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Ankur Agrawal
Engineer, US Denro Steels, U.S.A

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ROLE OF TECHNOLOGY IN MANUFACTURING UNITS

Ankur Agrawal*

Abstract

To maintain the competitiveness of a manufacturing industry, there should be accent on improving technology. An internal technological dynamism involving a continuous stream of technical improvements to their methods of industrial production had yielded results in Japan and South Korea. On the other hand, an incorrect choice of technology for a product or process in a unit, can be self-destructive. The major reason for the poor performance of few companies in India like surgical instruments plant of IDPL, Madras, or Hindustan Fertilizers Plant at Haldia was wrong choice of technology whereas the secret of success of Maruti in the automobile sector and NALCO or HINDALCO in the aluminium production sector is attributable to a large extent to the right choice of technology (both design and production) for the manufacturing of compact high quality fuel efficient car or production of aluminium ingots.

Technology is defined as the know-how to transform concepts into goods and services for the satisfaction of users/customers. Technology accordingly to the Indian philosophy is like 'god' and can produce anything and everything on earth provided it is ordained by the Creator to the inventor/builder god 'Vishwakarma'. Technology as created by Vishwakarma, can convert impossible things into possible things. Thus technology is continuously improving.

Technology in its forms would include know-how, know-why, designs, drawings, specifications, manufacturing process, management information system, training, retraining, etc.

Pt. Nehru[1] stated that the creation and adoption of new scientific techniques can, in fact, make up for deficiency in natural resources and reduce the demands of capital. Now a days, it has become a readymade instrument to solve labour problems which were considered in the Marxian age as indomitable.

MAGIC OF TECHNOLOGY.

The countries, which dominate the global scene today, are the ones which also happen to be technology leaders like USA, Germany, U.K., Japan and France. Classic studies by Kendrick, Solone and Dennison reveal that bulk of improvements in output of developed countries can be attributed directly to technological changes.[2]

Brooking's Institution study ascribes 44% of productivity increase in the USA to technological innovations.[3]

According to another study, almost 40% of GNP growth in USA during the past two decades was on account of technological innovations[4]. We have the Korean and Japanese (now crossed that stage) examples where dramatic changes have been brought about through extensive use of technologies imported from developed countries. Recently, between 1980 and 1992, the production of the French chemical industry has increased by 31%, whilst the number of people was cut by 12%.

The productivity of a power-loom doubled between 1815 and 1835, and had then progressed five folds by 1900.

"New products, new services and new markets are the major benefits offered by the technological progress of the modern times. As a result, there are more jobs, improved working conditions and better quality of life.[5]

That is why less developed countries like India are engaging themselves in constant technological updation to keep themselves in the global competiton."Nearly 70% of all foreign collaborations approved during the last 10 years by India were for importation of technology to Indian companies from the developed countries.[6]

TECHNOLOGY IN MANUFACTURING UNITS

In recent years, service industries have grown at a much faster pace than the manufacturing industries. Many have expressed concern over the decline of US manufacturing. In some fields, US goods have become uncompetitive in the

* *B.Tech.(Manufacturing Science & Engineering) from IIT, Kharagpur and is working as Engineer, Operation in M/s. U.S. Denro Steel Inc. Houston, Texas, U.S.A.*

world markets. Barras(1986) showed that in the British economy, the services sectors productivity was growing at 2% annually (based on the real value of output per employee) from 1960 to 1981 whereas the manufacturing productivity grew at at a lower percentage[7]. In Japan, lesser growth rate in the manufacturing sector is estimated. From 1976 to 1986, manufacturing job shifted markedly among both industries and regions. However, the service sector is dependent on manufacturing whereas on the other hand, a healthy manufacturing sector is equally dependent on services.

Successful manufacturing increasingly requires rapid feedback from the market place, more customized products and accurate delivery in shorter cycle time. Integration of services and manufacturing systems should lead to some added manufacturing in times to come. The government will have to see that specialised manufacturing capabilities exist for key strategic purposes. For example, one cannot allow total import of milk and milk products or defence equipments and ammunitions because at the time of emergency like war or some such contingencies, these can not be imported without compromising the nation's honour which no citizen or government will like. Thus, manufacturing being the mother field, its total output capacity will not drop drastically low in the twenty first century. Some innovative manufacturers will arrive on the scene who will learn to compete against low cost foreign operators. It will be easily possible in LDCs where surplus work force will be available at lesser cost.

CHOICE OF TECHNOLOGY

While selecting a technology, one should assess the stage of development of that technology. Technology also undergoes different phases like 'embryonic'. 'growth', mature' and 'decline' during its life cycle. A technology at the maturity phase calls for innovations or changes, depending upon the new innovations or competitions, before it becomes outdated or extinct just like human civilization. If a human civilization does not change with times, it becomes talk of history only.

