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Identifying Dimensions of Regional Innovation System in Iran: A Grounded Theory View

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Abstract: Today, in innovation discussion, a new concept called Regional Innovation System (RIS) has formed that defines arisen concepts and aspects in the national system at a regional level. RIS can be defined as a complex set of actors and institutions present in a place that are in direct relationship with production, distribution and allocation of technological innovation as well as interaction between innovation actors. Iran's RIS requires a model upon which it is possible to identify the full extent possible. Grounded theory approach helps us understand this model from the internal structure of values, attitudes and experiences of actors and stakeholders of the issue. In this model, it is explained that the data is collected using deep and semi-structured interviews with 14 senior managers and experts of organizations in relation to innovation in Iran and through a comparative study in five countries of Norway, Canada, South Korea, Russia and Australia. Using data analysis it was found that the factors are classified in five groups of causal, underlying, intervening, strategic and outcomes factors that are included in this issue into 19 categories. At the end, the mechanism of the effect of these factors on the RIS in is presented in form of an imaginative model.

Key words: Innovation systems, regional innovation system, grounded theory, South Korea, outcomes

INTRODUCTION

Achieving the goals 20 year outlook of Iran requires developing innovative and creative capacities and this requires a comprehensive system to lead the scientific and technical foundations of the country together and towards the development of innovation.

Strengthening the innovation capacity of the country will pave the ground to increase innovation and ultimately economic growth. Being innovative is one of the best and effective strategies to compete, penetrate a new market and expand the market share. Today with advances in science and technology and its growing complexity in the business world, the development of science and technology is not something to be reached by a specific person or company and requires interagency collaboration along businesses and strategic alliances. In other words, innovation in today's world requires the establishment of a collaboration system or network called a national system of innovation. National Innovation System (NIS) is one of the most important organized systems at large-scale that with the advent of development of the knowledge-based economy and increase in the competitiveness of some countries in the field of science and innovation systems has received utmost importance (Roveda and Vecchiato, 2008). A new concept called regional innovation system has taken shape that defines dimensions and the concepts discussed in the national system at the regional level. The main research question is what are the dimensions of RIS in Iran?

Literature review

Innovation systems: Today, we are witnessing a diversified national, regional and sectoral innovation system, the common aspect of all of which is attention to make the system functional rather than making changes in it (Chang, 2002). In recent years, checking these systems in innovation studies has found prevalence (Delvenne and Thoreau, 2012). Despite the increasing importance of use of NIS in developing countries, examining the studies has shown that in general, studying the subset of management of innovation system has been dealt with enough and it can be said that in attention to solve this problem is a challenge that will jeopardize the management of projects in this field in the future.

Thus this study tries to first check these functions by providing meta-analysis and finally suggest a structure using the applied research method. NIS is one of the major integrated approaches that have found great importance with the advent of the knowledge-based economy and increase in the competitiveness of some countries in the field of science and technology. By change in the positionand status of innovation at the global field, the

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Table 1: Compare innovation systems

Category	Global Innovation System (GIS)	National Innovation System (NIS)	Regional Innovation System (RIS)
Focus	The multinational company's global innovation process	The innovation process at the national level	The innovation process at the regional level
The main actors	Multinational companies and many national systems	The national government, local, university, industry, public institutions	Industry, academia, public research institutes
Structure/network	Network world	National networks connected to GIS	Local area network connected to the GIS and NIS
Political goals	NIS integration in GIS	National competition	Regional competition
Policy direction	Exploit the global opportunities	Promoting cultural exchanges in science and technology	Improve local government connection with the Science and technology policy

need for change in its policy making approaches has shown itself at national arena and approaches such as NIS are trying to respond to these needs (Spielman *et al*., 2009).

In the context of an innovation system, innovative performance of firms does not just depend on the innovative performance of the actors in this regard (such as companies, research institutes, universities, etc. but depends on how the actors interact with each other as members of an innovation system. Accordingly, innovation system approach tries to identify existing institutions in innovation and the quality of their interaction and communication and the functions expected within these interaction (Spielman *et al*., 2009).

There is a growing consensus in the literature on innovation systems that innovation is an institutional process and not specific to an entrepreneur individual responsible for innovation in firms. Thus, innovation should be located within a system of institutions to be well supported. The overall task of an innovation system is to produce innovations for market, disseminating these innovation and using them (Kubeczko *et al*., 2006). Innovation systems include a set of actors related to each other that make a system where the performance of each actor and the interaction among the actors are considered as a collective system (Kubecsko *et al*., 2006).

