Knowledge Economy Dimensions

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Abstract

The purpose of this paper is to present an analysis of the emergent knowledge economy and its dimensions. The knowledge economy is based primarily on the development of intangibles, and knowledge processing. The knowledge revolution is changing the way we think and work, and the knowledge worker reflects the nature of the new economic driving forces. The knowledge economy opens new directions, and offers unprecedented opportunities to produce and sell on a mass scale, reduce costs, and customize to the needs of consumers, all at the same time. The dimensions of this new economy are the following: economic and institutional regime, education and skills, information and communication infrastructure, and the innovation system. Based on these dimensions, the World Bank Institute developed two important indices: the Knowledge Index (KI), and the Knowledge Economy Index (KEI).

Keywords: *intangible, knowledge, knowledge economy, knowledge economy index*

JEL classification: M10, M14

Introduction

Knowledge has always had a significant impact on the economic and social development. However, only nowadays the number of knowledge workers and knowledge embedding process in technologies, products and services increased significantly. In the same time, globalization and the technological revolution of the last few decades have made knowledge and the intellectual capital key drivers of competitiveness and they are profoundly reshaping the patterns of the world's economic growth and activity (Roos, Pike & Fernstrom, 2005; Debowski, 2006; Nicolescu & Nicolescu, 2006). For knowledge we shall consider the new dyad: cognitive knowledge – emotional knowledge, where knowledge is viewed as a mental and emotional representation and interpretation of the world we are living in (Bratianu & Orzea, 2009).

In this paper we will first concentrate on outlining some of the most important conceptual dimensions of the knowledge economy such as: emphasizing

the importance of the knowledge revolution for the emergence of the knowledge economy, deepening the notion of intangible, analyzing the concepts of data, information and knowledge, and presenting the four basic dimensions of the knowledge economy: 1) economic incentive and the institutional regime; 2) education and skills of the human resources; 3) information and communication infrastructure; 4) innovation system. These four dimensions have been considered by the World Bank Institute to be significant for the Knowledge Economy Index (KEI), used to evaluate the emergence of the knowledge economy in different countries.

1. The knowledge revolution

The knowledge economy is a term that refers either to: an economy of knowledge focused on the production and management of knowledge in the frame of **economic** constraints, or to a knowledge-based economy. In the second meaning, more frequently used, it refers to the use of **knowledge** technologies (such as **knowledge engineering** and knowledge management) to produce **economic** benefits as well as job creation (Drucker, 1969). The phrase was popularized if not invented by **Peter Drucker** as the title of Chapter 12 in his book ***The Age of Discontinuity***, published in 1969.The essential difference is that in a knowledge economy, knowledge is a product, while in knowledge-based economy, knowledge is a tool. However, this difference is not yet well distinguished in the subject matter literature.

The background for the knowledge economy stands in the knowledge revolution. The knowledge revolution refers to a global-scale paradigm shift that many compare to the agricultural and industrial revolutions. It refers to a fundamental socioeconomic change from: an industrially-based economy to a knowledge or information-based one, from adding value by producing things which is, ultimately limited to adding value by creating and using knowledge which can grow indefinitely. The knowledge revolution sustains that the new source of wealth is knowledge, and not labor, land, or financial capital. It is the intangible, intellectual assets that must be managed (Nicolescu & Nicolescu, 2006). Many authors maintain the idea that in the following decades, wealth, in the form of physical assets will diminish, while wealth, in the form of knowledge assets will increase. As Rifkin (2000) indicates that whereas the industrial age emphasized the exchange of goods and services, the coming age will emphasize the exchange of cognitive and emotional knowledge.

Intangibles have different meaning depending on the context. In sports, intangibles typically refer to the value driver that differentiates one team's performance from another. In arts, intangibles commonly refer to the artists' unique embodiment of substance and form. In business, intangibles are commonly referred to as **intangible assets**, which are part of the **intellectual capital**. In financial analysis, intangibles refer to the difference between the book value per share and the share price, or the firm's accounting value and its publicly traded

market value (established through the Stock Market, or through mergers, acquisitions). In law, legally created intangibles are referred to as **intellectual property** and include **trademarks**, **patents**, customer lists, and **copyright**.

