literature review and data extraction is presented in Figure 1.

Findings show that the publication of papers pertaining to the innovation capability has increased considerably during the recent decade. Between the year 2000 to 2009, 2 Persian (5%) and 6 English (15%) papers and from the year 2010 to 2016, 14 Persian (35%) and 18 English (45%) papers have been published showing a growing trend. Eight articles (20%) were of review study type, 12 papers (30%) included descriptive-analytical type, 6 papers (15%) were qualitative and 14 papers (35%) comprised the descriptive-correlational paper type. From among 40 papers, 24 papers (60%) were in English language. The target population consists of the managers (20%), staff and researchers (35%), industrial and academic research centers (17%), university scientific board members (7.5%), and data reviewers (20%). The review results for the selected articles are summarized in Table 2.

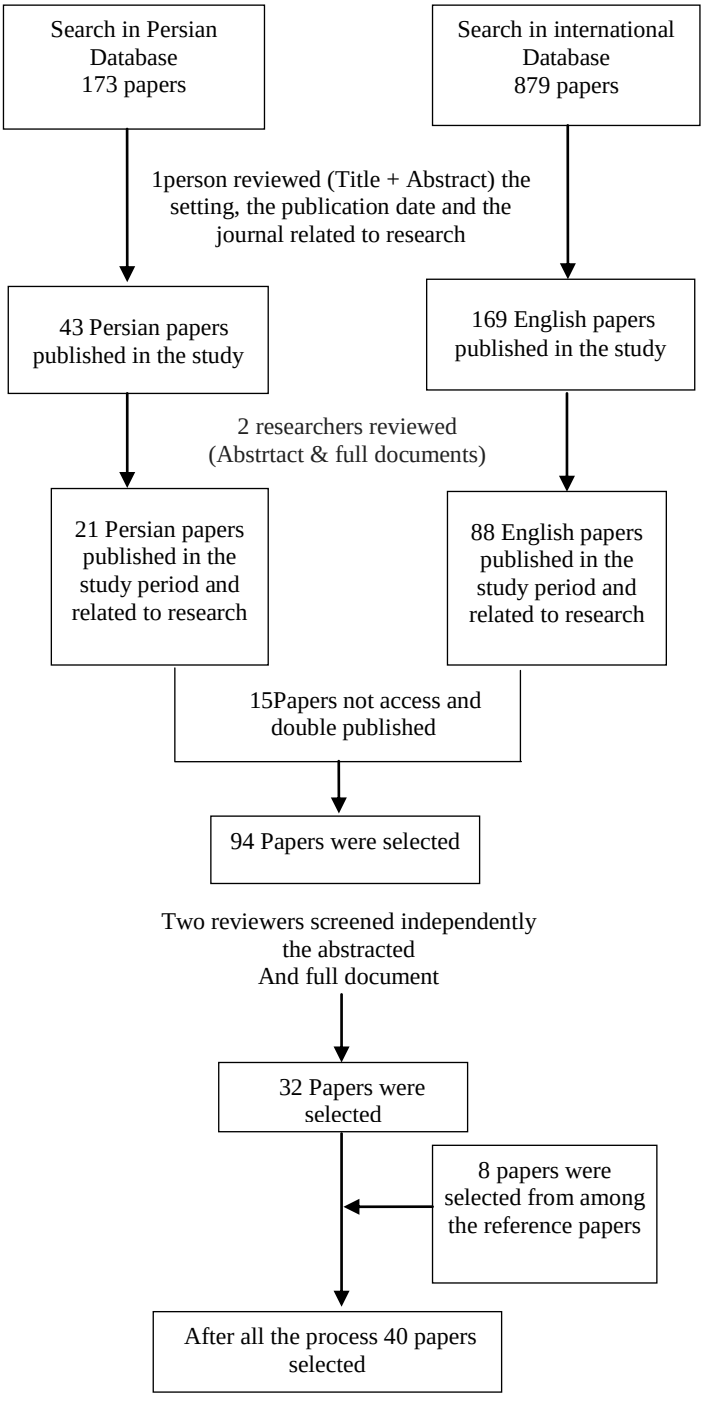

Fig. 1. Literature review and data abstraction flow chart

Table 2. The review results for the selected articles

Authors	Study objectives	Summary Results
Ramazanian, Moradi et al (2013)	Determine the impact of the process of knowledge sharing and the ability to absorb knowledge on innovation capability.	Absorb knowledge mediator between knowledge sharing and innovation capability.
HaghighiKafash, Hajipor et al. (2016)	Modeling the factors affecting food industry innovation capability.	Innovation capability depends to three dimensions: operational capability, human and structural.
Zareei, Hasanzadeh et al. (2015)	The relationship between knowledge sharing and Innovation capability in academic libraries.	There is a significant relationship between knowledge sharing and Innovation capability
Nicnami & Hematpur (2009)	Determine the relationship between organizational culture and increase innovation	Effective organizational culture of innovation Academic Staff.
Qavamipur & Irandost (2013)	The role of inter-organizational relationships, organizational learning and the creation of open innovation in SMEs.	Knowledge acquisition and Knowledge dissemination could open innovation company.
Asadi & Zakery (2013)	Determine the impact of organizational culture variables on organizational innovation with fuzzy logic.	Availability Management Most effective and evaluate the performance of the least impact on creating a corporate culture that supports innovation.
Siadat, Chopani et al. (2013)	Identify factors affecting the realization of innovation organizations in Iran and providing strategies for its development.	Factors in three categories: individual, organizational and human resources were identified. 14 strategy for the development of organizational innovation identified.
Mirkamalian & Rezaian (2015)	Determine the impact of organizational structure and culture on innovation.	Culture has a significant effect on innovation and structure due to the impact of culture on organizational innovation is effective.
Haghighi Kafash et al. (2015)	Modeling organizational innovation capability.	There is a direct link between Innovation capability and human capabilities, operational capability and structural features.
