J. Basic. Appl. Sci. Res., 3(6)783-796, 2013
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ISSN 2090-4304
Journal of Basic and Applied Scientific Research
www.textroad.com

Iran and Knowledge Creation Infrastructures in the Knowledge Economy Era

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ABSTRACT

In the knowledge-based economy, knowledge is the most important factor of production and it is ahead of other factors of production from the perspective of role playing in the creation of added value. Therefore, factors affecting the production of knowledge should be investigated. Factors influencing knowledge creation are divided into two categories of physical infrastructures and institutional factors. The present study focuses on investigation of physical infrastructures and examines the knowledge creation infrastructures in Iran. Some of the investigated infrastructures are libraries, scientific communications, universities, laboratories, Internet, and field studies. In this study, documentary and library methods were used, to collect data. Also a descriptive-analytical method was employed for analyzing the data. The results prove this reality that Iran has not yet acquired the necessary physical infrastructure for substrates of knowledge-based economy and in this regard this country has a lot of shortcomings and weaknesses.

KEYWORDS: Knowledge, Knowledge-Based Economy, Technology, Innovation

1. INTRODUCTION

During recent decades, the world has entered a new era known as knowledge-based economy or knowledge economy. This economy is based on production, distribution and application of knowledge. In the era of knowledge based economy, the role of knowledge and innovation in economic growth and creation of added value are getting more and more important. In this period, knowledge is considered as the most crucial factor of production and has played a key role in the growth of developed societies. Considering the importance of the role of knowledge in economic growth, the necessity of paying attention to infrastructures of creating knowledge, especially in developing countries that have ignored these developments and did not accordance themselves with them, is of crucial importance. The present study first reviews the definition of knowledge, its various types and the main components of knowledge-based economy like innovation and technology. Afterwards, the main focuses are on the knowledge creation processes and physical infrastructures of knowledge creation and finally Iran's situation is investigated. The research questions that are designed based on the main issue of the study and the attitude toward it are 1 - How are the process and the mechanism of the knowledge creation? 2 - What are the infrastructures of knowledge production? 3 - How is the status of the knowledge infrastructures in Iran?

1. Definition of key terms

1.1. Knowledge

Alan Burton-Jones (1999) defines knowledge as 'the cumulative stock of information and skills derived from use of information by the recipient'. He distinguishes knowledge from data (signals which can be sent by an originator to a recipient) and information (data which are intelligible to the recipient) (Burton-Jones, 1999).

Therefore, the base of knowledge is information and the base of information is data. "Knowledge is a mix fluid of experiences, values, available information and systematized professional attitudes that provide a framework for the evaluation and use of new information and experiences. Knowledge is not only in records and stores of knowledge in organizations, but also it is embodied in working procedures, organizational processes, practices and norms" (Momeni and Shamsi, 2006: 3).

To stress on importance of knowledge, Stiglitz state that "Knowledge and information is being produced today like cars and steel were produced a hundred years ago. Those, like Bill Gates, who know how to produce knowledge and information better than others reap the rewards, just as those who knew how to produce cars and steel a hundred years ago became the magnates of that era" (Stiglitz, 1999: 37).

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From economic perspective, knowledge is divided into two types, implicit and explicit knowledge. Implicit (tacit) knowledge is a type of knowledge that the individual has in mind and thought. This type of knowledge is not reachable to others since it is not explicit. This knowledge can be expressed by its holders or encrypted and became widely available. Hence, transferring knowledge does not take place till implicit knowledge converted into explicit one.

As Michael Polany (1966: 4), put it "we can know more than we can tell". Knowledge that can be expressed in words and numbers only represents the tip of the iceberg of the entire body of possible knowledge. Polany classified human knowledge in two categories. "Explicit" or codified knowledge refers to knowledge that is transmittable in formal, systematic language. On the other hand, "tacit" knowledge has a personal quality, which makes it hard to formalize and communicate. Tacit knowledge is deeply rooted in action, commitment and involvement in a specific context. In Polanyi's words, it "indwells" in a comprehensive cognizance of the human mind and body (Nonaka, 1994: 16).

1.2. Knowledge-Based Economy

As a result of the knowledge-based economy revolution, fundamental changes in the economic and social structures of human societies have occurred. These developments led to profound changes in global economic and competition both in and outside countries. In this new economy, knowledge creation and innovation are vital conditions for countries to survive and remain competitive in the global arena. Those countries which cannot match themselves with these developments and participate in the competition that is based on creation of new knowledge will be pushed aside from the competition scenes and will not achieve development. The Organization for Economic Development and Cooperation first developed the term 'knowledge-based economy'. In OECD view "science, technology and industry policies should be formulated to maximize performance and well-being in "knowledge-based economies" – economies which are directly based on the production, distribution and use of knowledge and information. This is reflected in the trend in OECD economies towards growth in high-technology investments, high-technology industries, more highly-skilled labor and associated productivity gains. Although knowledge has long been an important factor in economic growth, economists are now exploring ways to incorporate more directly knowledge and technology in their theories and models. "New growth theory" reflects the attempt to understand the role of knowledge and technology in driving productivity and economic growth. In this view, investments in research and development, education and training and new managerial work structures are key (OECD, 1996: 7).

This economy is not only based on creation of knowledge; however, distribution and the application of knowledge are the main factors for increased development and creation of wealth in all industries. Knowledge, in this economy, is the major stimulant of growth and wealth creation in all industries with high and medium technologies. In this economy, the application of knowledge creates more added values in comparison with traditional factors of production like labor and capital. In traditional economics, labor, capital and land were the main factors of production. As a result, the competitiveness of different economies depended on the rate of their advantages of cheap labor, abundant capital so on and so forth. In knowledge-based economy or "the new economy", "knowledge" is the most important factor of production. Hence, the economic competitiveness depends on whether individuals, firms and communities can create, acquire and promote the knowledge and use it successfully or not? (Stiglitz, 1999: 37).