PLANNING THE TECHNOLOGY FOR A UNIT

Every enterprise or unit employs technology of some sort which has to be managed. It is one resource which influences the entire gamut of business management operations viz. human resource management, financial management, engineering, manufacturing, marketing, etc. more intensely than any other singe factor. This is primarily due to:

(i) the rate of technological obsolescence is becoming significantly high,

(ii) globalisation of markets,

(iii) emergence of faster information technologies, and

(iv) significant reduction of time between innovation and commercialisation of innovations except in LDCs (Lesser Developed Countries.)

In view of above developments, technology planning is becoming an essential focus for a unit.

MANAGEMENT OF TECHNOLOGY AT UNIT LEVEL

There is a relationship between indigenous and imported technology which can be expressed as follows [8]:

T	=	F (R&D, IMP,IAS)	Where:
T	=	source of technology to a unit	
R&D	=	in -house R&D efforts of that enterprise	
IMP	=	technology input from abroad.	
IAS	=	relationship between imported and indigenous technology	

The relationship can either be one of the substitution or complementary in nature. The former means that an enterprise will develop its own technology or it purchases its requirement from abroad or from other enterprises or technology suppliers in the domestic economy. On the contrary, the latter means that the firm is following the "import and adapt strategy".

Investment in in-house R& D efforts in most firms in LDCs is too meagre to generate any significant technologies and that too on a commercial scale. So their main option for obtaining technology is to import it from foreign sources. One of the main characteristics of technology is that it is extremely location specific. So any technology that is imported from abroad will have to be adapted to local conditions. From this line of reasoning, it can be deduced that the relationship between technology import and domestic R&D efforts is complementary in nature in LDCs.

COST OF TECHNOLOGY

The technology is chosen on the basis of techniques of forecasting of technologies. The four popular methods are:

1. Expert opinion,
2. Polls,
3. Panels &
4. Delphi

However, acquisition of technology is preferred where in-house R&D is expected to be too costly and time-consuming or customers prefer a particular technology like in the case of modern PCs. In-house development of technology is preferred where technology acquisition cost is prohibitive or technology is not available commercially like technology for nuclear, space or defence applications. And sufficient skills, time and space are available to undertake indigenous development. Average Propensity to Adapt may be defined as:

Expenditure on in house R&D/ Direct cost of technology import

Apart, there are direct and indirect costs involved in technology. Direct cost includes royalty payments which are linked to the net ex-factory sale value of the products manufactured under collaboration. It is usually expressed as a percentage of the latter.

"Royalty = P (C-I-B)

where

P = percentage mutually agreed upon by the collaborator and the host firm and in conformity with government guidelines.

C = ex-factory price of the products manufactured under collaboration.

I = imported materials which are used in the production of the item.

B = brought out items either procured from indigenous sources or through imports.

However, indirect costs resulting in restrictions on the recipients production and marketing activities, equity participation by the supplier with no capital contribution and repatriation of profits. Thus, the balance of technology, trade can be defined as ' Net Foreign Exchange Inflow Rate (NFIR) as follows:

NFIR[9] = X-I/X

where

NFIR = Net Foreign Exchange Inflow Rate

X = Exports of technology and products

I = Imports of technology and products

Thus, all pros and cons are to be weighed before a technology is brought at the unit level considering overall national or social costs in view which are sometimes reflected in various government policies.

NEW VISTAS IN THE FIELD OF MANUFACTURING

(a) Newer Materials

Advanced Material Research involves the development of various insulating polymers, varnishes and dielectric liquids assessing corrosion of various materials in different environments and development of techniques to overcome corrosion, development of erosion and corrosion resistant and thermally insulting coatings, advanced ceramic materials and development of energy efficient photo voltaic solar cells and semiconductor devices, characterisation of materials for their high temperature behaviour, development of fracture mechanics and fatigue data under different environmental conditions and erosion studies, development of new steels and alloys and development of newer and improved metallic materials.

Development of silicone varnishes, epoxy resins and hardeners for epoxy formulations, polyester resins etc, used in rotating equipment, dielectric liquids for high voltage capacitors, indigenization of several insulating materials, lubricants corrosion studies on various condenser tube materials to assess the suitability of these materials for different power plant applications and suitable inhibitors to prevent untimely failures are some of the other latest areas [10].

"Discovery of new semi-conductor, super conductor materials have revolutionized the manufacturing world. Mitsubishi Electric Corporation has developed a new semi conductor made of fullerences, carbon molecules. Mitsubishi used the ionised cluster beam (ICB) method to improve the fluerences crystallinity to make high speed thin film formulation at the rate of several nanometers per minute."