Davarzani, Kazemzadeh et al. (2011)	The model is designed to evaluate the effect of organizational learning capability on innovation.	There is a significant relationship between learning capability and organizational innovation.
Zafarian, Mohammady Elyasi et al. (2012)	Determine the role of network capital on organizational innovation capability.	Capital of industrial network through inter-organizational learning has a positive effect on product innovation capabilities.
Dehqan (2014)	Determine the role of	The use of social web tools (Web 2)

Continue Table 2. The review results for the selected articles

Authors	Study objectives	Summary Results
	knowledge management in innovation organization.	and collaborative knowledge management (KM 2) causes of social organization (organization 2) that leads to innovation opens.
Saida Ardakani, Konjkav Monfared et al. (2013)	Identify factors affecting the development of individual innovation.	7 factors (interaction, leadership, communication, knowledge, integrity, organizational support and motivation) have a significant effect on innovation. Knowledge a greater impact on innovation.
Azad & Arshadi (2009)	Determine the role of organizational culture on perceived support of innovation.	There is a positive correlation between support for innovation with perception of support, solidarity and organizational reward systems.
Namamian & Faezalahi (2015)	Determine the effect of organizational culture on organizational performance Mediating Role of Innovation.	Organizational cultures (group, logical, developmental, hierarchical) are effective the performance of the organization with innovation intermediary.
Dashty, Taqizadeh Harat et al. (2013)	How organizational justice influence on the behavior of individual innovative?	Innovative behavior is correlated with Perception of organizational justice, innovation climate and intrinsic motivation.
Farrukh, Butt et al. (2015)	Investigate the association between Islamic work Ethics (IWE) and innovation capability.	There is a positive relationship between IWE and innovation capability.
Delbufalo & Cerruti (2012)	Highlighting relationship between the Capability of Firms to Innovate and the supply network configuration.	The network configurations enhancing the joint generation or adoption of multiple innovation types.
Wang & Tsai (2014)	Designing a non-recursive model based on Amabile's (1988) componential theory of organizational creativity and innovation.	Resources, management practices, and organizational motivation have unique positive direct effects on innovation.
Bincheng & Qian (2013)	Describing the innovation ability of Chinese enterprise managers.	Managers with the spirit of innovation in the implementation of the more successful business. Dynamic and complex execution environment is the development of innovation capability managers.
Ruiz-Jiménez & Fuentes-Fuentes (2016)	The effect on performance management capabilities for industrial innovation in Spain.	Management capabilities have a greater influence on innovation when the management team is more balanced in number of men and women.

