

engineering is also related to mathematical logic, as well as strongly involved in cognitive science and socio-cognitive engineering where the knowledge is produced by socio-cognitive aggregates (mainly humans) and is structured according to our understanding of how human reasoning and logic works.

§ 12.5.1 Principles of Knowledge Engineering

Some of the key principles are summarized as follows:

- Knowledge engineers acknowledge that there are different types of knowledge, and that the right approach and technique should be used for the knowledge required.
- Knowledge engineers acknowledge that there are different types of experts and expertise, such that methods should be chosen appropriately.
- Knowledge engineers recognize that there are different ways of representing knowledge, which can aid the acquisition, validation and re-use of knowledge.
- Knowledge engineers recognize that there are different ways of using knowledge, so that the acquisition process can be guided by the project aims (goal-oriented).
- Knowledge engineers use structured methods to increase the efficiency of the acquisition process.

§ 12.5.2 Views of Knowledge Engineering

There are two main views to knowledge engineering:

- **Transfer View:** This is the traditional view. In this view, the assumption is to apply conventional knowledge engineering techniques to transfer human knowledge into artificial intelligent systems.
- **Modeling View:** This is the alternative view. In this view, the knowledge engineer attempts to model the knowledge and problem solving techniques of the domain expert into the artificial intelligent system.

§ 12.5.3 Activities of Knowledge Engineering

The various activities are as follows:

- Assessment of the problem
- Development of a knowledge-based system shell/structure
- Implementation of the structured knowledge into knowledge-bases
- Acquisition and structuring of the related information, knowledge and specific preferences
- Testing and validation of the inserted knowledge
- Integration and maintenance of the system
- Revision and evaluation of the system.

§ 12.5.4 Data Warehousing

A **data warehouse** is the main repository of the organization's historical data. It contains the raw material for management's *decision support system*. With the help of a data warehouse a data analyst can perform complex queries and analysis (such as *data mining*) on the information without slowing down the operational systems. They were developed to meet a growing demand for management information and analysis that could not be met by operational systems. As a result, separate computer databases began to be built that were specifically designed to support management information and analysis purposes. These data warehouses were able to bring in data from a range of different data sources, such as *mainframe computers*, *minicomputers*, as well as *personal computers* and office automation software such as *spreadsheet*, and integrate this information in a single place. The data warehouse architecture describes the overall system from various perspectives such as data, process, and infrastructure needed to communicate the structure, function and interrelationships of each component. The infrastructure or technology perspective details the various hardware and software products used to implement the distinct components of the overall system. Data warehouses have two perspectives, the data perspective and the process perspective. The data perspective typically diagrams the source and target data structures and aids the user in understanding what data assets are available and how they are related. The process perspective is primarily concerned with communicating the process and flow of data from the originating source system through the process of loading the data

- When this knowledge is processed taking other relevant variables and information to build a forecasting model to predict the rainfall, the model is a Knowledge asset. This model is built by Dr. Govarikar and is an acknowledged 'Intellectual Capital' of Meteorological lab of India.

Knowledge is of three types, explicit, tacit and intellectual. Explicit knowledge is the one which can be codified and/or modelled. Software products are packaging explicit knowledge. Tacit knowledge is intangible and can not be codified. The consultants and experts possess tacit knowledge. Intellectual knowledge could be tacit or explicit and is owned by some body. It is also termed as intellectual asset or capital. IC is made out of leveraging on personal understanding of organisation's action capabilities and use of other intellectual assets. Further knowledge is not a static entity. It improves changes and also obsoletes after some time. In a new business scenario knowledge plays a key role in management. In contrast with previous periods of economic development, the primary factor of production in today's economy is knowledge as against to capital and labour. In terms of inputs, the primary assets of the business are intangibles such as technology, brand, capabilities rather than land, machines, inventories and financial assets. In terms of outputs the shift is from 'manufacturing of goods' to 'delivery of services' where goods not only meet basic needs of customer but also fulfils other expectations - quality, delivery, support and continuous value addition.

There is a shift in business management paradigm. It is no longer only a management of resources of the organisation but also that of business partners who are in the organisation's network. It is also affected by the pace of change. The change is rapid, innovating and path breaking. The product life cycles are shorter and organisations must improvise products and services to remain competitive.

To manage this shift, knowledge is the key resource of the organisation and workplace. Due to this critical importance of knowledge, business economy is termed as Knowledge Economy.

