

# KNOWLEDGE-BASED SOCIETY AND ENGINEERING EDUCATION

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## Foreword

As we are newly ushered into the 21st century, the society has turned into the one where knowledge and information are the core elements in competitiveness for both individuals and nations, as well as serve as the resources for creating value. Thus, human beings are called on to prepare for new paradigms in every field including politics, society, economy, culture, and education.

## Outline of Knowledge-based Society

### Concept of knowledge-based society

The term, 'knowledge-based society,' appeared for the first time in the mid-1960s when heated discussions were being made regarding controversies over the post-industrial society, i.e., controversies over the fashions that would come after the industrial society. Daniel Bell wrote that the post-industrial society was the knowledge-based society, however, this did not win much repercussion at that time. Only of late, the modern society has gradually emphasized knowledge and its function. Nico Stehr suggested a theory on a knowledge-based society where it is emphasized that knowledge functions as a new production element replacing labor and capital as 'classical' production elements.

Terms related to the knowledge-based society such as knowledge-based industry are widely used, and their concept is reviewed as follows.

Knowledge-based economy is an economic system where knowledge and information or knowledge capital function as a core element in determining the performance of individual economic subjects or the national economy, and particularly the creation and distribution of information and knowledge are the focal point of economic activities, as well as serve as the main sources for creating wealth.

Knowledge-based businesses harness knowledge as a more important element than they do the traditional production elements of labor and capital. They further use knowledge in the existing industries, so as to enhance the productivity, achieve high-value-added products (In the case of agriculture, using bioengineering technologies), create new technologies-based industries (information telecommunication, new materials, and bioengineering), or provide high-value knowledge-based services themselves (business management consulting, design, etc.)

### Facilitation of knowledge-based society

As the time passes, we are more likely to speedily move towards the knowledge-based society. Now, let us look at what is driving us towards the knowledge-based society.

First, it is the advancement of globalization. After WTO was formed, facilitating the globalization is the expansion of the world markets, an increase of subsequent human and material exchange, the development of new telecommunication/information

technologies/transportation technologies to that end, and continued development of military technologies. These globalization phenomena are serving as the dynamo for creating knowledge, and the abilities to create/share/utilize knowledge are one of the most important elements in gaining the upper hand in international competitive edge in the process of globalization.

Second, it is the advancement of information. The acquisition level of information is now a barometer by which to measure the levels of productivity and cultures for individuals and organizations. Thus, knowledge and technologies are ever increasing designed to produce, process, and efficiently utilize valuable information.

Third, it is a change in the form/opportunities/contents of works. Since knowledge and experience in specific fields are losing their value gradually as the time passes, they need to continue to be replaced by, and complemented with new knowledge and experience. As repetitive works with the planning and forecasting available are automated, knowledge itself does not guarantee jobs. Hence, future jobs will require abilities such as creativity, intuition, and social responsibilities, as well as will pose doubts to regulations that have spurred personalization and have been successfully implemented.

Fourth, it is a change in the knowledge-handling systems and their intensity. If we suppose that knowledge is essential to the society and social coexistence, there must be special reasons to introduce the concept of today's 'knowledge-based society.' The first reason is that the knowledge-handling systems and their intensity are new in modern society. The regimes and structure under which knowledge has been produced have been expanded systematically all the while for the past decades. Expenditures have increased for researches and development efforts. As a result, they estimate that over 6,000 fields of sciences have been created in Germany. The second reason is that knowledge is becoming a principle in solving problems. Also, today's knowledge is strengthening its systems in the direction that it is used for solving our daily problems, rather than being used for basic researches, knowledge practically plays a more important role in our life.

Fifth, it is the explosive increase of knowledge. A certain futurist forecasts that the knowledge-based society will be into full-swing stage by 2005, knowledge will double every 73 days by 2020, and people will use 1% of

current knowledge by 2050, thus implying the explosive increase of knowledge.

### **Job abilities required in the knowledge-based society**

We have to essentially review what job abilities are required of workers in the knowledge-based society, in order to set the direction for engineering education.

#### **First, as basic abilities,**

(Basic abilities) is gradually increasing their importance, as scientific technologies change rapidly, the industrial structure changes, and the life cycle of jobs is shortened. Generally speaking, job abilities are divided into job basic abilities and job performance abilities. The job basic abilities include both the basic concept abilities and the abilities that are mostly common to jobs. In addition, job performance abilities indicate the abilities that are required by the kind of jobs.

They have proposed in Germany that the 'core job abilities in 2020' should include: the ability to understand multi-national cultures; the psychological-social ability; the ability to command foreign languages; the ability to perform technical and methodological learning; the ability to utilize the media; the ability related to specific fields; and other abilities.