1.3. Technology

"Technology is techniques of the use of instruments, machines, materials and processes that aid human to solve problems. Technology is a human activity; therefore it is more longstanding compared to knowledge and engineering. This term implies all available types of 'knowledge' for constructing supplies and artifacts of all kinds, practicing professions and hand skills (except doing religion tasks, magic, military efforts, or cooking) and extracting and collecting all kinds of materials (except materials that are used for foods, religious ceremonies and magic)" (Zahedi, 2005: 262).

OECD member countries agreed to define the ICT sector as a combination of manufacturing and services industries that capture, transmit and display data and information electronically. This definition is based on an international standard classification of activities (OECD, 2002: 81).

That is, it is considered as a collection of hardware, software and networking that makes the study, application of data and its processing possible in the fields of storage, transfer, transportation management, exchange, control and switching. Investments in ICT lead to capital accumulation resulting economic growth. With the reduction of costs of exchanges, ICT increases the turnover of exchanges and provides higher level of efficiency and output. In international level, ICT reduces the costs of transactions and thus increases the international competitiveness.

1.4. Innovation

Innovation is productive use of knowledge. It has been defined as "the application in any organization of ideas new to it, whether they are embodied in products, processes, services, or in the systems of management and marketing through which the organization operates (Leung, 2004: 2). Innovation can be the idea that leads to production of new goods, enhance quality products, new superior production techniques and new management and marketing approaches.

2. Statement of the Problem in This Study

In knowledge-based economy, knowledge and innovation are the main factors of production and creation of added value; such that the World Bank has accepted that one of the crucial factors in determining the level of development of countries is their utilization of knowledge. Despite the key role of knowledge in the knowledge-based economy era, unfortunately the developing countries have a negligible contribution to the global knowledge production. For instance, Iran that includes about one percentage of the world's population, only conducts 0/004 percent of the world's annual production of knowledge. This index indicates that the per capita production of knowledge in Iran is much lower than other countries' per capita production of knowledge.

In this line, one of the most important issues that developing countries are encountered with is identifying the reasons of low production of knowledge in their countries; so that through informed actions, they can produce a sufficient share of knowledge to overcome their underdevelopment. This problem has several dimensions, all of which are of great importance and cannot be neglected. Identifying each of its dimensions requires extensive independent research. This paper focuses on the aspect of required infrastructures for the knowledge and the issue of identifying the required infrastructures for knowledge production is studied and analyzed.

3. RESEARCH QUESTIONS AND METHODOLOGY

To collect data, in the present study, documentary and library methods were employed, using a descriptive-analytical approach to analyze data. The research questions that are designed based on the main issue of the study and the attitude toward it are as the following:

3.1. How are the process and the mechanism of the knowledge creation?
3.2. What are the infrastructures of knowledge production?
3.3. How is the status of the knowledge infrastructures in Iran?

4. Prerequisite to Attract Explicit Knowledge

Implicit (tacit) knowledge is the knowledge in the people's minds. If the holder expresses the implicit knowledge, then it converts into explicit knowledge. For individual who is not involved in its production process, explicit knowledge, while it is apparent, may seem unclear and incomprehensible. Implicit knowledge can't be easily transferred; however, its transfer has some limitations. One way of making the exchange of implicit knowledge possible and ease restrictions of transferring is its disclosure or encoding. Coding is integrating individual and organizational knowledge in formats through which all individuals' need to access knowledge is facilitated. Knowledge of encoding is in software applications and books. Through using them, applying it for all individuals in all places and times is possible. To make this knowledge more easily be written, it is encrypted and written. After encoding, explicit knowledge become intelligible to others and can be used. For transferring knowledge, the encoding alone is not sufficient; however, the transfer and assimilation of knowledge requires having a set of initial conditions. Attracting any type of encoded knowledge requires having the initial level of related knowledge and some practical experiences.

Then Stiglitz state that "The codified technical information assumes a whole background of contextual knowledge and practices that might be very incomplete in a developing country. Implementing a new technology in a rather different environment is itself a creative act, not just a copied behavior. Getting a complex technical system to function near its norms and repairing it when it malfunctions both draw upon a slowly accumulated reservoir of tacit knowledge that cannot be easily transferred or "downloaded" to a developing country (Stiglitz, 1999: 40).

5. The Importance of Implicit Knowledge as a Competitive Advantage

Private knowledge is the implicit knowledge of individuals and organizations or firms. This knowledge is the source of competitive advantage for an organization, a firm or an individual in the micro-level and macro-level for an economic system. When it s coded, implicit knowledge becomes explicit and can be transferred and be accessible to everyone and its application become public. Public knowledge cannot be the source of competitive advantage since it is not something unique for individuals, organizations, firms or even countries. This knowledge is available

to everyone. In other words, it can be achieved with minimal costs. However, if firm or country fails to apply it successfully, it can be the source of competitive failure. In fact, public knowledge is necessary condition (essential condition) and private knowledge is a sufficient condition (condition of development) for developing competitive advantages. Therefore, production of implicit knowledge is of great importance.

According to Stiglitz, implicit knowledge is really important and this embedded knowledge in employees of an organization can be a competitive advantage for that organization.

Take technology transfer as an example. The technical manuals, blueprints, and instruction books are the codified technical knowledge that could be seen as only the tip of the iceberg (Stiglitz, 1999: 40).

In this definition, explicit knowledge is only a small amount of the tip of the floating ice in the water and the main basic part is implicit knowledge that is under water.

To emphasize contest importance of tacit knowledge, lundvall state that "The reason why industrial districts remain successful in specific fields is that they flourish on the basis of tacit knowledge (according to Marshall, 'the secrets of industry are in the air'; we would add that they are also implanted in the backbone of the people living in the region). Tacit knowledge is knowledge that has not been documented and made explicit by the persons who use and control it (Lundvall et all, 2008: 683).

