

K-technologies in knowledge economy

The knowledge workers need to be innovative, therefore, they would have to continuously update their knowledge and skills through lifelong learning.



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The second half of the 20th century transformed the industrial society into an information society. The current century is witnessing a transformation of information society into a knowledge society. In knowledge society, a new economic form is emerging which is being referred as knowledge economy. Products and services of information and knowledge technologies are the base of this economy. The ingredients of these products and services are data, information, knowledge and wisdom. To understand the nature of this economy a better understanding of these ingredients is a must.

In physical terms these ingredients are weightless. That is why knowledge economy is also being referred to as weightless economy. In technical terms, their meaning can be understood in the context of Information Technology.

In knowledge economy, the basic commodity is knowledge. Knowledge generation, production of knowledge products and their commercialisation create wealth. The knowledge economy grows with the accumulation of knowledge. Information Systems and Intelligent Systems systemise and expedite the knowledge creation and accumulation processes. In this context, these systems (information as well as knowledge systems) themselves are the knowledge products. In order to succeed in the knowledge economy, a special class of workforce who can create and use such systems, is required. This kind of workforce is being referred to as knowledge workers. Their educational and training requirements drastically differ from the workforce of traditional economies like agricultural and industrial economies. To succeed in the knowledge society, societies must invest in all aspects of education and training of their knowledge workers.

Data, information and Information Technology

Observations yield data or facts. We use symbols to represent data. The sequence 08 09 07 08 00 20 05 13 16 05 18 01 16 20 21 18 05 of digits (symbols) 0 to 9 is an example of data. A transformation, when applied on a data set yields information.

If in the above sequence every pair of symbols represents a letter. (For example the pair (01) represents letter 'A', (02) represents letter 'B', ..., (26) represents 'Z' and (00) represents a blank), by applying the transformation (given below) on the sequence, we obtain the text string 'HIGH TEMPERATURE'. The string conveys information about the measure of the temperature of some entity.

Transformation

Begin with the leftmost symbol of the sequence, while not end of sequence repeat the following block-

- Convert each pair of symbols into a number (For example the pair (08) is converted to number 8, (09) is to number 9, and so on.)
- Map each number into a letter (For example the number 8 maps to letter H, 9 to letter T, and so on.)

The technology that creates tools and techniques for capturing, representing, organising, storing and retrieving, and transforming data elements into information is referred to as Information Technology.

Knowledge, knowledge technology and wisdom

Consider a temperature measuring device has been installed in a hospital to monitor the temperature of patients. The device has observed the data sequence given in the last

section. If the device has the ability of transforming the data into information, it may transform the recorded data into information 'HIGH TEMPERATURE'.

We can make this device intelligent if we make it learn the concepts like 'high temperature increases the chance of death' and 'call a physician when there is an increased chance of death.' These concepts are knowledge. They are gained from experience. We can make the device to acquire them over a period of time or learn them from a teacher.

The technology that gives the learning ability to a device (or systems in general) is referred to as knowledge technology. More precisely, the knowledge technology is the technology that creates tools and techniques for transforming information into knowledge and, in turn, knowledge into wisdom. Wisdom is the awareness of the useful knowledge. For example, if a device always calls a physician and/or seeks help from resources that might save a life, it is a wise device.

IT and intelligent systems

The data management process involves capturing, gathering, organising, storing and retrieval of data elements. An information extraction process associates known concepts that are embedded in the transformation rules with the data elements.

Using the extracted information from the data, the knowledge discovery process discovers knowledge and deduces rules of wisdom. The process of information extraction from the data, and discovering knowledge and deducing wisdom in the figure.