Intangible assets are defined as identifiable non-monetary **assets** that cannot be seen, touched or physically measured, which are created through time and/or effort and that are identifiable as a separate asset. There are two primary forms of intangibles - legal intangibles (such as **trade secrets**, **copyrights**, **patents**, **trademarks**, and **goodwill**) and competitive intangibles (such as knowledge activities (**know-how**, **knowledge**), collaboration activities, leverage activities, and structural activities).

- From an organizational perspective, Amidon (Amidon, 2005) indicates that the knowledge movement is reshaping how organizations are created, evolve, mature, and evolve or die. It is reshaping how business is done, how economies develop, and how societies prosper. Stewart (1997) points out that just as the industrial revolution did not end agriculture because people have to eat, this revolution will not end industry because we still need physical products. Also, Jennex notices that brands and knowledge are becoming a source of value, not unlike capital. Brands, for example, represent accumulated surplus value turned into client loyalty, which translates into lower marketing costs, higher prices, or larger market share for the owner organization (Davis & Meyer, 1998). In digital markets, brands are an invaluable source of trust and orientation to consumers who are looking for quality and security. Many organizations invest heavily in building a reputation that is conveyed through a brand. Some businesses have even outsourced almost all other activities just to maintain their focus on managing the brand. In an internetworked economy, knowledge is a key intangible asset that requires effort to develop and to protect (Jennex, 2008).

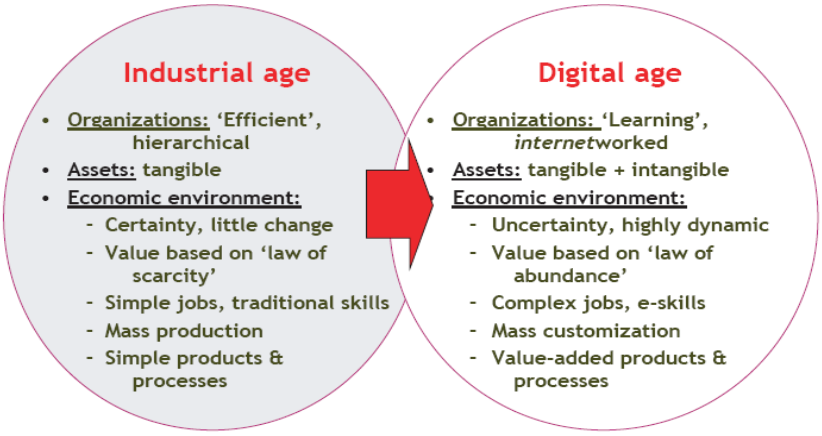

Figure 1 Industrial vs. digital age characteristics
Source: Jennex, M, (2008), *Knowledge Management: Concepts, Methodologies, Tools, and Applications,* published by Information Science Reference, London

The main causes of the knowledge revolution can be classified (Nicolescu & Nicolescu, 2006) as follows:

- **Technical and technological causes**. Growth of informational, communication processes. Growth of atomic level processes, through nanotechnologies. Growth of living cells level processes, through biotechnology.
- **Human causes**. Changes in the level of preparation of HR, quantitatively and qualitatively.
- **Managerial causes**. Efficiency results from the using degree of resources such as: material, financial, informational knowledge at organization level.

The migration of competitive advantage away from tangible assets towards intangible ones forces organizations to focus on generating, acquiring, transferring and combining such assets to meet customer needs. In order to be successful in these activities, firms and their managements must be entrepreneurial (Teece, 2000). This implies, according to Teece, that knowledge-intensive, entrepreneurial firms must have: flexible boundaries; high-powered incentives, non-bureaucratic structures, shallow hierarchies, and an innovative and entrepreneurial culture.