Thus, implicit knowledge leads to societies' success and progress. Due to their accumulation and development of implicit knowledge, industrial societies always remain successful. In the knowledge-based economy, those societies can develop that attend the global competitive arena and make a decent use of their implicit knowledge of individuals and organization. Hence, identifying and developing prerequisites for production of implicit knowledge is essential. According to Farnet quoting Xinhua news agency, through lawsuit in one of the American courts, Apple sued Samsung for what Apple called violations of property of Apple products. Apple claimed that Samsung's Glaxy S 4G and Nexus S phones and Galaxy tablet products has violated the commercially royalties of Apple. In this report quoting one of the legal representative of Apple, it is noted that it is no coincidence that Samsung's latest products are quite similar to the iPhone and iPad from its appearance design to internal hardware, interface and even the packaging of the product.

In fact, Apples lawsuit was because of the importance of this company implicit knowledge and its illegal use by Samsung. Since Apple's available implicit knowledge is this company's competitive advantage against other competitors. Through the application of implicit knowledge and special innovations, Apple could win the competition and allocate greater markets to itself.

6. Creation of Implicit Knowledge through Learning by Doing

One of the ways of achieving available implicit knowledge in different sciences is learning by doing. Among different types of knowledge, because of its nature, accessing the available knowledge in engineering sciences is more possible through learning by doing.

In the process of knowledge production during doing a job, implicit knowledge is produced. Through experience and in an implicit way, individual who is busy with doing something applies the knowledge that is in his/her mind. This knowledge is achieved through experience and is implicit in his/her mind. Therefore, the production of implicit knowledge and converting explicit knowledge into implicit one take place in the process of doing something (Stages 1 and 4 in Matrix SCEI). Each individual has their own implicit knowledge. The best way to get access to an individual's implicit knowledge is creating a direct connection with the holder of that knowledge. The kind of knowledge that is produced in this regard, till it is not transferred to others, remains implicit. As soon as it is encoded and become available to others, it converts into explicit one. Also, the bearers of knowledge can transfer the implicit knowledge to others while working. Educational institutions play an important role in the expansion of people's capabilities for creating implicit knowledge. Teaching methods that are associated with doing a work, create greater abilities for making implicit knowledge.

The explosive growth of productivity within the sciences makes it a major challenge to mediate such knowledge in the education system. Rather than trying to cover all new theoretical developments, it is necessary to define and teach 'basic tools' and 'basic perspectives'. The way to link the theoretical universe to practical problems may be to let students conduct experiments and find technical solutions to specific problems. Letting students go into some depth in a specific realworld problem and giving them a chance to make use of theoretical and engineering knowledge is a way of fostering a more coherent understanding of theory and practice (Lundvall, 2008: 684).

Over time, an individual who has been involved in doing a job or a profession acquires a lot of implicit knowledge that others are deprived of. Methods through which implicit knowledge can be embedded and became explicit and transferable should be found. In fact, over time, each individual involving in doing a job develops his/her specific implicit knowledge. This individual is like a book of information and implicit knowledge which is really valuable.

Since a vast part of knowledge is produced in practice, industry is one of the other places that knowledge is produced. Production of knowledge in industry occurs through learning by doing. Production of knowledge in industry and university should complement each other. Trainings in the universities will be incomplete if those trainings do not put into practice. As a result, these two institutions should interact with each other and share the produced knowledge; in a way that university produces the required knowledge of industry. Professors and students also should directly take part in practical tasks both in laboratory and industry and learn the implicit knowledge in the industry through the process of learning by doing and combine that with their own knowledge.

Implicit knowledge is perception of implicit concepts which not only fills the gap between information and perception but also indicates the methods of applying them to improve the process of producing goods and services. This process takes place if the individual be engaged in work and has a close relationship with professional skilled experts. Implicit knowledge is a competitive advantage of a firm. This knowledge is not only used for application of new knowledge in production system; however, it is indicated the quality, methods and approaches of applying the existing knowledge to improve the quality of products and services.

Since in developed countries, the accumulated knowledge is much more than the existed knowledge in developing countries, therefore achieving this knowledge is of great importance for developing countries. These interactions should be in a way that individuals in the country cooperate with foreigners to gain their implicit knowledge through the process of learning by doing and be able to apply that knowledge afterwards without help and make it dominant and convert it to an indigenous kind of knowledge; so that in continue, develop the existed knowledge and create innovations.