Edquist defined an innovation system as "socio-economic and political factors and other factors affecting the development, dissemination and use of innovations". In this regard, the innovation-production process is not independent of the environment and the texture and this process is embedded within innovation environment (Table 1). Three approaches innovation systems are identified that include:

- Ntional approach proposed by Freeman (1987), Lundvall (1992) and Nelson (1993)
- Sectoral/innovative approaches that are used by Carlsson and Stankiewicz (1991)
- Local/regional approaches suggested by Cooke *et al.* (1997), Strauss and Corbin (1994) and Chung (2002)

Research in the field of technological innovation in recent years has enjoyed significant growth. In most of the research done, it is suggested that the regional innovation system can be effective in competitive advantage. Until 1989, almost no specific research had been done in this regard (Asheim *et al*., 2011). The following feagure shows the relationship between all kinds of innovation systems (Fig. 1).

Regional innovation system: In the early 1990s, the concept of regional innovation systems was accepted by policy-makers and researchers, particularly researchers in regional studies, economic geographers and regional development policy makers as an acceptable analytical framework to develop increasing understanding of innovation processes in regional economies. The popularity of this concept reflects the importance of the relationship between the role of learning and the social domain in social and economic development and growth.

Regional innovation system, as it describes the intangible aspects of local economic development and circulation of knowledge and learning processes at a regional scale, is considered as a practical approach. Another rationale for the widespread acceptance of this approach by political landscape is easier management of economic policy at a regional level rather than global scale (Doloreux and Parto, 2005)

Regional innovation system can be defined as a complex set of actors and institutions existing in a place that is in direct relation to production, release and allocation of technological innovation as well as the interaction between innovation actors. The relationship between NIS and regional innovation system is a combination of three major players of innovation that include universities and research institutes, industrial enterprises and public institutions. A regional innovation system, through regional monopolies and close interaction between actors of innovation system can create the innovation system (Chung, 2002). The main debate is on a set of actors that produce pervasive and systemic effects that encourage firms within the region to develop certain forms of investment, resulting from social relations, norms, values and interactions within the community with the aim of strengthening regional innovative capability and competitiveness (Doloreux and Shearmur, 2005). The base of the concept of regional innovation system can be found in two forms of theory and research. The concept of regional innovation system in form of theory is the systems of innovation that are

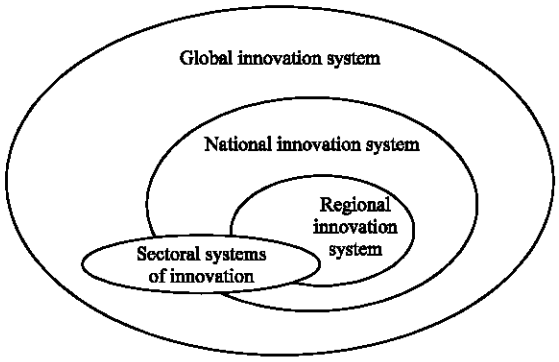

Fig. 1: Communication between all kinds of innovation systems

due to the evolutionist theories of economic and technological change. A regional innovation system is identified through innovative activities of co-operation between firms and knowledge creating and diffusing organizations such as universities, training organizations, research and development institutions, agencies of technology transfer and supporting innovation culture that enhance both firms and systems (Doloreux and Parto, 2005).

Regional innovation systems alone are not sufficient to maintain a competitive edge in the global economy and the other output of innovation systems may be more important that innovation systems at the regional level, so local firms should have access to innovation systems at national and international level. This argument confirms the point of view that regional innovation system develops its own borders through a process of economic integration and globalization. Given this sentence,the importance of the issue of strategic alliances in regional innovation systems becomes clear (Doloreux and Parto, 2005).

Local or regional innovation system refers to a specific geographical location with a particular culture where the innovation system has been built. A regional system of innovation has similar characteristics to a national system and eases conversion of scientific and technological advances to economic exploitation. Regional system of innovation tends towards more amenable social driving. The main difference in regional system of innovation and NIS is in their scale. A regional innovation system will be built around regional social structures and reflect development of knowledge and skills in the regional community (Chung, 2002).