In short, the following suggestions are made for the design of knowledge-intensive forms: reduce hierarchy, only provide the basic outline of production structure, and transfer decisions to connect knowledge worker tasks from the formal to the informal organization structure (Teece, 2000).

2. Knowledge and the knowledge worker

At the individual level, knowledge is created via cognitive processes such as learning, while social systems (i.e., groups) generate knowledge through collaborative interactions (Smith & Lyles, 2003). The factors taking part in the knowledge creation process in an organization may come either from internal or external sources. The knowledge creation process consists of the transformation process of raw data into information. In this process, the human capital utilizes technological tools enabling the collection and classification of knowledge. The definition of concepts such as raw data, information, and knowledge is based on the user's perspective, by which the data is considered as raw facts, the information is considered an organized set of data, and the knowledge is perceived as meaningful information (Bhatt, 2001).

The idea on which this definition is based is the recursive relationship between the raw data, information, and knowledge managed by the human capital, which is able to determine irrelevant information and return it to its previous status of raw data. Similarly, accumulated knowledge may be considered by the human capital as irrelevant, and returned to a previous status. The raw data, information, and knowledge are relative to each other. The raw data can become critical for a certain individual, resulting in the changing of its status to that of information, which is then combined as a basis for diagnosis and becomes knowledge (Schwartz, 2000).

Cohen and Levintal (1990) add that the ability of expanding the knowledge base in an organization depends on the level of learning and on the previous knowledge base of the individuals in the organization, which extend their ability to obtain further knowledge (Schwartz, 2006). Our distinction between data, information, and knowledge follows the mainstream conception found in current literature (e.g. Davenport & Prusak, 1998). We view data as isolated recordings that are often generated automatically and cannot be directly used to answer questions. Information is connected, condensed, or generally processed data that allows an individual to answer questions. Knowledge is what enables an individual to ask relevant questions. It refers to the capability of an individual to solve problems. Information only becomes knowledge if a person interprets that information correctly, connects that piece of information with his or her prior knowledge, and can apply it to problems or decisions (Alavi & Leidner, 2001).

It is important to distinguish between data, information, and knowledge. The primary distinction between the three lies in the degree to which they are organized and useful. Data are raw stimuli with little organization or ready utility (Avali & Leidner, 2001). Data become information when they are processed and organized in a systematic way. Information becomes knowledge when it is ready to be used to orient action. In Davenport, Long, and Beers' terms, *"Knowledge is a high value form of information that is ready to apply to decisions and actions"* (Davenport et al., 1998, p. 43). We see data, information and knowledge as parts of a three-stage rocket (Schreiber et al., 2000). Knowledge assumes information, and information in turn assumes data. The bottom layer is formed by data. Data are the noises, scratches, images and other unstructured elements, out there in reality. If the data are interpreted explicitly, we speak of information. If this information is used by people in reasoning or in performing actions – i.e., if it is interpreted – we have knowledge. This means that going from data, via information to knowledge, degrees of freedom increase. The same data can be interpreted in many different ways to serve as information. In a similar way, information can be interpreted in many different ways to serve as knowledge. Someone receives data and information, and with the aid of knowledge the person already possesses, information becomes knowledge, which, in turn, can consequently complement or change a person's current knowledge. The crucial difference between information and knowledge is interpretation and this interpretation is done with the human mind. It implies a cognitive perspective on knowledge. Presently, humans are the only carriers of knowledge. They are goal-oriented sign or symbol processing systems (Schwartz, 2006). What is exclusive for humans as carriers of knowledge, here, is different for information and data. In that situation, not only humans, but also other kinds of actors (software agents) are involved.

With respect to the knowledge actors have, various divisions can be made. The most important one is the distinction in knowledge content and knowledge type. Knowledge content concerns what knowledge is about: about cars, about physics, about making coffee, about computers or about coordination mechanisms. Domains, fields and disciplines are examples of knowledge content. Postrel (1999)

calls a knowledge domain a "singularly-linked cluster", also named "discipline". Scientific fields are good examples of knowledge domains, for example medical science, biology, chemistry or sociology (Schwartz, 2006).