7. The Process of Knowledge Creation

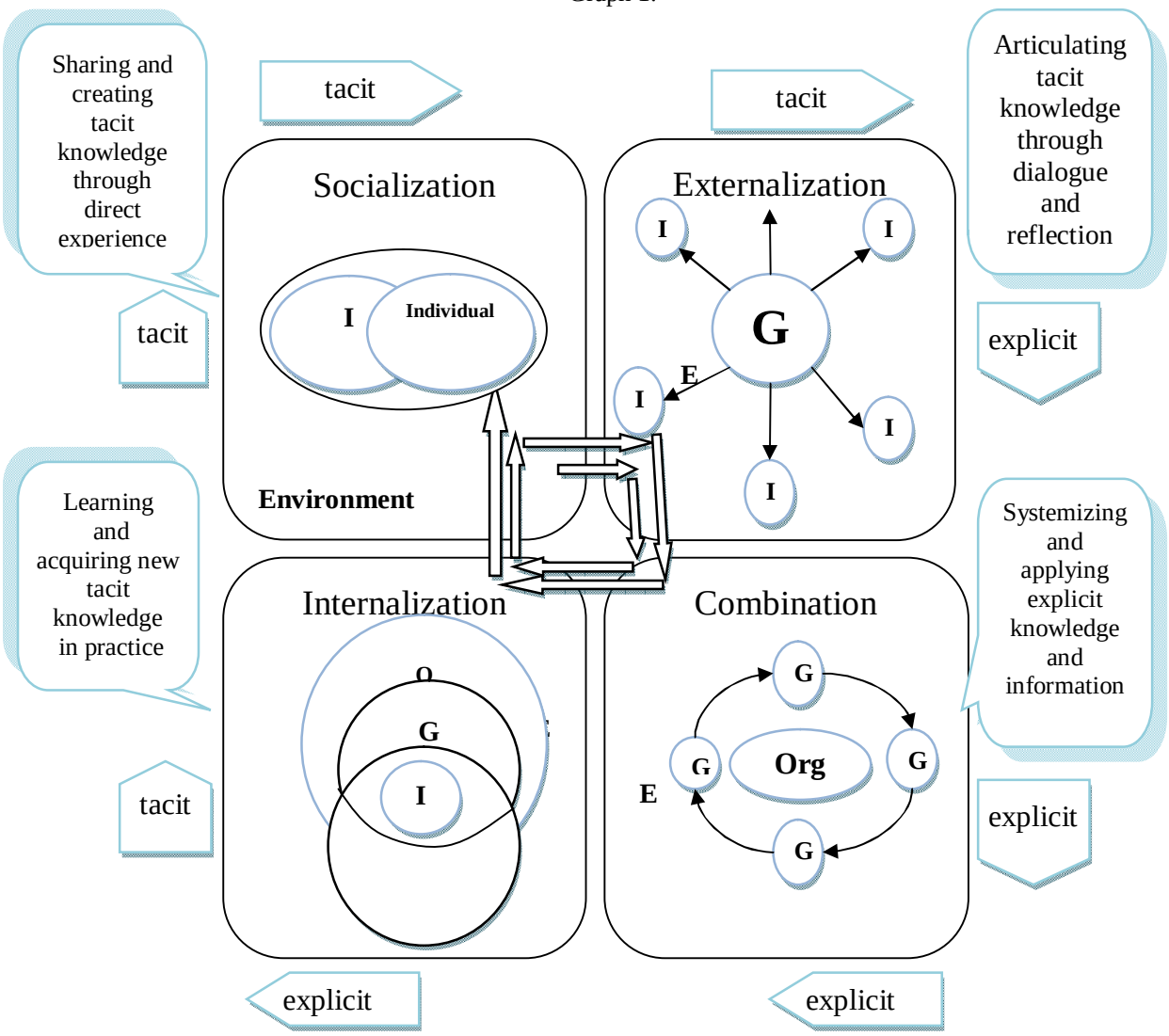
Note that in the knowledge-based economy era, knowledge is the most important factor of production. Moreover, it is an important source of competitive advantage for countries; therefore creation of this type of knowledge is really important.

Nonaka proposed that organizational knowledge is created through the continuous social interaction of tacit and explicit knowledge involving four sequential modes of knowledge conversion: socialization, externalization, combination and internalization, before returning once more to socialization. This process is a „spiral‟ one, a metaphor suggesting that each „circuit‟ builds on the previous one; knowledge creation is also, implicitly, knowledge accumulation (Nonaka, 1994: 15, 18). The process was depicted by a matrix, sometimes called the SECI model, described as the “engine” of the entire knowledge creation process (Nonaka and Takeuchi, 1995: 57; see Figure 1).

Initially a two dimensional theory of knowledge creation was proposed (Nonaka 1994: 16-17; Nonaka & Takeuchi 1995: 57-60). The first, or “epistemological”, dimension is the site of “social interaction” between tacit and explicit knowledge whereby knowledge is converted from one type to another, and new knowledge created (Nonaka et. al. 1994: 338; Nonaka 1994: 15). After Internalization the process continues at a new ‘level’, hence the metaphor of a “spiral” of knowledge creation (Nonaka & Takeuchi 1995: 71-2, 89). While knowledge conversion is a social process its effects in the “epistemological” dimension appear to be on the individual since the second (“ontological”) dimension depicts the passage from individual since to inter-organizational knowledge via group and organizational levels (Nonaka & Takeuchi 1995:73).

In every society, the process of knowledge creation varies. Because of inefficient institutions, in some communities, the process of creation of knowledge will never be over or if it proceeds to some level, it will never be completed. One of the most important institutions with a key role is training. Training should be organized in a way that it creates a sense of collaboration and creativity in individuals. Furthermore, in addition to theoretical courses in this educational system, individuals should present in the society and learn the related implicit knowledge in practice and involve themselves in doing a job.

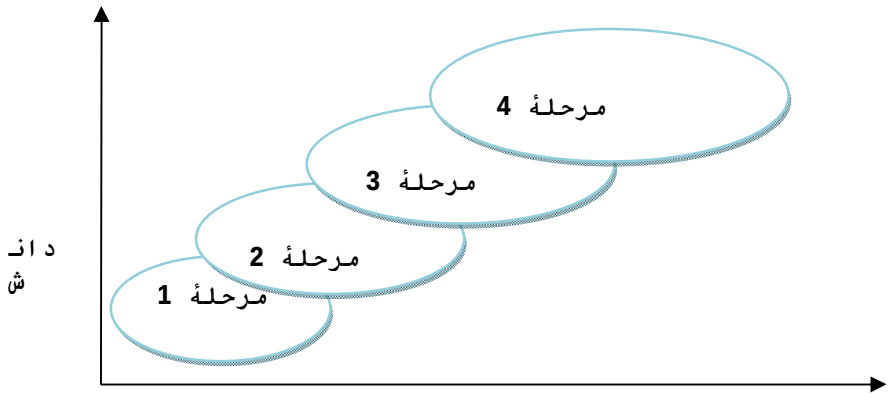
Graph 1:



source: (Nonaka & Takeuchi 1995, pp. 57, 62, 71)
I: individual G: Group O:organization E:Environment

Figure 2 indicates the spiral development process of the SECI matrix. As it shows, in each period knowledge is broader and more complete than the previous period. After spending each period of matrix SECI, knowledge increases compared to previous period and this increased knowledge will pass the route of creation of knowledge and will increase again and again. This process continues in each period and there is no end to it. Knowledge in this process increasingly enhanced.