For NIS systems as a complex context of sub-systems that can to be classified better in compliance with regional and individual levels, both sectoral SIS and regional approaches are used (Chung, 2002). NIS is composed of both sectoral and regional innovation systems. Due to the relationship between producer and consumer that are mostly in industrial sectors, the concept of innovation system will be useful for improving industrial and regional competitiveness by activating interaction and quality flow of information between main innovative actors in a region or sector.

National states and governments have lost their importance in the globalized economy and regional governments have been the focal point of economic activity. Regions act more dynamically and more reactively in economic, research and development activities than the state governments. Breschi and Malerba believe that regional groups will be effective in industrial groups in innovation activities (Florida, 1995). Regional innovation system can prevent the unfair geographical focus of economic and technological capabilities that like a pit prevent future development of the national economy.

According to the definition of NIS, we define RIS as a complex texture of institutions and innovation actors in a region that directly connected to development, expansion and ownership of innovation and the mutual relationship between innovation actors. Like NIS a RIS is composed of three innovation groups: universities, industrial firms and governmental research institutes. In a particular area where there is a close and full of trust relation among actors of innovations and RIS can develop its SIS. When a region does not have enough confidence in itself, confidence could and must be taught and stored so that cross training and technological innovation can effectively be activated (Asheim *et al*., 2011). All innovation systems seek to analyze and understand the process of innovation and increase competitive advantages.

Despite the various discussions over RIS, still many details remain. A lot of research done has focused only on the characteristics of the innovation systems and less on the functions of the system. Regional innovation system in general, discusses the region's economic development. Each of the approaches of innovation, including regional innovation system requires a process of continued cooperation between the companies and other organs in the region. RIS can facilitate the infrastructure for international cooperation. All the interaction in innovation systems is interactive and dynamic.

Regional innovation system is derived from the national system of innovation. In research conducted in this regard,the focus has mostly been on technology development in regions and less on the interaction between actors. Regional innovation system deals with generating, transfer and release of innovation (Komninaki, 2015) (Fig. 2).

One of the assumptions of RIS is that many of the innovations are done through regional innovation networks, collaboration and interaction between firms, customers, competitors and customers, competitors and suppliers (Laurentis, 2012).

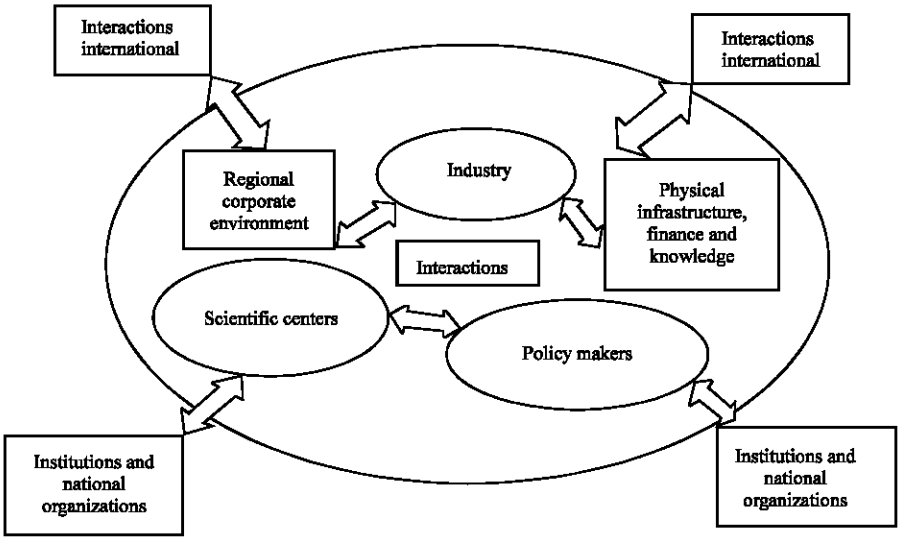

Fig. 2: Regional Innovation system (Todtling and Tripple, 2005)