In 1966, Peter Drucker described the difference between the manual worker and the knowledge worker: a manual worker uses his hands to produce „things", while a knowledge worker uses his intelligence to produce ideas, knowledge and information. The knowledge economy is a new concept which refers to using knowledge to produce benefices (Nestian, 2009). Knowledge workers in nowadays' social groups are individuals who are being assessed for their capacity to interpret information within a specific topic matter. They will frequently make progresses within the general perception of that subject through focused analysis, design and/or development. They make use of research skills to specify problems and to find out alternatives. Supplied with their own expertise and insight, they work to overtake those difficulties, aiming to influence company decisions, priorities and strategies.

Knowledge workers may be met across a variety of **information technology** roles, but also among professionals like **teachers**, **lawyers**, **architects**, **physicians**, **nurses**, **engineers** and **scientists**. As businesses increase their dependence on **information technology**, the number of fields in which knowledge workers must operate has expanded dramatically.

Typical knowledge workers (especially **R&D** scientists and engineers) in the age of knowledge economy must have some system at their disposal to create, process and enhance their own knowledge. In some cases they would also need to manage the knowledge of their co-workers (Thorp, 1998). Savage describes a knowledge-focus as the third wave of human socio-economic development. The first wave was the Agricultural Age with wealth defined as ownership of land. In the second wave, the Industrial Age, wealth was based on ownership of Capital, i.e. factories. In the Knowledge Age, wealth is based upon the ownership of knowledge and the ability to use that knowledge to create or improve goods and services. Product improvements include cost, durability, suitability, timeliness of delivery, and security (Sheridan, 2008).

Due to the rapid global expansion of information-based transactions and interactions being conducted via the **internet**, there has been an ever-increasing demand for a workforce that is capable of performing these activities. Knowledge Workers are now estimated to outnumber all other workers in North America by at least a four to one margin (Sheridan, 2008). Knowledge workers bring advantages for companies in a wide range of significant ways. These enclose: studying data to set up relationships, valuing input in order to assess elaborated or conflicting priorities, identifying and understanding trends, making connections, understanding cause and effect, talent to brainstorm, thinking broadly (**divergent thinking**), developing more focus (**convergent thinking**), creating a new capability, bringing forth or modifying a strategy.

These knowledge worker involvements found themselves in contrast with activities that they would typically *not* be asked to perform, including: transaction

processing, routine tasks, simple prioritization of work. There is a set of transitional tasks includes roles that are seemingly routine, but that require deep technology, product, or customer knowledge to fulfill the function. These include: providing technical or customer support, handling unique customer issues, addressing open-ended inquiries (Thorp, 1998). Generally, if the knowledge can be retained, knowledge worker contributions will serve to expand the **knowledge assets** of a company. While it can be difficult to measure, this increases the overall value of its **intellectual capital**. In cases where the knowledge assets have commercial or monetary value, companies may create **patents** around their assets, at which point the material becomes restricted **intellectual property**. In these knowledge-intensive situations, knowledge workers play a direct, vital role in increasing the financial value of a company (Cortada, 1998).

3. The main dimensions of the knowledge economy

One key aspect about the knowledge economy is that the economics are not of scarcity, but rather of abundance. Unlike most resources that become depleted when used, information and knowledge can be shared, and actually grow through application.

Therefore the global world has arrived to consider knowledge and technology as the heart and mind of the global economy. The countries that thrive are those that encourage their people to develop the skills and competencies they need to become better workers, managers, entrepreneurs, and innovators. Today's policy makers must extend their country's existing strengths through careful investments in education, institutional quality, and relevant technology. They must create enterprises that are knowledgeable enough to recognize new competitive opportunities—and skillful enough to convert those opportunities into wealth.