#### **Second, as a man of general knowledge,**

We can classify knowledge into professional knowledge or scientific knowledge, and general knowledge with the concept opposed to professional knowledge. Hence, in the society where people depend upon knowledge, they individually need to own the abilities to skillfully treat information and knowledge and manage efficiently the knowledge that they own. These abilities indicate special knowledge and abilities other than general subjects and professional knowledge. These are called general knowledge. General knowledge is characterized by the following features.

First, general knowledge forms the foundation for daily communication, thus providing the essential component for social activities.

Second, knowledge provides an essential qualification as well as the starting point for one to discuss with professionals and have his voice heard among them, thus opening the door to access professional knowledge.

Third, general knowledge helps to explore the criteria for evaluating the development of individuals, thus serving as a compass for us to navigate the sea of knowledge.

#### **Third, as an expert,**

To become a man of knowledge needed in the knowledge-based society, one needs to have professional knowledge as well as practical knowledge and on-the-scene experience, on top of firm basic abilities and abundant general knowledge.

Professional knowledge, a concept opposed to general knowledge, means scientific knowledge. Professional knowledge varies somewhat in its importance and need according to the development trend in each field of sciences. The Delphi survey reports in Germany say that the fields in which knowledge is forecast to continue to develop within 25 years to come are categorized into six; information technologies and media, new technologies, medicine and human body, ecology and environmental engineering, international economy and world of works, social changes and knowledge management.

Also, the fields in which new knowledge is projected to continue to grow are technical engineering mainly including especially information technologies, genetic engineering, environmental engineering, and other new technologies; as well as medicine, economics, and sociology.

However, we cannot cultivate in a short period of time the abilities that are required in the knowledge-based society. We need to cultivate the basic abilities at elementary school and middle school, and general knowledge at high school and the initial stage of the higher education. At higher education steps and a variety of educational institutes in the society, we further need to incessantly cultivate professional knowledge, practical knowledge, on-the-scene experience-based knowledge, and especially abilities to solve problems and creativity.

### **Direction for Engineering Education in the Knowledge-based Society**

Considering the above discussions, I propose a basic direction as follows for engineering education in the knowledge-based society.

First, in engineering education, it is vital to create new knowledge, collect necessary information speedily, and cultivate the abilities to effectively use it. To do this, it is the focal point in employing education methods whereby we can cultivate students' creativity, and emphasize their active activities.

Second, in engineering education, we must set it as its important objective to acquire the basic learning abilities. As observed above, in the knowledge-based society, we value the professional knowledge, and at the same time we equally value the job performance abilities that are commonly required with any job anywhere and enable us to effectively adjust ourselves to the circumstances to which we are exposed. We need to make efforts to achieve these objectives through the improvement of curriculums or reforming of the educational methods.

Third, we need to transfer the subjects of operating the educational systems including engineering education to the local governments and communities. Considering this, we can structure educational systems geared toward demands and on-the-scene education that fit the characteristics of the communities and are linked to their industrial foundations. Also, the local governments need to structure educational, systematic systems in industries, educational, government, and civil linkage, and provide administrative and financial support

for allotting the talented local graduates to their respective local businesses.

Fourth, we need to cultivate curriculums that meet the requirements as called for in this era and students' abilities to learn, and ensure quality education when students leave school. That is, we should formulate substantially the curriculums, so as to improve the students' abilities for basic sciences, mathematics, computer and foreign languages that fit the knowledge-based society in the 21<sup>st</sup> century, as well as to equip them with creativity and interpersonal relationship abilities plus technical knowledge. We can substantially formulate the curriculums when we fully reflect the requirements of students, communities and industrial scenes. Particularly, in the case of engineering colleges, we should include in the standard mandatory curriculums bioengineering and new materials-related courses, together with education on personality and sociability, information and globalization.

Fifth, in order to establish distinctively the role and function by engineering educational institute, it is desirable that in the case of technical high schools, we allow them to be prepared to continue with their education. That is, we need to allow technical high schools to expand their educational opportunities through vertical and horizontal linkage education, and to be linked with technical colleges or four-year universities.

Sixth, we need to enhance the ability to manage the nation's work force. To that end, we need to step up the career path education. We have to grasp the abilities and hobbies of individual students at middle school and high school, and guide them on their future careers at an earliest possible date. In order to do this, the government is required to manage the applicants resources for entering higher education institutes,

and to secure basic applicants resources by the school in the same fields and by the school of the same levels.

Seventh, we need to diversify educational programs and make them specialized. Take technical colleges for instance, we need to encourage them to open new subjects and specialized courses that are required by the communities, to diversify the period of lessons, and to open courses linked to obtaining certificates. This will eventually lead to establish the educational systems that are students-centered and life-long-oriented.

Eighth, we very much need to improve the climate for engineering technical education. We have to maintain it so as to allow one professor to take care of 25 students or so. We also need to essentially step up the facilities and equipment in order to offer test and experiment courses related to the frontline works. Without resolving these issues, it is difficult to turn out creative and practicable engineering manpower.

### References

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