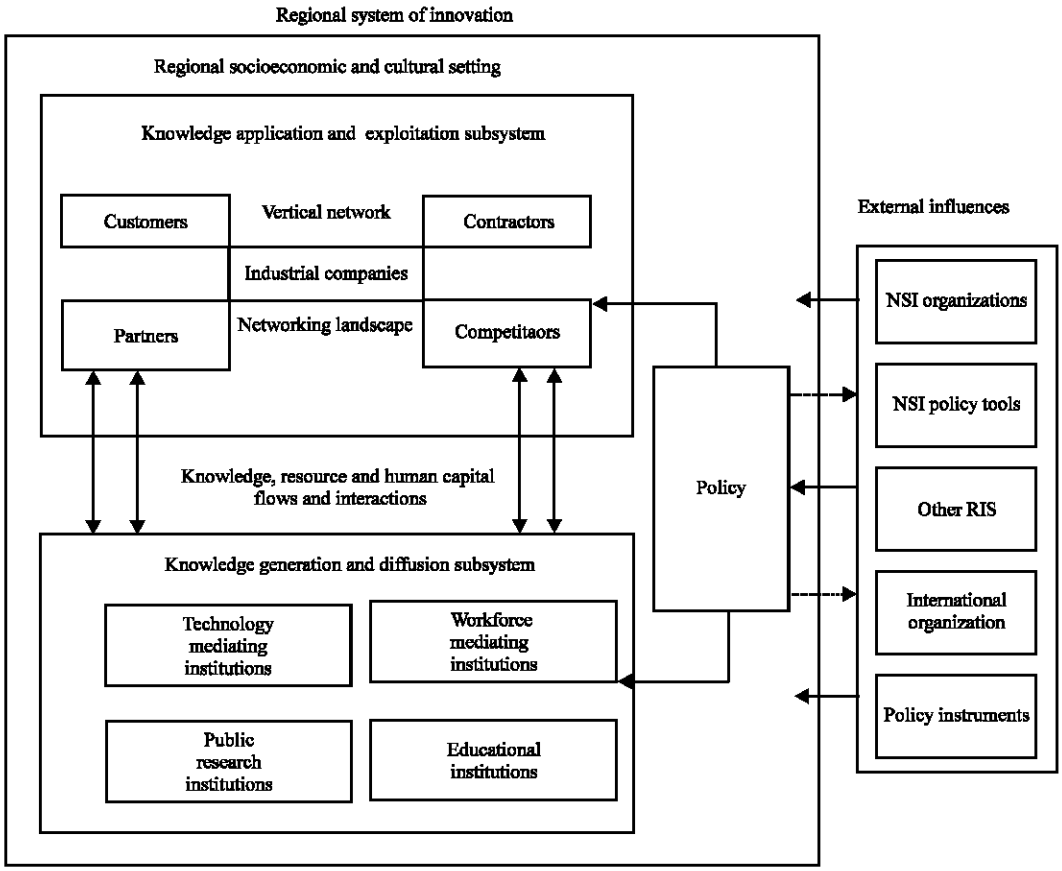

Fig. 3: Regional innovation system

Figure 3 shows a model of regional innovation system. This Fig. 3 shows two sub-regional innovation system: one is application and operating system of knowledge and other sub-creation and diffusion of

innovation. These two subsidiaries are consolidated through strategic formal and informal alliances. Four key points of this set include: customers, competitors, cooperation and contracts (Todtling and Trippl, 2005; Autio, 1998). Several factors affect regional innovation system stability:

- High-tech industries with an approach towards international markets.
- Relations between companies and universities
- Expert human capital
- International cooperation with entrepreneurial approaches
- Supporting institutions and organizations
- Social capital, values and norms and mutual trust
- Financial Empowerment

MATERIALS AND METHODS

In this study, the real data being derived from interviews and observations based on Grounded theory methodology taken from data is analyzed and to understand and explain the process of regional innovation system, qualitative data obtained from interviews, documentation and comparative study are used, so by use of regular methods of data collection, diagnosis of categories, themes and establishing relationship between these concepts have been performed and a model is provided to explain the phenomenon of regional innovation system. Since this model is driven from data, it is in accordance with the study case situation and provides better explanation of concepts for the situation of uncertain case.

Grounded theory is a general, inductive and interpretation research method that was created by Glaser and Strauss (1967). Corbin and Strauss (1998) have described this theory as follows: The grounded theory derived from data means the theory derived from data that has been systematically collected and analyzed during the research process. In this strategy, collecting and analyzing data and theory that will ultimately be derived from the data are in close contact with each other. Instead starting his study with a preconceived theory, the researcher starts with a particular field of study, allowing the theory to be emerged from the data.