Continue Table 2. The review results for the selected articles

Authors	Study objectives	Summary Results
Lai, Lin et al. (2015)	Explore ways of improving the interoperability of innovation service and corporate sustainability by strategic corporate social responsibility.	The SCSR from corporate innovation service has a significant influence on the performance of corporate sustainability.
Lisboa, Skarmeas et al. (2011)	Innovative capabilities: Their drivers and effects on current and future performance.	Orientation towards customer or competitor company was confirmed as drivers of innovation capability.
Verma, Singh et al. (2014)	Developing Innovation Capability: The Role of Organizational Learning Culture and Task motivation.	Organizational learning culture directly and work motivation indirectly affect the organization's ability to innovate.
Hailekiros & Renyong (2016)	Developing a conceptual framework , The role of technological competence in organizational learning capacity and performance.	The learning mediator between the organizations' learning capacity and the performance of the organization and positive effects on performance.
Nisula & Kianto (2013)	Evaluating and Developing Innovation Capabilities with a Structured Method.	Identify strengths and weaknesses of the organization by questionnaire innovation capabilities to better develop innovation and helps continuing innovation.
Romijn & Albaladejo (2002)	Determinants of innovation capability in small electronics and software firms in southeast England.	The potential internal resources (training, previous experimental work, research and development efforts) and the intensity of external interactions and the proximity of network relationships are effective on organizational innovation.
Subramaniam & Youndt (2005)	The influence of intellectual capital on the types of innovative capability.	Human, organization, social capital and their interactions selectively affect the organization's ability to innovate,
Saunila (2014)	Identify aspects of innovation capability and the relationship between these aspects of organizational performance.	Three aspects of innovation capability, namely ideation and organizing structures, participatory leadership culture, and know-how development, has some effect on different aspects of firm performance.
Saunila & Ukko (2014)	Identify intangible aspects of innovation capability in SMEs. And to examine whether a firm's size or the industry have a significant impact on intangible aspects of innovation capability in SMEs.	7 factors as intangible aspects of innovation capability in the organization identified .The size of the company does not explain the level of innovation capability.

Continue Table 2. The review results for the selected articles

Authors	Study objectives	Summary Results
Calantone, Cavusgil et al. (2002)	Learning orientation, firm innovation capability, and firm performance.	Learning orientation is critical for innovation and performance.
Saunila, Ukko et al. (2014)	Providing a comprehensive description of the effects of the determinants of innovation capability on profitability of SMEs.	Innovation capability is not realized in SMEs, at least in profitability measures.
Smith, Busi et al. (2008)	Factors Influencing an organization's ability to Manage Innovation.	Identified nine key factors influencing the organization's ability to manage innovation.
Vieites & Calvo (2011)	Identified nine key factors influencing the organization's ability to manage innovation.	R & D activities, management of information and IT resources on effective innovation results.
Saunila & Ukko (2012)	The definition of innovation capability and relationships with organizational performance.	Designing a conceptual model to measure the performance of the organization based on innovation capability.
Ibrahim, Zolait et al. (2009)	Describes the capabilities of innovation in companies in Malaysia.	Five innovation: market, product, strategy, and innovation behavior that the review process had achieved in Malaysian companies were also confirmed.
Nilsson & Ritzén (2014)	Determine the effect of Measuring innovation performance and innovation management on ability to innovate a medical device company.	Measuring innovation performance in innovation management could correct the mistakes and develop the innovation.
XU (2013)	Analyzing the causes of the lack of technology innovation capability	Relationship between industry and universities to accelerate the flow of information, transfer of knowledge, External Communications international and sharing sources of innovation, develops technology innovation capability.
Liao, Fei et al. (2007)	The relationship between knowledge sharing, knowledge absorption with innovation capability in Taiwanese companies.	Knowledge absorption is mediator between knowledge sharing and innovation capability.
Saunila, Pekkola et al.(2014)	Determine the role of performance evaluation as a mediator between innovation capability and organizational performance.	Rely on aspects of internal innovation capability have a significant positive effect on the performance of the organization.