Graph 2: The Process of increasing growth of knowledge



7.1. Converting Implicit Knowledge to Implicit Knowledge (Socialization):

That is when people directly share their implicit knowledge with others. For instance, through face-to-face communication, in this phase, implicit knowledge accumulated and transferred. Nonaka presented an example for this. The example was about developing bread machine. He indicated how technical implicit knowledge changes into social one. Engineering team failed in constructing bread bakery machines that bake delicious bread. Chef could not teach them what they needed. For constructing the bakery machine, therefore, the members of the team paid attention to how the chef kneaded the dough and they figured out that during making the dough, the chef not only pulled the dough but also twisted it. This was a mystery of producing delicious bread which they had to use. Thus, the engineers' ability in constructing a machine that was capable of producing delicious bread was developed after an apprenticeship alongside a chef and working with him (Nonaka & takeuchi, 1995: 64, 104 -105).

7.2. Converting Implicit Knowledge to Explicit Knowledge (Externalization)

Socialization is followed by externalization, the conversion of tacit into explicit knowledge (Nonaka, 1994: 24; Nonaka and Takeuchi, 1995: 66). That is encoding and encryption of experience and insights in a way that they become usable to others. For example, changing our implicit knowledge through discussion and question and answer to a more tangible knowledge and transfer it.

7.3. Converting Explicit Knowledge to Explicit Knowledge (Combination)

The interaction of explicit knowledge with explicit knowledge or "combination" was described as the process of "systematizing concepts into a knowledge system" (Nonaka and Takeuchi, 1995, p. 67). At this point, various sections of explicit knowledge are combined and a new form is provided. This occurs when people from different knowledge sources combine their knowledge. For instance, gathering different information about a particular issue from various sectors and departments of an organization and collecting them in a single report. Hence, in this stage the explicit knowledge is edited and transferred.

Nonaka and Takeuchi stressed that "an MBA education "one of the best examples" (Nonaka and Takeuchi, 1995: 67). And also combining including "embodiment" of knowledge into products (Nonaka et al., 1996: 207-8).

7.4. Converting Explicit knowledge to implicit knowledge (internalization)

Internalization, the conversion of explicit into tacit knowledge, is "closely related" to "the traditional notion of learning", and to "learning by doing"(Nonaka & Takeuchi, 1995: 69).

This occurs when individuals internalize their explicit knowledge and share it with others. In this regard, implicit knowledge broads and revitalizes itself. Internalizing the explicit knowledge occurs through training, practicing, imitating and experience. Based on four phases of creation of knowledge in the matrix SECI, the production of three types of knowledge is imaginable that can lead to a competitive advantage in national and international level for firms, organizations and finally the countries.

Lundvall state that "knowledge always has tacit elements. It is impossible completely to separate the competence from the person or organization that acts. The outstanding expert – cook, violinist, physician, manager – may write a book explaining how to do things, but what is done by the new beginner on the basis of that explanation is, of course, less perfect than what the expert would produce. Attempts to use information technology to develop expert systems show that it is difficult and costly to transform expert skills into information that can be used by others (Lundvall, 2008: 684).

The difference between experts and novices is in the internalization of knowledge. Even if a beginner is aware of experts' implicit knowledge, he/she cannot fully do a related task since that knowledge internalized and dominated in him/her. To internalize the knowledge, one should be closely involved in doing the task.

8. Criticism of Nonaka's Model

Criticism of Nonaka's model of knowledge creation comes to mind. One of the objections is that implicit knowledge has never become explicit and will remain in the first level. This can be a subject to some existing institutions in societies that prevent from disclosure of personal implicit knowledge. Moreover, many organizations do not reveal their implicit knowledge since it creates a competitive advantage over other organization. This prevents the implicit knowledge to go through the third level and enter into the fourth one.

Lundvall state that "The fact that a certain piece of knowledge is tacit does not rule out the possibility of making it explicit – to codify the knowledge – if incentives to do so are strong enough. To make this clear, it is useful to distinguish between tacit knowledge that can be made explicit – tacit for lack of incentives – and knowledge that cannot be made explicit – tacit by principle (Lundvall, 2008: 683).

Therefore, "motivation" plays a key role in revealing implicit knowledge and can lead to reveal some parts of personal implicit knowledge. Upon the introduction of motivations, institutional structure and social-economical reward system are presented. The fate of societies in terms of their institutional quality varies from one another. One of the most important institutions with great impacts on this process and the one which has a key role in revealing the knowledge is intellectual property rights. North asserted that, "the most important step toward creating incentive structures is the evolution of property rights" (North, 2001: 66). Without intellectual property rights and supporting the knowledge owners, individuals and organizations avoid disclosing their knowledge and implicit knowledge will never become explicit and the explicit knowledge within the organization will not be transferred. This is due to features of knowledge. Knowledge, unlike physical goods, is non-exclusive that is the application of one individual do not prevents others to use it. In addition, knowledge is such that after providing initial costs, the costs of reproduction is insignificant. Hence, the knowledge that has produced for an organization and a firm with great costs is exclusive and it will not be available to other individuals and organizations. On the other hand, rigid property rights leads to low dissemination process of knowledge and knowledge in most cases stays exclusive.

9. Infrastructures of Creating Knowledge

Every society that demands progress should have the ability of applying its individuals' embedded implicit knowledge and provides the backgrounds for converting this knowledge into explicit one. Basic sciences, engineering, medicine, social and human sciences are some of the most important knowledge needed for various communities. Production of implicit and explicit knowledge is possible through different specific directions. Explicit knowledge, in all kinds of sciences, is gained through reading new books, articles and scientific sites. However, implicit knowledge is learned by participating in seminars, laboratories, research opportunities, exchanging knowledge of professors and students, participating in productive projects, field studies, taking part in industry, manufacturing and so on and so forth. More technical engineering knowledge is produced through participation in industry, laboratories and through the process of learning by doing. Therefore, some of the infrastructures required for creation of knowledge include: libraries, scientific communication (seminars, student and teacher exchanges, research opportunities, attracting elite students, etc.), laboratory, Internet, and field studies.