Knowledge Management

Knowledge management is the systematic and explicit management of knowledge related activities, practices, programs and policies within enterprises to create a vital knowledge share it with others and improve continuously its content and quality. Knowledge management comprehensive strategy is to focus on three perspectives of business operational, tactical and strategic.

Knowledge management dispels some myths which must be mentioned for correction.

- 'KM initiatives and activities lead to more work'. Instead, improved knowledge and its use enhance competitive ability of organisation with less work and rework.
- 'KM, initiatives and activities, is an additional function'. Instead, it is an extension to existing technology driven information management function.
- 'People are often afraid to share their knowledge'. Instead, such fear is unwarranted as most people enjoy sharing as they tend to be considered important in the community, and gain status and recognition.

To be competitive, proactive business organisation must increasingly manage knowledge systematically through knowledge management. KM activities and functions are implicit in

each employee's and departments daily work. Organisation will continue to be motivated by several end goals and evolve strategies to achieve them. In this endeavour, KM objective is to develop the best available knowledge (Explicit, Tacit and ICs) to make people and enterprise capable as a whole to act effectively to implement various strategies.

Driving Forces Behind KM

The emergence of KM is a result of many forces. In today's business world KM is not an alternative or luxury, but is a necessity due to demand of customer centric business initiatives. The forces which drive KM are external and internal.

External Forces

Business organisations perform in environments that they can not control. Their success depends on how they deal with these forces and still grow. The more impacting forces in external environment are following.

- **Globalisation of business:** With loosening of trade barriers and advances in Internet/Web technology, business operates beyond the local and national boundaries. It has a bigger market to tap and more sources and resources to bank upon. The immediate impact is business organisation finds itself in stiff competition.
- **Demanding customers:** Customers have easy access to information about product and services, and are now more knowledgeable to demand more value at least cost. Customers drive your business by demanding higher quality, new features, quick response and door delivery.
- **Innovative competitors:** Competition is no longer limited to quality and cost but extended to providing value adding new features using technologies and best practices.
- **Resourceful vendors:** Vendors continue to increase their capabilities by use of technologies, innovative product features and better logistics.

These external forces together demand business organisation to be more effective in business operations, be more knowledgeable on customer needs, be always in learning mode to remain competitive and get into collaborative partnership arrangements with resourceful vendors.

Internal Forces

Like forces in external environment, there are forces internal to organisation which impact business operations. To control negative impact of these forces knowledge initiatives are necessary

- **Bottlenecks in effectiveness:** Organisations have implemented various management and technology strategies to remove bottlenecks in workflow and processes. Bottlenecks are no more physical but intangible, namely capability of anticipating the change in market and environment requiring proactive action to deal with it.
- **Technological Capabilities:** Business operations need technology implementation to bring in efficiency and effectiveness. Today business operates through collaborative work, high end information management and technology and use of advanced search

engines for information search. All this put together is an organisation's technological capability.

- **Understanding of human cognitive functions:** People and organisation behaviour affects effectiveness of the business enterprise. Knowledge about people, in terms of understanding mental models and associations affecting decision making is essential. KM initiative is the result of this requirement.

These forces require organisation to work with knowledge, calling for formal implementation of KM with initiatives on number of technology fronts, behaviour and information management. The cutting edge for business operations is HR capability to anticipate, assess and act before competition moves in. To build such capability, KM is necessary for development and application of tacit, explicit and embedded knowledge (IC).

Changing workplace

Once KM initiatives are in, it would affect the workplace scenario drastically. Visible changes are extensive use of technology, networks, supply chain, collaborative work culture and so on. Visible changes, but more importantly, affecting the people side of the business are following:

- Configuring interdisciplinary teams for better mix of competencies.
- Work completion needs more application of conceptual knowledge.
- Work completion needs more collaboration and co-ordination between people in a network.
- People show more understanding and involvement in the work due to increased understanding of personal benefits.
- More reliance on models, search engines, embedded decision support systems and knowledge sharing.

As a result, the people in workplace would experience less physical work, more intellectual work, increased dependence on others and collaborative relation among participants.

Key Aspects of Knowledge Management

There are four key aspects of knowledge management which are of importance.

- **Accelerating knowledge creation and application:** In competitive global business economy knowledge is not static it changes dynamically. Obsolescence is its character. Its application also changes. To meet this challenge searching new knowledge and developing knowledge based capabilities to remain ahead in business is a prime need. KM systems are designed for rapid search, formulate and model the knowledge.
- **Converting tacit into explicit knowledge:** Tacit knowledge is intangible, distributed and possessed by individual employees. KM converts tacit knowledge into explicit through coding, modelling, putting into manuals for acquisition and guidance to the HR. After conversion to explicit knowledge, it is integrated into processes and systems which deliver goods and services to customer.
- **Build knowledge Assets-IC:** Some of the knowledge bodies are so strategically important for organisation's business that they need to be protected taking legal recourse, such as patent, trademarks and rights to use.