This study was a broad systematic review in which more than 400 abstract papers and full text of more than 100 articles have been studied. Based on the conducted study, the innovation capability dimensions and their relationships in two internal and external dimensions were plotted in a conceptual model framework (Fig. 2). On the basis of the reviewed studies, 6 intra-organizational and 2 extra-organizational capacities effective in organization's innovation capability and innovative ability have been determined.

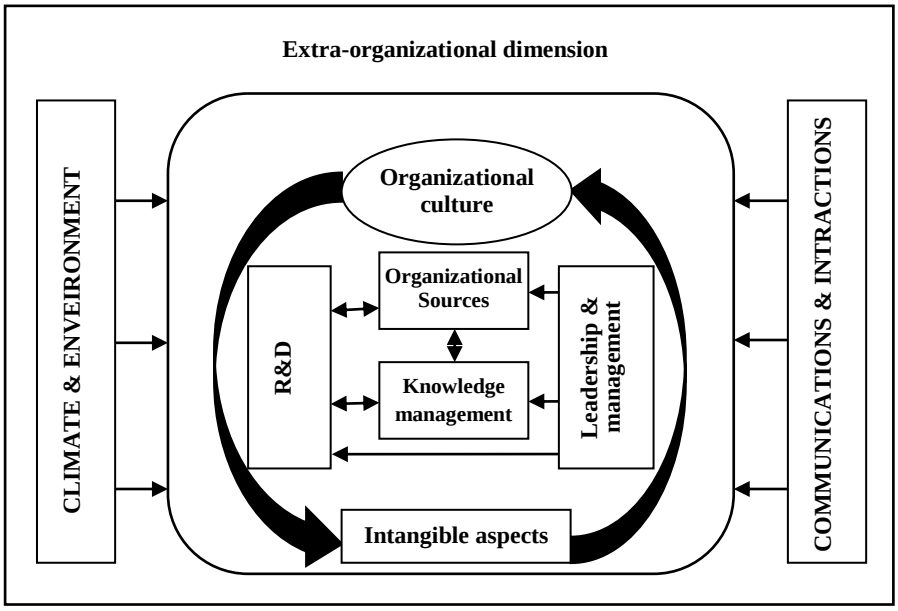

Fig. 2. Conceptual model based on the systematic review study

Analysis of Model and Discussion

Based on the existing studies, the organizational innovation capability was plotted in two intra and extra-organizational dimensions**.**

Internal Dimension of Organizational Capability

Most of the studies believe that intra-organizational capacity, ability and competency constitute the organizational innovative capabilities (Kianto, 2008; Teece, 2009; Saunila et al., 2014; Verma et al., 2014). The review results showed that the innovation capability is multi-dimensional and consequently an overlapping combination of the

capacities is created. In intra-organizational dimension, 6 capacities including the management and leadership, organizational resources (human capital, structure and strategy, financial and technology sources), knowledge and information management, research and development (R&D), organizational culture, and intangible aspects of organizational innovation capability constitute the innovation capability (Table 3).