Grounded theory methodology being derived from data emphasizes on the use of steps to analyze data through open coding, axial coding and selective coding that in proportion to the process of this research in part of findings, each section of the coding is discussed.

In this study, deep and semi-structured interview tools with senior managers and experts of organizations associated with the innovation background were used and in the aspect of model strategies comparative study was used in 5 countries of Norway, Canada, South Korea, Russia and Australia. Sampling in this method was purposive sampling and interviewees were selected based on research objectives. Sampling and interviews were continued so that the analysis and detection process would reach to theoretical saturation. In this regard, 14 people of key informants were interviewed.

Since interviews were semi-structured, so, in advance, the interview questions were designed that were used to start interview and direct its way toward study calendar; at the same time we tried so that he interview way would find its direction and only the pre-defined questions and answers would not be considered enough to create dynamism in the research so that process aspects would be better revealed.

RESULTS AND DISCUSSION

Research findings and designing conceptual model: Step one open coding: By making the information part by part, issues of information was formed about the process of regional innovation system in Tehran province and based on data collected from interviews and comparative studies, issues were gathered.

Step two; axial coding: The main issue and the classification of other issues in five other groups including causal conditions, strategies, underlying and intermediate conditions and outcomes were determined. Thus, the issue of regional innovation system development as candidate of main issue was considered by researchers and by referring to previous notes and interviews, as well as theoretical foundations this become more confident; thus, in subsequent interviews and observations, the regional innovation system development subject was considered and part of the questions were designed about it to gather effective and impressionable issues.

The third step; selective coding: By continuing interviews and observations, various issues were divided into categories so that some of the issues were identified as Causals condition to fulfill the main category, some as underlying intervening factors and some were identified as outcomes.

It should be noted that given that the aspects of the model strategies may not be developed through interviews, to solve this problem comparative studies of Norway, Canada, Australia, South Korea and Russia that are leading in this regard in the valid data centers such as WIPO, GEM were used. In this way, the initial overall

Table 2: Encoded data in three steps

Selective coding	Open coding	Axial coding	Selective coding
A_{11}	The uncertainty of regional priorities	The lack of regional priorities	Causal conditions
A_{12}	The uncertainty of the strengths and weaknesses of innovation in the region		
A_{13}	Lack of regional competition		
A_{21}	The absence of think tanks and expert groups in the field of regional innovation	The uncertainty of the duties of	
A_{22}	Lack of regional government agencies with responsibilities in the area of	organizations innovation	
A_{31}	Refusal by the government to the needs of companies	Inconsistency of institutions and	
A_{32}	Lack of sense of responsibility among government agencies	organizations together	
A_{33}	Failure to identify the needs of each university, industry and government		
A_{41}	Technical challenges of technology commercialization	Weakness in technology diffusion	
A_{42}	The absence of appropriate legislation	and commercialization functions	
A_{43}	The current lack of transparency rules	and rules of regional inappropriate	
CC	The development of Regional Innovation System	Regional Innovation System	Core category
B_{11}	Scientific and educational dimension	Making structures and appropriate	Strategies
B_{12}	market and human resources dimension	mechanisms in the system	
B_{13}	creating infrastructure and regulations dimension	of regional innovation	
B_{14}	investment and private sector participation dimension		
C_{11}	The size of regional innovation policies	Scales	Underlying
C_{21}	The intensity of regional innovation policies	Intensity	
C_{31}	Short term	Period	
C_{32}	Midterm		
C_{33}	Long time		
D_{11}	Accompanist	Government	Intervening factors
D_{12}	Stockade		
D_{21}	Funds available	Resources	
D_{22}	Non-financial resources available		
D_{31}	The flexible structure of university, industry and government	Structure	
D_{32}	The modernization		
D_{33}	Sense of responsibility		
D_{41}	Microeconomics	Economic conditions	
D_{42}	Macroeconomics		
D_{43}	International Economics		
D_{51}	Spopulation number	Social and demographic conditions	
D_{52}	Population distribution		
D_{53}	Reference groups	Political and legal conditions	
D_{61}	Political system and government structure in the region		
D_{62}	Government ideas		
D_{63}	General rules		
D_{64}	Obligation to act	Cultural conditions	
D_{71}	Regional culture		
D_{72}	Culture and sociology of technology		
E_{11}	Regional capacity development	Economic development	Outcomes
E_{12}	Organized and effective use of resources		
E_{13}	Promoting cultural		
E_{14}	Economic prosperity		
E_{15}	Balanced regional development and improve infrastructure business		
E_{16}	Regional solidarity		
E_{21}	Development jobs	Improve the environment for	
E_{22}	Technology transfer	entrepreneurship and business	
E_{31}	Identify opportunities outside the region	Scientific and technological	
E_{32}	The development of competitive advantage	cooperation	