In summary, KM involves knowledge generation through creation and acquisition and knowledge application through integration, pooling, replication, storage and identification.

Designing for Business Benefits from KM

The trend in knowledge economy is to use KM for business benefit by designing products, services and process which deliver them. The processes which are largely benefited by KM are the feeder process which contributes to the efficiency and effectiveness of core process like manufacturing, purchasing, delivery and so on. The organisations which treat 'knowledge' as key resource are likely to be benefited most. The KM processes are generation and storage of knowledge, identification and exploitation of knowledge, and generation and application of knowledge delivery strategies.

These processes put together create organisation which is knowledge competent. It is important to note that there are barriers in this process of KM. The biggest barrier is people who suffer from inertia to change, lack of motivation, difficulties in transferring knowledge to new people and so on. The next barrier is management itself, afraid of giving power (knowledge) and sharing power (knowledge) with others. Knowledge management process also suffers from structural barriers namely fragmented organisation functional systems and reluctance to change traditional systems. KM processes are executed through various methods and tools. They are traditional database tools, process modelling tools, work flow/work group management tools, search engines and navigation tools, visualisation tools and collaborative tools. Using these tools, KM manages knowledge related activities, processes and policies within the enterprise; KM ensures the organisation viability through building competitive quality of its knowledge assets and applying them in all its operational, management and strategic activities.

7.9 BUSINESS INTELLIGENCE

Business intelligence is a term that refers to the sum total of gathering and processing data, building rich and relevant information and maintains it live and up to a date. Organizations leverage on business intelligence to develop strategies and use it to put strategy into operations. BI is used for timely, effective decisions and better plans for the future. Business Intelligence (BI) is a terminology representing a collection of processes, tools and technologies helpful in achieving more profit by considerably improving the productivity of an enterprise and its people.

BI is an outcome of turning a raw data into intelligent information by analysing and rearranging the data according to the relationships between the data items by knowing what data to collect and manage and in what context

Business Intelligence definition and concept encompasses following things.

- *Technology and software infrastructure:* An enabler to capture and process the Data, Information, Knowledge.
- *Data bases, data warehouses:* Storing the data of current and future relevance from decision making view point.
- Develops and maintains knowledge data bases for all core functions and for business at large.

6. Exception reporting is based on the concept of management by exception, in which an executive gives attention to significant deviations from standards.
7. In order to save the executive's time in conducting a drill down, finding exceptions, or identifying trends, an intelligent EIS has been developed.
8. Integration with DSS. Executive information systems are useful in identifying problems and opportunities.
9. With the introduction of the Intranet & corporate portals, the traditional EIS has become a part of an enterprise information system, and it now often appears under the name of business intelligence

Executive support systems (ESSs) - specialized decision support systems designed to meet the needs of senior management

§ 1.5.7 Knowledge Based System (KBS)

§ 1.5.7.1 Knowledge Management

According to knowledge management expert John Naisbitt "We are drowning in information but starved of knowledge". To day ,and in the future, effective information and knowledge management is and will be fundamental in achieving technical and business superiority, and is a key discriminator between competing organizations.