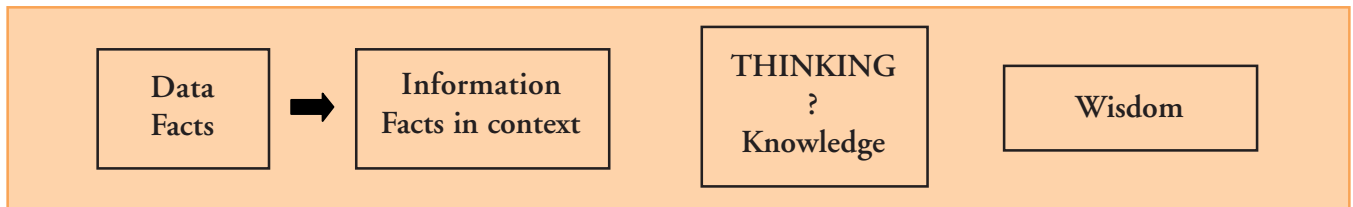
These processes are based on the relationships between Information Technology and Knowledge Technology. The IT

Knowledge products and knowledge workers

The products of knowledge economy are data, information, information systems, knowledge, meta-knowledge, intelligent systems, hardware and software tools. These tools help in producing the knowledge products and they are also needed for data handling and creation of information, information system, knowledge and intelligent system. The knowledge products are kept on electronic media like hard disks and Internet servers. Therefore, all the hardware and software items needed for storing and dissemination of data, information and knowledge are knowledge products. The software products are the most important commodity of knowledge economy.

A software product is a set of symbolic instructions. Knowledge workers are symbolic analysts. They manipulate symbols. The WINDOWS is a perfect example of knowledge product. Its sale has created enormous wealth for the Microsoft, an American company. The WINDOWS is operating system software. It manages hardware and software resources of a computer system and it allows external entities to interact with the computer through devices like keyboard and mouse.

Why we consider it a knowledge product? The answer is that the WINDOWS started with a little knowledge of user behaviour and rudimentary design. It reached to its present maturity level after a long period of experimentation. Over the years, the data on user behaviour, technological advancement and the performance of the functions of earlier versions of operating systems were thoroughly explored to gain the knowledge needed for better functionality of an operating system. This knowledge led to the improved design. The search for better functions of operating systems is still on. Improved versions of operating systems keep on appearing periodically.



facilitates the knowledge creation process. It provides effective and flexible processes for data management and information extraction. These two processes collectively constitute the information system that essentially transforms the observed data into information. On the contrary, an intelligent system transforms information into knowledge and wisdom. These systems discover knowledge from information, deduce wisdom rules from knowledge, and use these entities to their advantage.

The thinking ability of the intelligent systems gives them power to apply existing knowledge, generate new knowledge, transmit knowledge and work with knowledge effectively. Such systems help in knowledge accumulation and creation and maintenance of intellectual assets like digital book libraries, computer software libraries, digital (still/video) image databases, databases of useful observations, and so on. Usage of intelligent systems strengthens the knowledge economy because they themselves are the items in the inventory of the knowledge products.

The process of improving the functionality of all the software systems is more or less the same. Observations and analysis of the field data give insight that helps in quality improvement. The implication of this aspect of software development process is that the learning and knowledge creation from observations have become a factor of prime importance because they improve the software quality to give the competitive edge.

Knowledge society

A knowledge society is the society that emphasises on knowledge centric activities, where the knowledge is created and technological advancement is achieved. Here, economic growth is measured in terms of knowledge accumulation. The knowledge is created through knowledge centric activities. The knowledge centric activities make technological advancements. The technological advancements create environment that encourages innovations. Innovations lead to increased returns on investments. Increased returns on

investments encourage research and development. The research and development paves the way for further technological innovations.

In knowledge economy, innovation is the key to success. The reproduction of knowledge products will lead to nowhere. Therefore, societies must invent new knowledge products, if they want to succeed. In order to attain some degree of success, a knowledge society must, at least, have efficient telecommunications systems, high computer literacy rate, well developed information and information technology industry, strong communications and media industry, and focused education and training systems.