model of grounded theory derived from the data was revealed foe researchers in which the issue of regional innovation system development was considered as the main category. In other words, the key informants wanted to implicitly refer to this subject that what factors as causal conditions could lead to the development of regional innovation system and this concept according to what strategy would lead to what outcomes and in this way what underlying and intermediate factors would affect it.

In subsequent interviews with the emergence of the primary general model, the researchers tried to collect more information to fill conceptual model holes and reveal the relation of main issue with secondary issues so that they would reach theoretical saturation to obtain conceptual model derived from real data. The results of the three steps of open, axial and selective coding were classified in Table 2.

As shown in Fig. 4 from interviews 549 were primary codes, 210 were secondary codes and 91 were conceptual codes and finally 19 general issues were obtained. In

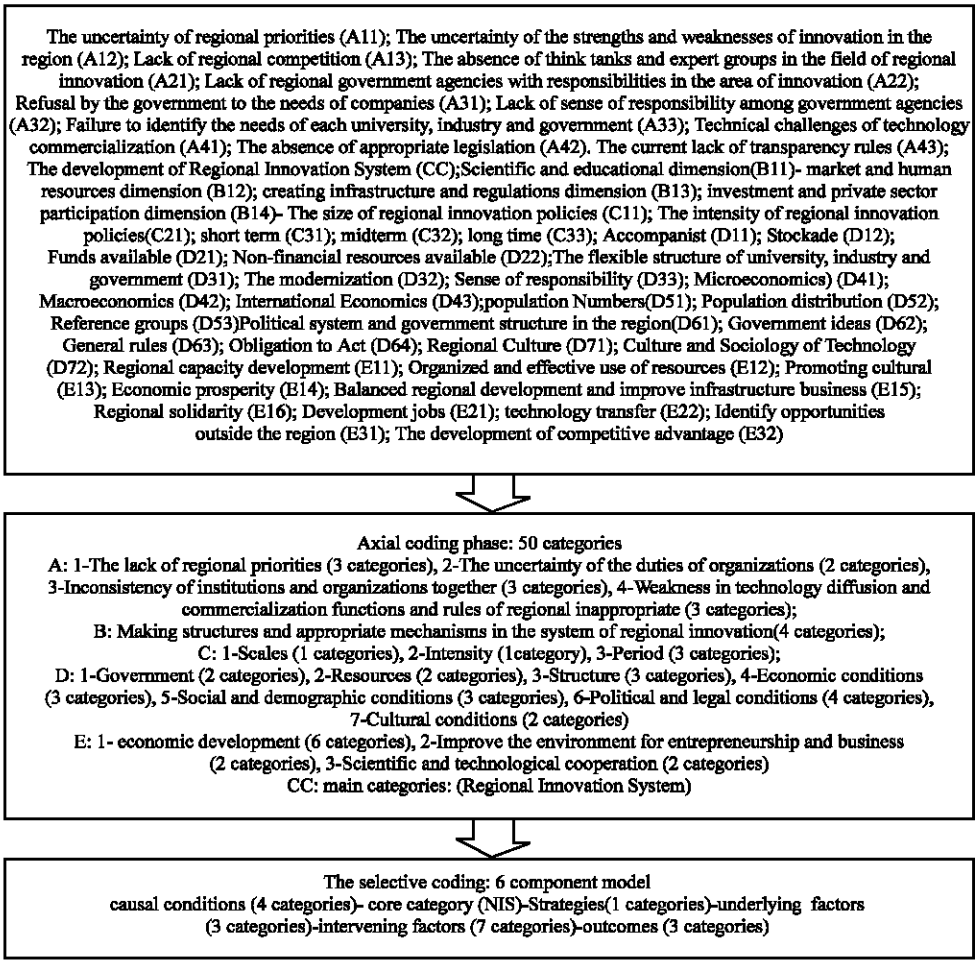

Fig. 4: Data management stream and transfer to model in three stages of coding

selective coding step, relationships between the issues were revealed and conceptual model was provided. As was seen in the previous figure,five dimensions were identifiedin Iran's RIS. The central issue is the development of RIS in Iran. Governments around the world are moving towards the development of RIS. Over the past few years, governments have seriously encouraged innovation and used innovation systems in doing so.