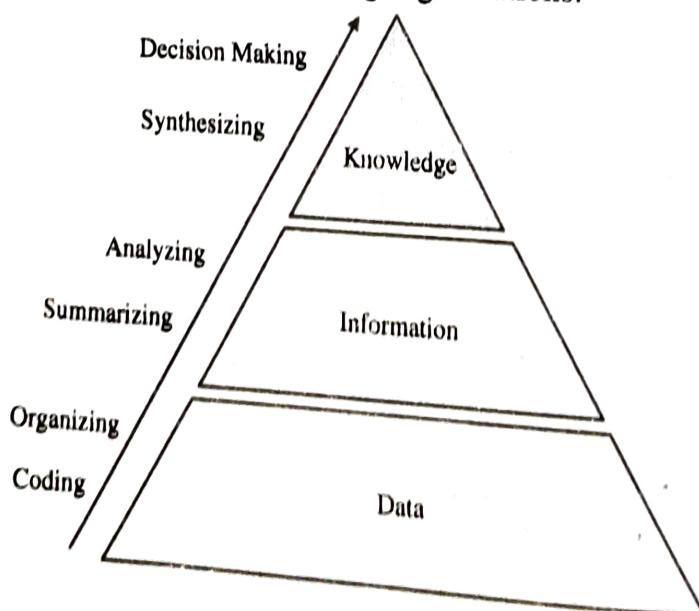
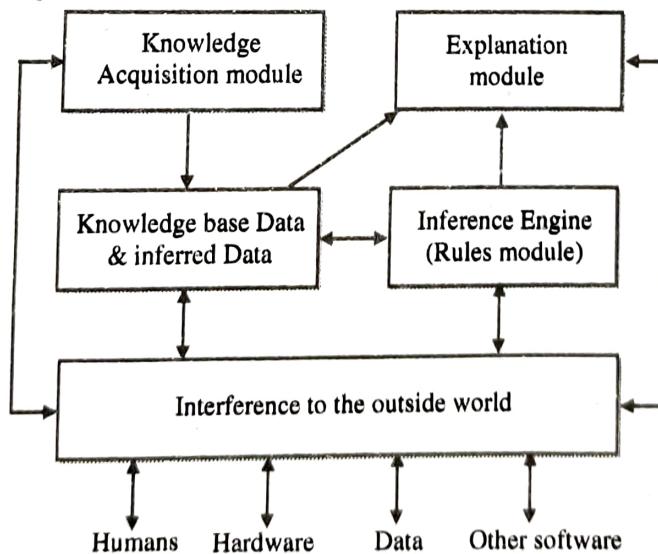


Fig: Knowledge Management Layers

Knowledge management (or "KM") is the management of knowledge within organizations. There are plenty of data everywhere but not enough knowledge to process the data. The development of suitable techniques to gather the required information from a vast collection of data in the possession of an organization is one of the main problems facing the software engineers. In fact knowledge discovery from systematically maintained data is a big challenge. The shift in the emphasis in the area of marketing from stereotyped mass production to designer items calls for precise knowledge of customer behaviour. The available data in the archives of an establishment will have to be picked, cleaned, evaluated and compared.

Knowledge-based systems make extensive use of knowledge to perform complex tasks. This, in turn, led researchers to develop knowledge representation schemes and techniques to manipulate knowledge.

Knowledge-Based Systems



Knowledge is defined as the remembering of previously learned material. It is the psychological result of perception learning and reasoning. It is the body of truth, information, and principles acquired by humankind. In humans, knowledge is stored as a collection of interconnected neurons (brain cells) in the brain, which contains approximately 10^{12} neurons. These neuron interconnections provide approximately 10^{14} bits of potential storage capacity.

Knowledge plays an important role in building intelligent systems. There are many knowledge-based systems have been developed for different

fields, for example, for diagnosing diseases, for configuring computer systems, in electrical circuits and financial markets, for scheduling airplanes and buses, and so on. A knowledge-based system depends on quantity as well as on quality of. **Knowledge needs to be acquired** from different sources such as specified procedures, rules, and facts. Knowledge-based systems usually require thousands of facts and rules to be incorporated in a system. Therefore, it is essential that **knowledge should be stored in an organized manner** in such a way that retrieval of information can be easy. In knowledge-based systems, decisions and actions are based on the manipulation of knowledge in specified ways. The manipulation process is continued (may require further inputs) until a final solution is found. Knowledge can be acquired, organized, and manipulated but it is meaningless unless represented in a proper manner.

AI researchers, for developing intelligent systems, have used several representation schemes. One of the most successful and widely used representation schemes is **First Order Predicate Logic (FOPL)**. It has gained popularity because it is a well-developed theory, which uses valid forms of reasoning, and has good expressive power. However, this scheme cannot be used in areas involving common sense reasoning. Another representation scheme commonly used is *Associative Networks*. It is a graphical representation scheme and uses concepts and nodes where each node represents a concept and arcs are used to define relations between the concepts. Other type of representation scheme includes *Fuzzy Logic*, which is a process of reaching conclusions based on information and facts that are not 100 per cent certain.

§ 1.5.7.2 Knowledge In a Business Enterprise

Knowledge in a business enterprise can be classified in two distinct categories. They are **Explicit** and **Tacit**.

Explicit Knowledge: It can be converted into a process and can be stored and explained. The obvious knowledge found in manuals, documentation, files and in other sources. Explicit knowledge is relatively easy to document and circulate. Information available in reports, statements, process and work flow related information, patent rights and proprietary information are some of the examples of explicit knowledge.