Table 3. Internal capacities of organizational innovation capability

Innovation capability	Authors
Sources Human capital	Haghighi Kafash et al. (2015), Haghighi Kafash et al. (2016), Romijn & Albaladejo (2002), Saida Ardakani et al. (2013), Siadat et al. (2013), Subramaniam & Youndt (2005), Smith et al. (2008), Saunila & Ukko (2012)
Organizational structure & strategy capital	Haghighi Kafash et al. (2015), Mirkamalian & Rezaian (2015), Haghighi Kafash et al. (2016), Lai et al. (2015), Nisula & Kianto (2013), Smith et al. (2008), Saunila & Ukko (2012)
Financial and technological capital	Delbufalo & Cerruti (2012), Wang & Tsai (2014), Romijn & Albaladejo (2002), Smith et al. (2008), Vieites & Calvo (2011)
Leadership and management	Haghighi Kafash et al. (2015), Haghighi Kafash et al. (2016), Siadat et al. (2013), Ruiz-Jiménez & Fuentes-Fuentes (2016), Wang & Tsai (2014), Nisula & Kianto (2013), Smith et al. (2008), Saunila & Ukko (2012), Bincheng & Qian (2013), Asadi & Zakery (2013).
Knowledge and information management	Ramazanian et al. (2013), Zareei et al. (2015), Hailekiros & Renyong, (2016), Davarzani et al. (2011), Zafarian et al. (2012), Nisula & Kianto (2013), Saunila et al. (2014), Smith et al. (2008), Vieites & Calvo (2011), Liao et al. (2007)
R&D	Haghighi Kafash et al. (2015), Haghighi Kafash et al. (2016), Lai et al. (2015), Romijn & Albaladejo (2002), Smith et al. (2008), Vieites & Calvo (2011)
Organizational culture	Farrukh et al. (2015), Saunila & Ukko (2012), Nicnami & Hematpur (2009), Mirkamalian & Rezaian (2015), Azad & Arshadi (2009), Namamian & Faezalahi (2015), Saunila (2014)
Organizational intangible aspects	Bincheng & Qian (2013), Wang & Tsai (2014), Ruiz-Jiménez & Fuentes-Fuentes (2016), Lisboa et al. (2011), Ibrahim et al. (2009), Verma et al. (2014), Calantone et al. (2002), Dehqan (2014), Nisula & Kianto (2013), Saunila & Ukko (2014)

Leadership and management capability

The managerial styles and methods (Smith et al., 2008; Wang & Tsai, 2014), human resources management (John & Doty, 1996), the morale and the manager's ability are effective factors of organizational

innovation (Bincheng & Qian, 2013). Today, the traditional methods of managing organizations are unable to respond adequately to the competitive and variable environment requirements of the industry (Yaghoubi et al., 2012).

The leadership and decision making processes (Zurina et al., 2011; Saunila & Ukko, 2012; Nisula & Kianto, 2013; Saunila et al., 2014) and innovation management (Smith et al., 2008) ,especially the innovation performance measurement due to correction of mistakes may result in the development of innovation capability (Nilsson & Ritzén, 2014). The studies' results are indicative of the significance of this ability in the organizational innovation and its effect on other organizational innovation capabilities. Innovation process mismanagement is a major barrier to the organization's innovation (Assink, 2006). The result of senior managers' decision making process, strategic orientation, organizational learning and the planned systems and rules for the staff encouragement and reward all affect the performance and development of other organizational capabilities of the organization (Amabile & Kramer, 2010; Bel, 2010; Lisboa et al., 2011; Bincheng & Qian, 2013; Wang & Tsai, 2014; Haghighi Kafash et al., 2015).