Causal conditions are factors that affect the central issue. These terms lead to development the phenomena or issues beyond that. Causal conditions of the need to RIS in Iran include inappropriate regional rules, the uncertainty of the duties of organizations and institutions, inconsistency of institutions and organizations with each other, the weakness in the diffusion and commercialization functions, the lack of regional priorities and lack of technology gain strategy. These factors indicate the need for a regional innovation system in Iran and developing its framework and running it are very necessary. These factors cause companies to be confused in developing their activities and unable to identify their future roadmap.

The underlying factors are the ones that affect the strategies that based on studies; they are three categories of intensity, time and period. This means how much the policies of the development of RIS have been and to what extent regulatory policies are needed. The more the regulatory policies are the companies will be more relieved to continue their activities. The intensity means the effect of these policies on the development process and their spread. However, the extent of these policies should be reasonable and do not lead to government and government institutions intervention in the current affairs of the company. The period can be short-term, medium-term or long-term. According to the results of this research and studying the theory from data, it seems that our country needs all three periods. It is needed that by developing short-term, medium-term and long-term goals help companies achieve goals.

Intervening factors, like underlying factors, affect actions and interactions of factors (strategy). According to the research, mediating conditions include seven categories of government, resources, structure, economic conditions, social and demographic conditions, political and legal conditions and cultural conditions. In this study, government means state and other state related organizations, all of which has a governing role in the surrounding environment. The budget set by the state for the companies activities could be one of the mediating conditions of the strategy of the organization affecting the conditions to develop this process. Information on the relationship between the government and its policies (at regional level) shows that the government will play an important role in the process of creating and continuing to work. It should also be borne in mind that increasing reliance on public sector companies will push them away from creativity and innovation. Among other important issues in the intervening factors is the structure. If the companie's structure is flexible has modernization and responsibility in the dynamic conditions, it affects development process as a intervening factors. The properness of the economic conditions to develop the activities of the companies is very important, where the dimensions of microeconomics, macroeconomics and international economics should be paid attention to and all three categories should be in listed in coordination with regulatory policies of RIS. Along with that the method of conducting business activates and monetary and fiscal policies should be amended. Population issues should also be taken into consideration. One of the important political and legal conditions is one of the important mediating conditions to adopt regulatory policies to develop RIS in the country. The systems of development of governmental RIS, categories are general rules and requirements of the law. Every political system has a clear idea of governance with a mutual structure. Cordination of this structure and compatibility with each other's ideas provides favorable conditions for RIS. Actions and interactions (strategy) refer to actions done in relation to the central issue. As was observed in the article, for this episode as it was not possible to achieve good results through interviews, comparative studies of five countries, Canada, Russia, Australia, Norway and South Korea were used.

CONCLUSION

The results include scientific and educational dimension, the market and human resources, the infrastructure and regulations as well as the private sector involvement and investment.Scientific and educational dimension could include topics such as increasing the participation of education with higher education, training creative students, expanding technical and vocational training centers, research-oriented universities, emphasis on applied research and so on. Market and human resources dimension could be topics such as establishing a close relationship between business and the academy, increased participation by researchers at market-based centers for R&D, cooperation with educational institutions, industry and other institutions to exchange information and benefiting from the experiences, encouraging creativity and innovation and so on. Creating infrastructure and regulations aspect includes topics such as the strengthening of intellectual property laws and the removal of superfluous bureaucracy in the field of innovation. Investment dimension and private sector participation includes topics such as granting tax breaks, applying incentives supporting policies by the government, export guarantee and insurance support and more. In case of adopting regulatory policies in order to develop RIS in Iran, the country's economic development, improving the entrepreneurial climate and business and scientific and technological cooperation will occur when these elements are seamlessly intertwined. These factors lead to more efficient use of regional resources and lead to balanced regional development and infrastructure improvement of businesses and ultimately competitive advantage rises.

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