9.1. Libraries

Libraries are one of the places that play significant roles in creating knowledge. Among various sciences, producing knowledge in social sciences due to its nature is often conducted based on library research and documentation. In developing countries, production of knowledge in social sciences is underperforming. A few percent of global scientific production in the field of social sciences has been assigned to developing countries and compared to the production of knowledge in other sciences, it achieved a lower position. Access to an enriched library plays an important role in the process of creating knowledge of social sciences. Social sciences are of great importance since social sciences investigate individuals and societies and the progress of each society depends on modifying that society, identifying and removing the existing barriers to development. So that advance in other sciences takes place slowly, till social sciences do not develop. Increasing the quality and quantity of libraries and providing required facilities for field studies play a key role in developing social sciences.

9.2. Scientific Communications

In addition of using explicit knowledge should also benefit from the embedded knowledge in other societies through participating in conferences, training courses, seminars, and alike. In addition to the encoded knowledge, implicit knowledge also has a crucial key role in achieving knowledge-based economy. Having a close relationship with the owners of this knowledge is necessary for getting access to it. So, one should have access to those who

know the related sciences well and have great skills in applying that kind of knowledge. To access this knowledge, some certain conditions should be provided to communicate and collaborate closely with experts and authorities and to utilize their knowledge in an effective way.

North considered that the process of accumulation of knowledge occurs through mutual exchanges of ideas of scientists and innovators (North, 2001: 201-198). "Scientific communications both within scientific organizations and institutional frontiers have always been a factor of progress, production of knowledge and creation of the backgrounds for continuous reconstruction of fundamental systems of knowledge throughout history (Mohammadi, 2005: 200).

Coates & Wawrick presented an example for this.

Once, The UK Department of Trade and Industry considered a support program for automobile parts production. For this reason they asked a Japanese engineering team for advice and guidance. One of the English companies which had an extensive studies and experiences in producing automotive parts wrote that "only after meeting and working closely with the Japanese, they noticed that they did not know what they do not know" (Coates & Wawrick, 1999: 26).

English engineers were unaware of implicit knowledge in Japanese firms and only after creating a close communication and collaboration with the Japanese, they noticed that there is related implicit knowledge which they are not aware of. Therefore, transferring implicit knowledge is really difficult and it can occur through continuous training and direct interaction with the owners of the knowledge. University professors and students' participation in seminars, research opportunities and exchanging knowledge between professors and students of in and outside the country can lead to a quick access to new knowledge of the local universities and universities of other countries. Professors and students exchange of information leads to broadening the existed implicit knowledge to other individuals and universities. Individuals can learn this implicit knowledge and combine that with their own knowledge and produce new knowledge. This new types of knowledge is in fact the intelligent implicit knowledge.

9.3. Universities

Universities are one of the most important places for producing knowledge. Knowledge that is produced in universities should be in a way that it can be applicable within the county. Implicit knowledge, which is produced in universities, becomes explicit in the form of national and international scientific articles. This revealed knowledge can lead to communities' progress just when they increase the production and make a great contribution to domestic productivity. This knowledge must be generated and used according to the community needs. Otherwise, it will not be effective on economic growth and people's lives. Hence, the demand for producing this knowledge should increase within a country. In fact, increasing the number of national and international articles alone would not be a sign of progress and growth of a community.

9.4. Laboratories

Laboratories are another place for producing knowledge. Technical and engineering knowledge mostly is produced by participating in industry, laboratory and through learning by doing processes. Medical knowledge due to its nature is produced based on laboratory studies. Creating the required laboratories for different sciences and providing needed equipments play significant role in the advance of those sciences. It should be noted that studies carried out in laboratory should meet the national needs and industry requirements.

9.5. Internet

Having information is one of the key factors of the knowledge-based economy. Specific aspect of knowledge-based economy is the continuous need for learning classified knowledge and the ability to apply this information. In this economy, there is a great emphasis on the dissemination of information, knowledge, methods of its application, and production of knowledge. Without having information, there is no possibility of producing knowledge. Without having proper information infrastructure, the use of existing information in all around the world is not easily possible. Due to the key role of knowledge and innovation in creating the ability to participate in international competitions, acquiring new information is of great importance in the knowledge-based economy era. Information technology is a convenient means to get access to classified knowledge. The digital revolution has accelerated the classification of knowledge. Electronic networks like e-libraries, e-government, e-commerce, e-learning, and digital revolution have reduced the cost of access to classified knowledge. Knowledge accomplishments are coding consistently and continually and are distributed via computer networks. Access to high speed internet can increase information and gaining the latest data and electronic libraries and thus facilitates and accelerates the process of knowledge production.

9.6. Field Studies

In addition to library research and documentation, field study and access to on time statistics and free flow of information play significant role in the production of social sciences knowledge. Field observation varies from other

types of observations in a way that it is not only limited to collecting data; however, theorization is also occurs within that (Earl Babbie, 2008: 581). Some Advantages of field research are:

1. Studying the behaviors in a natural situation.
2. Increasing the researcher's depth of understanding the under study phenomenon.
3. Providing conditions for paying attention to those aspects of issue which were not considered before the study began.

The strength of field research is that it provides a comprehensive perspective for the researcher. In this kind of study, with a direct confrontation with the under study social phenomenon and providing a more comprehensive observation, a deeper and more complete perception of the phenomenon can be achieved (Ibid, 588).

On time statistics and free flow of information can lead to investigating the current condition of society correctly and provide full knowledge of the existing facts. This information aids to identify the existing issues well and investigate effective cause and reasons correctly. In this process, the needed knowledge to overcome social issues and deficiencies will be developed. Field studies provide an opportunity for individuals to directly achieve the existing information about the society. Field studies are relatively expensive and due to their significance and for enjoyment of their benefits, the required costs should be allocated to them.

10. Evaluation of the Condition of Knowledge Production in Iran

Production of knowledge in Iran can be studied from various perspectives. Studying each of these perspectives depict some aspects of the reality. Here we examine some of these aspects.