Organizational sources capability

Human capital

The most important capability and the major capital of an organization especially in research centers is its human capital (Zurina et al., 2011); environmental monitoring, idea making and personal knowledge are among the capacities of this capability (Bahadori et al., 2013; Haghighi Kafash et al., 2015; 2016), risk taking (Siadat et al., 2013), personal creativity (Saunila & Ukko, 2012; Siadat et al., 2013), knowledge, previous experiences and skills (Romijn & Albaladejo, 2002), personal learning and personal development (Saida Ardakani et al., 2013) all constitute the personal characteristics of the employees which can affect the organizational innovation (Zurina et al.. 2011; Siadat et al., 2013). Results of the three-year longitudinal study undertaken was indicative of the human capital interactions with the

organization and the social capital on various types of innovation (Subramaniam & Youndt, 2005).

Organizational structure and strategy capital

The deducted strategy and structure shall be necessary for innovation in the organization (John & Doty, 1996; Zurina et al., 2011). There is more possibility for change and innovation in decentralization (Mirkamalian & Rezaian, 2015), and horizontal expansion (Lai et al., 2015) of the organization. However, different components such as intra-organizational relationships, managerial, cultural and organizational knowledge capacities concerning organizational structure are also seen in categorizations made by some studies (Subramaniam & Youndt, 2005; Haghighi Kafash et al., 2015; 2016). The organizational structure is basically under the effect of the management and leadership capability in terms of the complexity, formality, and concentration of the decision making in the organization (Zurina et al., 2011; Saunila & Ukko, 2012; Saunila et al., 2014; Mirkamalian & Rezaian, 2015). The results of Lai et al. (2015) study however were indicative of ineffectiveness of the organizational structure on the innovation.

The innovation as a competitive advantage and long term performance in the organization requires a common organizational vision and strategic orientation (Lawson & Samon, 2001), and the objectives of research and development (R&D) organizations must be regulated to support the development of innovation capability in the organization (Kianto, 2008; Nisula & Kianto, 2013). Findings of this study showed that the five type known innovations including the market innovation, product, strategy, process, and behavior can be accessible based on the adopted strategy of the organization (Ibrahim et al., 2009).

Financial and technological capital

Romijn and Albaladejo (2002) believes that the research centers to achieve professional superiority and a sustainable competitive advantage require supportive financial budget during the first 5-6 years of establishment. The supply of resources network is one of the

capabilities effective in the organizational innovation (Delbufalo & Cerruti, 2012; Wang & Tsai, 2014); also the exclusive technology resources are considered an organizational innovation capability (Vieites & Calvo 2011; Yi et al., 2013).

In sum, all the three capability resources capitals (human, structure and strategy, financial and technology) are affected by the performance and behavior of the management and leadership and have bidirectional relationship with the knowledge management and research technology management.

Knowledge and information management

Knowledge is one of the basic capabilities of organizational innovation (Zurina et al., 2011; Andreeva, 2012; Saunila, 2014; 2016). Combining the knowledge elements in the organization is one of the important challenges of the management, neglecting of which could result in the degeneration of innovation and creativity in the organizations (Yaghoubi et al., 2011a; 2011b). All the knowledge management processes (Kianto, 2011; Nisula & Kianto, 2013; Inkinen, 2015) including the acquisition (Liao et al., 2007; Fulvio & Miguel, 2013), knowledge sharing (Rıfat & Fusun, 2010; Ramazanian et al., 2013; Zareei et al., 2015), and exploitation of knowledge affect the organizational learning (Davarzani et al., 2011; Zafarian et al., 2012; Hailekiros & Renyong, 2016) are regarded as organizational capability. Paying attention to the organizational learning and creating learner organizations helps promote the innovation and creativity culture in the workplace and among employees (Yaghoubi et al., 2010). Experimental studies' results indicate that the knowledge sharing is effective both directly and indirectly in the organizational innovation through creating motivation and empowerment of the employees and thereby increasing the knowledge absorption capacity (Liao et al., 2007). Huge organizations need the development of their data sources to adapt with the changing circumstances for better competition in the market. Domestic resources and market information as well as the other resources must be well managed (Vieites & Calvo, 2011).

