Go Back

ADOPTION OF TECHNOLOGY: A SYSTEMS PERSPECTIVE

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ABSTRACT

Systems thinking in management is getting increasingly popular through out the world. Management of Technology in an industry or an organisation assumes a lot of importance in view of tough competition, globalisation and emerging of new technologies very fast across the globe. In this article a holistic view of management of Technology is presented, which may help an industry to gain competitive advantage. Importance of Technology in the organisation, Technological lockout, Adoption of new Technology, Competitive Advantage through Technology, The impact of Information Technology and HRD for Technology Management are discussed in detail in this article.

INTRODUCTION

The practice of any or all of applied sciences that have practical value and/or industrial use is called Technology as per dictionary. Practice encompasses the complete steps required to get desired output from specified input with the necessary equipment. We may view Technology having both software and hardware. Hardware consists of equipment and facilities and software includes operating sequences and practices. Technology may encompass measurements, controls, sequences of operations, equipment condition and feedback and checks etc. Therefore Technology can not be viewed in isolation. Selection of appropriate Technology has an competitive advantage over others. Technological lockout is described as a phenomenon, where it is no more able to deliver the output for which it is designed. Melissa A. Schilling[1] in his article has given two types of Technological lockout, which may happen in an industry. Schooling defines technological lockout as a situation in which a firm finds itself unable to develop or competitively sell products to a particular market because of Technology standards. In Type-1 Technological Lockout, the firm produces products in the absence of a dominant product design, that are subsequently rejected by the market and the market moves towards a dominant design. In Type-2, there is an existing dominant design and the firm is unable to (or barred from) producing or selling products conforming to this standard. The author has admitted that idiosyncratic events such as government legislation, bundling partnerships influence the Technology adoption. The authors opine in his model, since other attributes and

action also affect Technology selection in an ordered way, the firm can reclaim some degree of control over the Technology selection process.

The author identifies the following possible reasons of technological lockout in type-1.Failure to invest in learning is considered as one of the reasons for such situation. Expansion of knowledge and skill base (core capabilities) and assimilation and utilisation of future capacity (absorptive capacity) are the two important factors in organisational learning. Failure to invest in continuous learning results in forfeiture of both the development of new capabilities and an increase in absorptive capacity. Another factor is the lack of complementary goods. Some firms make both a product and its complements. For example, Kodak produces both cameras and film, where as others rely on other companies to provide complementary goods or services for their products. The firms that do not produce their own complementary goods may find themselves vulnerable to technological lockout because of lack of availability of complementary goods to consumers. On the other hand, in an industry characterised by network externalities, a firm producing a Technology for which there is a lack of complementary goods is likely to find its Technology rejected. The author notes that the size of the installed base is directly related to the benefits a consumer derives from using Technology. The other things being equal, a Technology with a large installed base, is preferable to a Technology with a smaller installed base. In the initial stages of Technology adoption, the customer's expectation is highly uncertain. Further, necessary complementary goods and services may not be developed. In the later stage, if the Technology proves to be valuable, because of so many competitors, Technology offerings will have little opportunity to capture market share.

In addition to the factors enumerated in Type-1, the factors that prevent a firm from being able to produce or sell a product conforming to an established dominant design are patents, copyrights and other forms of legal protection. Critical capabilities and ability to gain these capabilities depend upon the investment in continuous learning. Existence and effectiveness of competitor patents: By this, the firm may be Technologically locked out in two ways. Firm B may be able to prevent Firm A from producing a compatible product if Firm B has strong legal property rights to the Technology. A second generation Technology can be introduced in the market if it is compatible, then Firm B will prefer incompatibility and if Firm B has got strong property rights, the second generation Technology will never be introduced.

Thus Schilling1 has identified a set of factors that have predictable influences on Technology adoption. He has tried to integrate economics, strategy and marketing research. In type-1, Technological lockout , the identified factors are investment in learning (Core capabilities, absorptive capacity), installed base, complementary goods and timing. In Type-2 technological lockout, patents, copyrights etc. are critical factors for technological lockout. In addition, idiosyncratic factors such and Govt. regulations, mergers etc. do influence Technology adoption and lockout.

The authors also opine that suitable HRD schemes are essential for nourishment of Technology in an organisation.

ADOPTION OF NEW TECHNOLOGY IN THE ORGANISATION

Panda and Upadhyay2 in their Prism model, describes Technology as an important part of the organisation along with the Systems, Structure, culture, people etc. It is the compatibility of these parts that constitute the successful implementation of systems in an organisation. By simple adoption of new sophisticated Technology, we may not get the desired result. The other factors such as process, systems, culture and people play a very important role.