10.1. Universities' Scientific Production

Iran's contribution to global knowledge production in 2005 has been studied based on Iran's indexes in Profiles of America in the Institute for Scientific Information (ISI). During this year, the number of Iran's indexed articles in Basic Sciences was 5423 (0.42 percent of global amount), in Social Sciences was 225 (0.13 percent of global amount) and in Humanities and Arts was 11 (0.008 percent of global amount) which were in overall 5575 (0.36 percent of global amount). Chemistry generated more than 30 percent of the country's scientific production. In this year, the share of medical universities knowledge production was about 28 percent (Sabouri and Poursasan, 2006). In 2010, based on the number of scientific papers, Iran achieved the 22nd place in the world. In this year, the number of Iran's indexed articles in Basic Sciences was 18034 (1.28 percent of global amount), in Social Sciences was 652 (1.12 percent of global amount) and in Humanities and Arts was 77 (0.07 percent of global amount) along with 18319 scientific and research articles published in Iran, its contribution to world's knowledge production has increased to 1.12 percent of global amount and achieved the 22nd place of knowledge production in the world (Sabouri, 2011:16). But do the increasing numbers of scientific articles indicate progress in the field of development of science and technology?

To answer this question, we can investigate the impact of ISI articles on increasing the export of goods with high knowledge and technology and also export of ICT products. Exporting these goods indicated the extent to which the country can employ scientific productions for producing goods and knowledge services and to what extent these goods response to the national needs in industry sections. Export commodities are shown in Tables 1 and 2, 3 and 4. As it is noted, Iran's export share compared to other countries indicated its weakness in this field. India allocated a high income from exporting ICT services. In 2010, India's share of ICT services exports was 47 percent of construction (World Bank, 2012).

Table 1: High-technology exports (current US $)

Time	Iran	India	Turkey	Malaysia	Singapore
2000	12263196	2062488338	1077574539	47025984953	73920978262
2010	584312861	10086626314	1713837053	59331817835	126981502643

worldbank (2012)

Table 2: High-technology exports (% of manufactured exports)

Time	Iran	India	Turkey	Malaysia	Singapore
2010	4	7	2	45	50

worldbank (2012)

Even with its growth from 2000 till 2010, exporting goods with high technology in Iran is still small compared to other countries. If we consider these numbers per capita, due to Iran's higher population in comparison with other countries like Singapore, Iran gained a lower position.

Table 3: ICT service exports (BoP, current US $)

Time	Iran	India	Turkey	Malaysia	Singapore
2000	...	5326188262	...	262368412	680102229
2009	...	48140805587	645000000	2013821985	2641515930
2010	...	58112024590	554000000	...	3137521721

worldbank (2012)

Table 4: ICT goods exports (% of total goods exports)

Time	Iran	India	Turkey	Malaysia	Singapore
2010	0	2	2	34	34

worldbank (2012)

Export of ICT goods in Iran is 0 percent. We did not assign any share of our exports to these goods till 2012. This reflects the fact that the produced knowledge in this field is not applied in producing goods with high technology and ICT and also shows that we failed to participate in international competitions in the knowledge-base economy. By investigating other indices like commercialization of knowledge, record inventions and patent, the impacts of increasing number of articles can be realized.

In recent years, higher education in Iran sought to adopt various policies to enhance the number of Iranian articles published in international journals. To this end, faculty members of universities are now compelled to publish articles in foreign journals to earn points for promotion. Publishing articles in international journals has always been one of the multi-axis research points for professors' promotion, but now it has become a necessity. Thus, increasing the number of articles meets the professors' and students' needs and it is not in line with national industry.

In 2008, Shanghai University in China listed 500 world's top universities in the U.S., Europe, Asia, Africa, and the Pacific. While six universities of Turkey and Israel were in this long list, there was no mention of Iranian universities. This means Iranian universities had no rank in terms of production and scientific validity in global scale. It has been noted that the report of Shanghai University in china was the result of two years of continuous work for collecting comparable data from different universities around the world. Criteria for ranking universities included Nobel Prize, the number of researchers, published articles in nature and science journals, the numbers of articles published in reputable ISI journals, and also the performance of researchers.

Moreover, the results of Harvard University study in 2001 which was carried out to investigate different countries' status of scientific and technological development and in which according to the technological development index the countries were divided into three technological areas of "innovators", "users", and "technological eliminated". The report indicated that Iran was categorized in the group of "technological eliminated". This means that Iran was among countries which had negligible contribution to production, absorption and consumption of advanced technology. Because, for instance in 2001, Iran only had one patent or exploratory right while in 1997 America had 111906 patents. Unfortunately, except in exceptional cases, content of provided ISI articles in Iran are not related to the society needs and most generated papers are not used in industrial sections.

10.2. Library

Since producing social sciences in Iran has a poor performance, hence paying attention to libraries as one of the infrastructures of producing knowledge is of great importance.

Developed countries conduct large investments for developing their libraries and therefore they have enriched libraries. Library of Congress is one of the international libraries in United States of America. This library includes 32 million books and more than 61 million manuscript versions. It also contains more than a million newspapers over the past three centuries and more than 5 million maps. Among 35 the world's top libraries, this library has achieved the first place. National Library of Belarus has gained the last place among all those libraries. This library includes 8 million books and was reopened in 2006. Central library and Documentation Center of Tehran University is the largest academic library in Iran. This library now includes more than 200000 volume of Arabic and Persian printed books collections which contain more than 110000 titles and the number of books in English and other Latin languages is more than 120000 volumes. This collection contains about 17000 handwritten volumes of Persian, Arabic, and Turkish books. Hence, the total number of Persian and Latin books in this library is about 320000. According to statistics, the number of books in the Library of Congress is 100 times more than the number of books in the Iran's largest library. Statistics issued by institutions of libraries in Iran also revealed that Berlin Library, with an estimated population of 3 million and 431 thousand people, contains 22 million and 800 thousand books and documents and it is not the only library of the capital of Germany. All Tehran libraries, with a population of 12 million people, overall include 1 million and 342 thousand books. Statistics reveal the fact that Iran in terms of individuals' access to libraries does not have a desirable situation.

10.3. Scientific Communications

Scientific communication includes holding seminars, information exchange of students and professors, research opportunities, attracting elite students and so on and so forth.