Plasma, the fourth state of matter, is different from the conventional states of solid, liquid and gas, in that the atoms and molecules, the basic constituents are broken up into electrons and positrons or nuclei.

Plasma technology allows structural modification of materials, which are much smaller in size, relaxing location constraints. Increased productivity will make smaller units economically viable. One interesting feature of plasma technology is the possibility of integrating various stages of manufacturing, thereby increasing the overall productivity[11].

Plasma technology has often been hailed as a harbinger of a new industrial revolution because of the qualitatively different and so revolutionary change, it offers in modes of production. Therefore, industrialised countries are making huge investments in the development of Plasma based industrial processes.

Operations such as welding, cutting, melting of scrap, plasma refining and alloying are the common metallurgical and material engineering applications of thermal plasmas. Plasma spraying and deposition is now a well-established commercial process.

The most important class of composite materials is polymeric composite materials such as Fiberglass, Reinforced Plastics (FRPs) having a potential for a wide range of applications.

Biotechnology is revolutionizing production of products from raw materials with the aid of living organism to cover baking, brewing and other industries. This may herald better standard of life for vast population in areas such as agriculture, animal husbandry, healthcare, mineral processing and pollution control. Biotechnology is the answer to future food grain production. A discovery of an appropriate bio insect can eat any pollutant. Gene therapy's approach to genetic diseases is to use genes or nucleic acids to regulate or foster gene expression. Now commercial quantities of medically important human proteins from animals can be produced.

There are so many other innovations, fields or technologies which will bring about unprecedented changes or revolutions.

(b) Newer Processes/operations

The understanding of temperature, structure and deformation processes have led to new and more efficient metal forming techniques like pressure die casting, explosive cladding, super plastic forming, precision forging, profiled extrusion etc.

Automatic shell making and continuous investment casting assemblies controlled by real time computers for achieving very high dimensional accuracies, hot isotatic pressing of power compacts and components, faithful forming of contours inside dies through controlled explosion techniques, use of precision forging and such other methods opened up new avenues for achieving greater precision, productivity and reliability [12]. Similarly heating, extrusion, tooling, rolling, slitting methods, etc have largely improved.

The gantry robot of the machine, loads and unloads work pieces automatically unmanning the machine operation. It can increase the productivity by reducing idle times possible and reduce wastages in the form of reworks and rejections. It could also improve quality of work pieces machined. Tool automation and work piece gauging are additional features to adapt to future factory automation requirements. Adequate interlocks are provided to ensure operational safety. It can eliminate time loss for lunch breaks, shift changes, tea breaks and other time outs needed for personal reasons. The machine utilisation can be as high as 90 percent.

Computer controlled on line production systems have ensured high level of efficiency and output. It can also do toolwear monitoring and breakage detection, ultrasonic machining, sand-moulding process, V-process techniques, under water welding etc. are few of the comparatively newer manufacturing processes which have been adopted to increase manufacturing convenience and productivity of the enterprise.

Standardisation as a tool of healthy manufacturing practices.

Standarisation in industry has helped in designing, production, quality control, procurement, materials handling, construction work and maintenance of plants and offices. Standards are set up at various levels, i.e. company, industry, national and international. Standardisation programmes help to coordinate activities which otherwise result in waste and compound problems seeking solutions.

The International Organisation of Standardisation (ISO) and International Electro-technical Committee (IEC) are two major bodies coordinating the development programmes and approving majority of the international standards used around the world. "In amplification of ISO 9000, some more additional standards were issued. These are:-

IS:9001- Model for Quality Assurance in design and development, production, installation and servicing.

IS:9002- Model for Quality Assurance in production and installation.

IS:9003- Model for Quality Assurance in final inspection and trial.

IS:9004- Quality Management and Quality System elements.[13]

As per ISO 9000 accreditation, it is not too difficult getting certificate but its ensuing adherence to the prescribed quality standards should be ensured. Nonconformance will mean cancellation of the certificate. The unit should sincerely and honestly adhere to these standards. Both ISO 9000 and TQM (Total Quality Management) are complementary to each other with the common objective of creating a positive work culture and motivation. " The motivation in an Organisation ensures optimum output and due quality of products manufactured." [14] The Japanese are the fastest to adapt to the new techniques and then to continuously improve them in house. As a result,the Japanese industries achieved miracles not only in the field of machines but also in the domain of systems management and though a country wide movement spreading from one unit to another unit and then from one industry to another industry and then assimilating it as a part of the Japanese work culture.