In short, they must build a knowledge economy. The model is not new. In recent years, several economies, such as Chile, Finland, Ireland, Korea, Malaysia, and Singapore have been its avatars. China and India are following the same path.
Why, then, have many developing countries been slow to identify the strands of global knowledge that, when woven together with unique pieces of local knowledge, will produce the tapestry of the knowledge economy? If the basic components of the knowledge economy are readily available, why not appropriate them for growth and innovation? The answer lies in limited awareness, disincentives, and weak institutions. Together these challenges can keep the knowledge economy from taking root, preventing countries from forging powerful combinations of the best that the globe has to offer them and the best they have to offer the rest of the globe.

In order to benchmark a country's position compared with others in the global **knowledge economy**, we use the Knowledge Indexes which are interactive tools created by the **World Bank Institute**. The Knowledge Index (KI) is an economic indicator prepared by the **World Bank Institute** to measure a country's ability to generate, adopt and diffuse knowledge. Methodologically, the KI is the

simple average of the normalized performance scores of a country or region on the key variables in three Knowledge Economy dimensions: education and human resources, the innovation system, and information and communication technology (ICT).

In a larger perspective, the Knowledge Economy Index (KEI) takes into account whether the environment is conducive for knowledge to be used effectively for **economic development**. It is an aggregate index that represents the overall level of development of a country or region towards the Knowledge Economy.

The KEI is calculated based on the average of the normalized performance scores of a country or region according to the following four main dimensions of the knowledge economy (World Bank Institute, 2007):

- **Economic incentive and institutional regime**. The country's economic and institutional regime must provide incentives for the efficient use of existing knowledge, the acquisition of new knowledge, and the application of both to economic activity in order to improve production, to raise quality, to innovate, and to launch new enterprises.
- **Education and skills of human resources**. People need education and skills development that enable them to create and share knowledge, and to use it well.
- **Information and communication infrastructure.** A dynamic information infrastructure is needed to facilitate the effective communication, dissemination, and processing of information.
- **Innovation system**. The country's innovation system – firms, research centers, universities, think tanks, consultants, and other organizations – must be capable of tapping the growing stock of global knowledge, assimilating and adapting it to local needs, and creating new technology that underpins the development of new products and processes that can compete in export markets and meet needs at home.

Based on these above dimensions, the World Bank Institute developed the Knowledge Economy Index (KEI), which is a broad measure of the overall level of preparedness of a country or region for the knowledge economy. The KEI summarizes each country's performance on 12 variables corresponding to the four knowledge economy dimensions presented above. The KEI is constructed as the simple average of the normalized values of those indicators, from 0 (weakest) to 10 (strongest).

Both developed and developing countries must consider their future in a world system where knowledge is gold. To become successful knowledge economies, countries must act simultaneously on their education base, their innovation systems, and their information and communication technology infrastructure, while also building a high-quality economic and institutional regime. Strategies must be adapted to a country's level of development, and progress is usually gradual, but some countries have been able to achieve spectacular progress in a decade (World Bank Institute, 2007).

The 12 variables corresponding to the four dimensions of the knowledge economy

Table 1

Dimensions	Indicators
Economic and institutional regime	Tariff and non-tariff barriers Regulatory quality Rule of law
Education and skill of population	Adult literacy rate Gross secondary enrollment rate Gross tertiary enrollment rate
Information infrastructure	Telephones per 1000 people Computers per 1000 people Internet users per 1000 people
Innovation system	Royalty payments and receipts, US$ per person Technical journal articles per million people Patents granted to nationals by the US Patent and Trademark Office per million people

In 2008, Denmark retains its leading position as the world's most advanced knowledge economy. With a 2008 KEI of 9.58, it ranked 1st place as it did in 1995. Table 3 presents the rankings for 25 countries based on the Knowledge Economy Index (KEI) 2008. Although its KEI ranking remains the same, Denmark saw measurable improvement in the education: the education dimension index rising from 9.61 ranking 9th in 1995 to 9.80 to rank 1st in 2008, and the education dimension index growing from 9.57 ranking 3rd in 1995 to 9.66 second only to Singapore in 2008. However its performance in the ICT dimension fell from the 5th position in 1995 to the 6th, and the innovation dimension remained at 4th place compared with 1995 rankings.