Developed countries have implemented extensive programs for scientific communications. With providing better facilities, these countries have tried to attract elites from all around the world. For instance, higher education institutes in Germany as venues of promotion for science through research and development have been strengthened the international directions in fields of science and research with creating international competition and collaboration with other groups and research networks. With offering a variety of research scholarships and awards to the world's leading scientists, this country provided a suitable situation for large-scale and long term research in all fields of natural sciences, humanities and engineering. In 1993, the number of foreign students in higher education institutes of Germany was 35000 individuals. This number has increased to almost 68000 students in 2002. In general, an important aspect in the development of international cooperation is the German Research Policy (Shokravi and Shokravi, 2006). Nowadays, Germany, after U.S.A. and UK, has the largest number of foreign students. With hosting about 233 thousand and 600 hundred foreign students, Berlin-Germany has the higher number of foreign students after U.S.A and Britain. Scholarship and non-scholarship acceptance of non Iranian students in Iranian universities is as follows: in 2009, the number of scholarship students was 319 and for 2010 and 2011 this number was 508 and 207 respectively. In 2009, the number of non- scholarship foreign students was 62, in 2010 and 2011, this amount was 138 and 606 students respectively. Overall, from 2009 till 2011, 1034 non Iranian scholarship students and 806 non Iranian scholarship students were admitted in Iranian universities. The number of Iranian students with scholarship studying is 25 thousands and 45 students. Comparing to other developed countries and considering per capita, this amount is really insignificant. With attracting elites from other countries, countries like Germany conduct their research projects and employ them in their industrial sections so that the benefits of offering scholarship is much more than the consumed costs. Hence attracting elites occurs with the aim of increasing national production and applying these individuals' existing implicit knowledge. In the third world countries, the opposite is happening. In these countries, a large percentage of elites migrate to developed countries. This is one of the social, economical, and educational issues of this country. According to the Parliament's statistics in 2010, 60 thousand of Iranian that migrate in that year could be classified as elites. These individuals are usually those whom achieved a rank in Science Olympics and/or the top individuals in the university entrance exams. Despite efforts to decrease this trend, still a considerable group of scientific graduates want to migrate to developed countries. In its 2009 report, the International Monetary Fund asserted that among 91 developing and underdeveloped countries in the world, Iran has achieved the first place in terms of its elites' migration.

10.4. Internet

Based on millions of new tests which were conducted in 30 days, "Net index" service classified the speed of loading in 170 countries in the world. In this classification, Iran is in the place of Hundred and seventieth. This indicates that Iran is still unable to access appropriately to new information. In addition, this conducted ranking has been evaluated by "speed test" from March 16, 2009 till September 15, 2011. In this ranking, Lithuania is in the first place with downloading speed of 33.15 Mbps, South Korea is in the second place with a download speed of 28.63 Mbps and Sweden ranked in the third place of the world with a download speed of 25.69 Mbps. In this ranking, U.S.A. is 30^{th} , U.A.E. 38^{th} , Ghana 58^{th} , Turkey 60^{th} , China 70^{th} , Saudi Arabia 80^{th} , Oman 84^{th} , Tajikistan 88^{th} , Malaysia 94^{th} , Angola 100^{th} , India 137^{th} , Pakistan 142^{nd} , Tanzania 151^{st} , Iraq 153^{rd} , Afghanistan 155^{th} , and finally Iran is in the 170^{th} place and is ranked the last country in the world with the average download speed of 0.53 Mbps.

11. CONCLUSION

- As a result of the knowledge-based economy revolution, fundamental changes in the economic and social structures of human societies have occurred. These developments led to profound changes in global economic and competition both in and outside countries. In this new economy, knowledge creation and innovation are vital conditions for countries to survive and remain competitive in the global arena. Those countries which cannot match themselves with these developments and participate in the competition that is based on creation of new knowledge will be pushed aside from the competition scenes and will not achieve development.
- From economic perspective, knowledge is divided into two types, implicit and explicit knowledge. Implicit (tacit) knowledge is a type of knowledge that the individual has in mind and thought. This type of knowledge is not reachable to others since it is not explicit. Implicit knowledge has two key characteristics. First, it constitutes the largest volume of human knowledge and second that it is the most important competitive advantage of various firms and countries due to being exclusive and implicit.

- Factors influencing Knowledge creation are divided into two categories of physical infrastructures and institutional factors. Some of the investigated infrastructures are libraries, scientific communication, seminars, information exchange of students and professors, attracting university elites, laboratories, Internet, and field studies.
- One of the ways of achieving available implicit knowledge in different sciences is learning by doing. To achieve this type of knowledge, due to the significant role of implicit knowledge, the environment for the targeted knowledge must be provided.
- Each individual has his/her own implicit knowledge. The best method to access individuals' implicit knowledge is having the direct communication with the holders of knowledge. The type of knowledge that is produced in this way remains implicit since it is not transferred to others. While it is coded and transferred to others, it converts into explicit knowledge.
- Basic sciences, engineering, medicine, social and human sciences are some of the most important knowledge needed for various communities. Production of implicit and explicit knowledge is possible through different specific directions. Explicit knowledge, in all kinds of sciences, is gained through reading new books, articles and scientific sites. However, implicit knowledge is learned by participating in seminars, laboratories, research opportunities, exchanging knowledge of professors and students, participating in productive projects, field studies, taking part in industry, manufacturing and so on and so forth. The conditions for conducting and performing related tasks in that field should be provided to produce implicit knowledge in any scientific fields. This is more crucial for researchers of social sciences and humanities like technological fields, medicine and basic sciences.
- In addition to library research and documentation, field study and access to on time statistics and free flow of information play significant role in the production of social sciences knowledge. The strength of field research is that it provides a comprehensive perspective for the researchers. In this kind of study, with a direct confrontation with the under study social phenomenon and providing a more comprehensive observation, a deeper and more complete perception of the phenomenon can be achieved researcher.
- The results of the present study prove this reality that Iran has not yet acquired the necessary physical infrastructure for substrates of knowledge-based economy and in this regard this country has a lot of shortcomings and weaknesses.

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