ORGANISATION LINKAGES IN TECHNOLOGY MANAGEMENT

Technology management is best done through the Technology Management Groups so that technology is well adapted and culturized in the unit. The effective management of technology at an enterprises level calls for close linkages between all the key players involved in the task viz. customers, business to marketing groups and the corporate agencies apart from the technology management group. It will assess identification of technology gaps existing as well as emerging areas for current and future market needs and will ensure the entire chain of events from R&D project formulation to commercialization in case of in-house R&D. The activities of MNCs in the field are to be studied as they spend large amounts on technology innovation. The competitor's activities are also be scanned apart from ascertaining latest trends or researches in that field of technology through trade fairs, seminars, research institutes, universities, etc. And accordingly the management of the enterprise should be readjusted.

SYNERGY IN TECHNOLOGY MANAGEMENT

Formulation of suitable strategy to integrate R&D activities with corporate strategy is the pre-requisite for technological innovation. The R&D activities are both of short-term and long-term nature.

MNCs attain major breakthroughs by utilizing resources systematically through R&D having different time horizons leading to viable products.

"Technology Fusion" Consisting of combining existing technologies and functional expertise, aims at blending incremental technical improvements form several previously separate fields of technology and results in new products and technologies.

Michael Porter, an authority on 'Core Competencies' holds the view that technological innovation is the single most important source of major changes in market share among competitors and is probably the most frequent cause for the demise of entrenched dominant firms. One of the additional features of technology is that it can be used to change the way an organisation communicates, interacts and coordinates its activities. In future, it is knowledge laced with innovation management that will spin money.

According to Dr. C.K. Prahlad, who is regarded as the Guru of Core Competencies, future industries will capitalize and consolidate knowledge creating fundamentals based on competitive advantage. Managing is itself a core-competency. Businesses have to have external orientation, commitment to accomplish and concern for performance, significance of continuous innovation in the technologes.

In advanced technologies, harmonious orchestrating and synergistic tendency of the salient factors of working of the industry is to be accomplished through teamwork. Shared vision of the economic future ad perceptions of vulnerability is to be kept in view by the captains of industry using future technology.

Thurow, an American expert in 1992 envisioned seven key technologies. He stressed the need for a focus on process rather than on product innovation. These technologies are micro electronics, bio technology, new materials, civil aviations, telecommunications, robotics, machine tools, computers and software. In addition, the commercial opportunities for exploitation in future are advanced materials manufacturing systems including Artificial Intelligence, flexible integrated management and sensor technology, life sciences including bio-technology.

Technology seems to have simultaneously rendered global financial systems more fragile and vulnerable. It is the great equalizer and enabler, bringing real time information to all at the speed of light or more.

It can help regulators, who seem habitually to be caught napping, do their jobs better. It will render traditional intermediaries such as banks and asset management companies obsolete.

Today, more than ever, the market necessitates the need for customer centric business model to provide efficient and cost effective services.

SOCIAL RESPONSIBILITY OF TECHNOLOGY

When Einstein discovered the formula for the conversion of matter into energy and vice-versa, he never wished that the formula could be used to put the world on the brink of disaster. It is, however, debated whether man behind technology is more important. Technology in itself is not good or bad. It is the man behind who should be credited or blamed for its use or misuse.

However, the fact should not be lost sight of that even man behind the worst technology can give best results and demotivated or idle men behind the best technology can produce the worst output as the output is controlled by the men behind technological device. For example, in the US Denro Steel, the workforce and the management have demonstrated that they have produced top quality output of saw pipes after taking over old and outdated technology with the help of the same workforce by suitably motivating them through training and retraining the workforce and by means of adopting step by step in-house improvement and modernization and by ensuring that the technology is completely assimilated by the workers.Hence the contribution of each worker, technician or engineer cannot be overlooked who without going through the process of input or purchase of technology, improved the process at each location though their ingeniousness, research and devotion to improve. Really, man's genius knows no bounds and can always surpass technology.

The technology should also duly consider its social responsibilities. If a new technology is adopted only with a view to evict the workforce, it will fail in its total purpose as the work force ultimately will destroy the unit or enterprise itself through labour movement or violent protests. Thus, technology should be based on 'dharma' or righteousness. It should aim at increasing production, customer satisfaction and payment of more dividends and interests to the shareholders. Technology should take into consideration its costs on the society through consumption of power and other civil facilities and also its effect on the environment. Technology should aim at becoming eco-friendly. If it is subjected to social audit before its implementation, there should be no objection or hurdle. If technology is intended only to fill the coffers of the proprietors or directors of the enterprise, it will not be able to sustain itself.

Therefore, technology should be one which should be all pervading and acceptable by all right thinking persons. However, the significance of the role of technology in manufacturing units by all means, is tremendous and requires to be recognised in all developing counties (LDCs) with utmost earnestness to ensure the competitiveness of their industries in the present global scenario.

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