Research and development (R&D) capability

According to the Frascati and Oslo instructions, the research and development (R&D) activities are necessary for technology innovation (OECD, 2002; OECD & Eurostat, 2005). The experimental results of the studies are also indicative of direct effect of R&D on different types of innovation (Romijn & Albaladejo, 2002; Vieites & Calvo, 2011; Lai et al., 2015). In most of the studies, the R&D are recognized as an important and essential capability for establishment of innovation in the organization (Romijn & Albaladejo, 2002; Vieites & Calvo, 2011; Zurina et al., 2011; Haghighi Kafash et al., 2015; Lai et al., 2015; Haghighi Kafash et al., 2016). The R&D work climate is important for innovation (Abbey & Dickson, 1983). The activity and performance of research and development capability is affected by all company capacities and abilities (Sher & Yang, 2005). The resources capability is effective on the performance of R&D activities through human capital performance and direct effect of technological and financial capital. The outcome of R&D will affect all the existing capacities of the organization through solving a problem, devising a new technology, introducing a new process or product and so on; that is, the research and development (R&D) capability has a bidirectional relationship with other organizational capabilities in line with the creation of innovation.

Organizational culture capability

The organizational culture is one of the essential components in the individuals' perception of the organizational objectives (Shoujun et al., 2014). Organizational culture gives identity to an organization. Principally the organizational culture is used for describing the conditions the employees are faced with, and that affects their attitude and behavior (Mirkamalian & Rezaian, 2015). Goal setting and team orientation, integration, performance emphasis, innovation orientation, members' participation, and reward orientation are presented as elements of corporate culture (Cheung et al., 2011).The organizational culture's capability significantly affects the innovation (Valencia et al., 2010; Saunila & Ukko, 2012; Mirkamalian & Rezaian, 2015).

Organizational culture is a key factor in innovation management (Smith et al., 2008).

The experimental studies results are indicative of the effect of organizational support and award systems (Azad & Arshadi, 2009; Cheung et al., 2011; Asadi & Zakery, 2013; Shoujun et al., 2014), risk taking by the organization, Islamic work ethics (Farrukh et al., 2015), and organizational equality (Dashty et al., 2013) on the organizational innovation, all corresponding to the organizational culture features. Leadership, coherence, integrity and management support can affect the organizational innovation (Nicnami & Hematpur, 2009; Namamian & Faezalahi, 2015). Organizational culture is influential on all organizational capacities and is influenced by all of them (Smith et al., 2008). The proposed model obviously shows the bidirectional relationship between organizational culture and all organizational capacities.

Organizational intangible aspects capabilities

An innovation orientation that directly leads the organization's strategy and performance toward a particular type of innovation is an intangible aspect of organizational innovation that embraces the philosophy of learning, strategic orientation, and mutual beliefs of the organization (Siguaw et al., 2006).

The management orientation and the manager's innovative spirit (Lisboa et al., 2011; Bincheng & Qian, 2013), the participatory management culture (Saunila, 2014; Saunila & Ukko, 2014), and participatory knowledge management are effective in organizational innovation. The learning orientation for obtaining competitive advantage is a requirement for the organization and is determined by four elements, namely the commitment to learning, common vision, intellectuality, and intra-organizational sharing (Calantone et al., 2002; Nisula & Kianto, 2013). The organizational learning culture will also affect the innovation through occupational motivation (Liberati et al., 2009; Verma et al., 2014; Zareei et al., 2015). The strategy orientation of the organization (Ibrahim et al., 2009; Lisboa et al., 2011), organizational equality (Dashty et al., 2013), organizational

motivation (Dobni, 2008; Verma et al., 2014; Wang & Tsai, 2014), exploitation of time (Nisula & Kianto, 2013), internal motivation, and individual activity (Saunila & Ukko, 2014; Saunila, 2016) are other invisible capabilities effective in innovation in organizations (Zheng et al., 2013). It must be noted that some studies have rejected the effect of the age and size of the organization in innovative capability (Saunila & Ukko, 2012; 2014).