The improvement in the education dimension is largely attributed to its increase in tertiary enrollment rates. Its tertiary enrollment rate rose from 48.17 (normalized score 9.28) to 79.94 (normalized score 9.53). Despite large improvements in telephone, computer and internet penetration, the normalized scores of all three ICT variables fell, especially that for Internet penetration, which fell from 9.43 in 1995 to the most recent of 9.07. The abatement of Denmark's ICT dimension reflects that other countries have made even larger improvements in their ICT infrastructure over the same time period.

The Nordic countries remain among the best performers in the KEI. Sweden is ranked 2nd, with Finland and Norway following closely at the 3rd and 5th places, respectively. The four KE dimensions in these countries are all well developed in a balanced manner. These countries are characterized by their strong performance in the education dimension - all rank within the top 7 places, and to a lesser extent in the innovation and EIR dimensions – all rank within the top 13 spots.

The countries' ranking according to their KEI and KI performances

Table 2

Country	KEI	KI	Economic Incentive Regime	Innovation	Education	ICT	2008 Rank
Denmark	9.58	9.55	9.66	9.57	9.80	9.28	1
Sweden	9.52	9.63	9.18	9.79	9.40	9.69	2
Finland	9.37	9.33	9.47	9.66	9.78	8.56	3
Netherlands	9.32	9.36	9.18	9.48	9.26	9.36	4
Norway	9.27	9.27	9.25	9.06	9.60	9.16	5
Canada	9.21	9.14	9.42	9.43	9.26	8.74	6
Switzerland	9.15	9.03	9.50	9.89	7.69	9.52	7
United Kingdom	9.09	9.03	9.28	9.18	8.54	9.38	8
United States	9.08	9.05	9.16	9.45	8.77	8.93	9
Australia	9.05	9.17	8.66	8.72	9.64	9.16	10
Ireland	8.92	8.82	9.23	9.04	9.08	8.33	11
Austria	8.89	8.76	9.30	8.90	8.53	8.85	12
Iceland	8.88	8.87	8.92	7.98	9.44	9.18	13
Germany	8.87	8.83	8.99	9.00	8.46	9.04	14
New Zealand	8.87	9.00	8.48	8.65	9.79	8.56	15
Belgium	8.73	8.70	8.82	8.96	9.14	8.02	16
Taiwan,Rep of China	8.69	8.80	8.35	9.24	7.91	9.26	17
Luxembourg	8.65	8.40	9.42	8.91	6.66	9.62	18
Japan	8.56	8.84	7.71	9.15	8.71	8.66	19
France	8.47	8.69	7.82	8.61	9.08	8.38	20
Estonia	8.34	8.22	8.68	7.49	8.27	8.90	21
Slovenia	8.25	8.29	8.11	8.31	8.24	8.33	22
Spain	8.24	8.13	8.58	8.14	8.21	8.04	23
Singapore	8.24	7.75	9.71	9.56	5.19	8.50	24
Israel	8.22	8.24	8.16	9.34	6.72	8.64	25

Source: *www.worldbank.org/wbi/k4d.*

Conclusions

These last decades managerial focus shifted from the traditional factors of production to *knowledge* processing. But knowledge is not something new, it has been here for centuries, the only thing that changed was managers and companies' perception on knowledge power to create wealth and value for society. The new economy made knowledge the main raw material and the power of our brains the intellectual capital of the companies. The knowledge workers became the main driving forces of the new economy, and the importance of intangibles overcome that of tangibles.

The conceptual dimensions of knowledge economy presented in this paper revealed that this economy requires new ideas and approaches from policy makers, managers and knowledge workers. Investments in education and training, innovation and technological adoption, the information infrastructure, and a conducive economic incentive and institutional regime are necessary for sustained creation, adoption, adaptation and use of knowledge in domestic economic production, which will consequently result in higher value added goods and

services. This would tend to increase the probability of economic success, and hence economic development, in the current highly competitive and globalized world economy.

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