Impact of knowledge economy

The efficient use of computers is strengthening the information societies day by day. They are continuously gaining expertise in information and knowledge processing and microelectronics technologies. This is gradually placing them in dominating positions in the arena of world power and continuously widening the digital divide gap. Now, knowledge-divide is further strengthening these dominant societies because they can create and apply knowledge effectively. This trend poses new challenges to the thinkers, educators and administrators of all the societies to formulate effective policies and discover processes to prepare their societies that can meet the challenges.

The challenges are due to the unique nature of knowledge economy because it progresses with the new technologies and it allows sharing information and knowledge at the speed of light. These challenges can only be met with the efficient force of knowledge workers. Here efficient means the knowledge workers must be creative. This force can be prepared through investment on education and on creation of life-long learning and research and development environment. In knowledge economy, there is no limit to the area of activity. Workers from every walk of life can be trained as knowledge workers, but they must have enhanced creative ability that can be attained by focusing on basic education with emphasis on ICT, lifelong learning and creation of environment where technology is easily available and used. The impact of

the knowledge economy is that it is creating new form of relationships between people and their expertise. It demands that people must constantly update their knowledge and skills. On the other hand, institutions and organisations have to reform their way of creating wealth. Knowledge is being exploited for more rapid development. Outsourcing of IT related services are helping workers of marginalised societies. The benefits of e-Business and e-Service have started reaching to less privileged societies which are demanding for new skills. Thus, there is a need for creating a world class technology enabled learning system that must help learners of all ages at all levels so that their future is not insecure in the competitive world. In addition to this, not only the learning system should fulfill the demand of skilled knowledge workers but also it should allow continuous learning and innovation so that they should be able to use contemporary technologies and create future technologies.

Education in knowledge society

Learning is the sole objective of the conventional education. IT has introduced new concepts like unlearn and relearn. Here, 'unlearning' means forgetting momentarily about the functions of a system that is no longer in use and 'relearn' means learn the unlearned functions whenever that system comes in use.

An example of this scenario is the use of computer programming languages. A programming language is a software system. It is used to implement the software products. There are thousands of programming languages. They are designed to implement the software for different application domains like business, scientific and artificial intelligence applications. To implement a software product, a programmer should know only the domain specific programming language. He/she does not require remembering languages applicable to the domains other than the domain under consideration. In practice, programmers implement software from different domains, therefore they must learn to unlearn programming languages that are no longer applicable at a given point of time — learn (or relearn) them whenever they may need them.

In the knowledge society, knowledge

workers are the pillars of knowledge economy. Educating them is a very challenging task as they are expected to update their knowledge continuously. This continuous or lifelong learning is another new dimension that IT is adding to the education. In this system, teachers locate the knowledge source and guide the learners to the right knowledge source. They prepare personalised learning plans. Teachers are themselves lifelong learners. On the other hand, learners learn by doing and by interacting with each other. The performance evaluation guides learners towards improvement in future. The learning opportunities are open to learners over the lifetime.

How to compete?

First of all, the new realities of knowledge economy. In this economy has to be accepted our future prosperity depends on the way we meet the challenges are met. The knowledge economy is fundamentally different from the traditional economy, because its products are weightless and they are produced by highly skilled workforce. In order to compete in the knowledge society, we need strong institutions with high quality human skills and infrastructures are required.

Innovation and creativity are central to sustaining the competitive advantage. Therefore, our emphasis must be on such human skill development that enhances the learning capability. This requires not only formal education but also continuous training, life-long learning in narrowly focused specialties, vocational training, problem solving skills, inter-personal communication skills required for teamwork along with adaptive temperament. This may require such changes in the educational system that may ensure a complete understanding and use of information and knowledge technologies.

Besides, the knowledge of knowledge generation processes the other equally important aspect of the knowledge economy that is the integration of all knowledge sources such as the knowledge about customers, competitors, products, capital resources and people. For the integration of varied knowledge resources, one must have a flexible yet fast communication network in which knowledge can be propagated and accessed timely. ■