External Dimension of Organizational Capability

In extra-organizational dimension, two innovation capabilities of the (a) organizational climate and environment and (b) extra-organizational relationships and interactions have been considered (Table 4).

Table 4. External capacities of organizational innovation capability

Innovation capability	Authors
Organizational climate and environment	The complexity and dynamics of the environment (Bincheng & Qian, 2013), environmental uncertainty (Lai et al., 2015), innovative climate (Abbey & Dickson, 1983; Saunila & Ukko, 2012; Dashty et al., 2013; Saunila, 2014)
Organizational communications and interactions	Communications between the company (Ahmadi & Nasiri, 2009), supply network (Delbufalo & Cerruti, 2012), customer experience (Foroudi et al., 2016) , stakeholders ((Lai et al. 2015; Nisula & Kianto, 2013), Interactions with other universities and R&D Centers (Romijn & Albaladejo, 2002)

Organizational climate and environment

Porter (1991) believed that the environment produces positive effect on the enterprise performance through stimulating the internal innovation for outer competition. Complex and dynamic environment has positive effect on the organizational innovation capability (Bincheng & Qian, 2013); also, the uncertainty and environmental instability (Lai et al., 2015) are effective on the organizational innovation through motivating the managers and researchers. The study findings also indicate the innovative climate effect on the organizational innovation (Amabile et al., 1996; Saunila & Ukko, 2012; Dashty et al., 2013; Saunila et al., 2014). The extra-organizational environment can, through its motivations and support,

be regarded as underlying opportunities of innovation and is considered an innovative capability.

Organizational communications and interactions

As in the industry of alliances, close interactions increase innovation (Dunlap-Hinkler et al., 2010). Of course, there is a need for a boundary in the communication network and the transfer of information by the organization based on the nature of the organization's work (Tushman, 2007). The relationship and interaction with other research and academic centers (Romijn & Albaladejo, 2002; Nisula & Kianto, 2013; Qavamipur & Irandost, 2013; Xu, 2013; Puffal & Teixeira, 2014), as well as the relationship with suppliers, customers and stakeholders are effective on the organizational innovation. It was also determined that the proximity to academic centers and resource suppliers has no effect in increasing the enterprise innovation (Romijn & Albaladejo, 2002) but the industry and university participation is effective on the organizational innovation capability (Puffal et al., 2011; Perkmann & Walsh, 2007; Qavamipur & Irandost, 2013; Xu, 2013).

Conclusions

The innovation has a broad concept and plays a major role in all the industrial life cycle in any unit of organization including the production, product, process, market, research and development (R&D) and even the organizational behavior, and as a competitive advantage can act as the survival and stability factor of an organization. The study findings are indicative of the importance of innovation capability in industrial and academic centers. In this study six capacities including organizational resources (human capital, structure and strategy, financial and technological resources), organizational culture, management and leadership, knowledge management, R&D and finally the organizational intangible aspects capacity were identified as intra-organizational innovation capabilities; also the environmental capacity of the organization and the extra-organizational relationships and interactions were

determined as the extra-organizational innovation capabilities that can affect the development of the organizational innovation and can be accessible in any organization. In this model based on the study results, it was found that the relationship between the resource capacities and knowledge management on the one hand, and R&D on the other hand, is a bidirectional relationship. The management and leadership capacity is effective on all internal capacities. The organizational culture has a bidirectional relationship with all activities and performances of internal innovation capacities. The intangible aspects of the organization is more related to the orientation and culture of all internal capacities of the organization. In extra-organizational dimension, there exist the external relationships and interactions as well as the environment (or climate) that affect the organizational innovation and are considered as the organizational capabilities. Nevertheless, such relationships need to be confirmed by the experimental data.

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