In the event of Technological lockout, adoption of new Technology helps remove Technological obsolescence. The urge for competitive price, improvement in quality of products and the pressure from the competitors force the industries to adopt new Technologies. Business

opportunities, availability of resources also necessitate acceptance of different Technologies in industries. Other factors which is responsible for new Technology initiatives are availability of new alternate materials, meeting customer needs, presentation and aesthetic requirements. Nevertheless, the criteria for adoption of any new Technology remain clear so long as what is required to be achieved is clear. Otherwise implementation of new Technology can end up with alienation and apathy. Some of the inhibiting factors for selection of new Technology can be high investment cost, not a proven Technology, lack of information, high risk etc. Very often employees oppose strongly as it may affect their job security and pose new challenges in their work.

Systems thinking (Maani[6]) envisages long term focus and thinking as a whole. When Technology is viewed from wider systems perspective in an industry, all steps involved from input stage to output stage till the products reach the customer form a part of Technology. Each step is achieved through a well defined process which can be named as sub Technology. These again use several Technologies of subsystems. All these together determine the success of any business. Any Technology can not be successful unless the required specifications of the input raw material are met. A case study on successful adoption of new Continuous Casting (CC) Technology is described below of Bokaro steel Plant (Steel Authority of India Limited).

Case study: "Today, as much as 90% of liquid steel is being processed through the CC route throughout the world. This is so mainly because the advantages of CC over the conventional ingot route like increase in yield, decrease in energy consumption, improved product quality, smoother operation of down stream routes, reduced environmental pollution, improved labour productivity etc. The quality problems faced through the conventional Ingot-slabbing mill route are presence of fins, bulges, and scabs, laminations, non-metallic inclusions, higher sulphur manganese ratio, presence of dissolved gases and non-homogeneous chemical composition. In addition to the above problems, cracks, overheating and burning of slabs, camber, gauge variation and improper profile and shape of coils are also important problems. The introduction of CC facilitates at SMS-II of Bokaro gas has thus been a step forward guaranteeing the production of quality steel of International standard. Steel refining facilities have also been provided to improve the quality and stabilise the parameters of liquid steel for casting in CC machines in sequence. The steel refining unit (SRU) performs the following Technological operations.

- Homogenisation of temperature/chemical composition of liquid steel
- End point temperature control
- De-sulphurisation and shape control of inclusions
- Chemistry corrections
- Reduction in dissolved gases and non-metallic inclusions.
- After modernisation, the sulphur and phosphorous contents of various grades have been limited to 0.01%-0.03% depending upon the end requirement. Partial de-sulphurisation for limiting the sulphur content in the final analysis is being done by adding synthetic slag i.e. lime, alumina and flourspar for increasing the basicity, fluidity and composition of the slag. Argon purging to improve the kinetics between slag and metal interface and reducing the total oxygen in steel by adding aluminium.
- To ensure stability of casting and quality improvement of cast slabs, advanced Technologies have been incorporated. These are: Refractory shroud between ladle and tundish and submerged nozzle between tundish and mould to avoid oxidation and metal stream, High capacity tundishes with capacity for blowing argon through zircon nozzle for better control of inclusions and to reduce incidence of tundish nozzle clogging, Slide gates in ladle and tundish for better flow

control to improve quality of casting, Multi point bending and liquid core straightening on CC machine to minimise straightening strain in order to improve equality of cast slabs, Air-mist cooling of slabs in secondary cooling zone for uniform of cooling and high efficiency in terms of heat removal, Automatic mould level control based on eddy current for fixed steel level control in mould, Microprocessor based strand condition monitor for measuring roll gap, roll movability and roll wear within tight tolerances for maintaining uniformity in the containment pass line to avoid strand bulging and cracks- both internal and surface, Microprocessor based automatic process control system for controlling various service and operating parameters of SRU, CCM, material tracking etc.

The feedling of calcium wires in every cast helps in the shape modification of oxide and sulphide inclusions. This reduces weld line failures and improves formability of our products. A computer aided monitoring system tracks the condition of slab produced and informs about the inspection status of the slab. In order to improve the productivity, the following measures have been incorporated in the CCS. Ladle turret is equipped with lifting/lowering facility for change of ladle during casting and facilitate quick change of tundish for achieving higher sequence of casting. Flying tundish exchange mechanism has been provided. Two tundish cars equipped with lifting/lowering facility for quick change of tundish to facilitate longer sequence casting is possible. Tundish of higher capacity (Apr. 50 tons) has been provided to prevent the reduction in casting speed during ladle change and inclusion free casting of steel. Sequence casting for achieving higher yield is being practised. Remotely adjustable mould with provision for changing the width during casting has been provided. The introduction of dummy into the mould is being done by the top charging system to reduce restraining time. Marking unit, slab tracking, slab handling cranes with rotating trolleys for trouble free operation of slab handling have been provided.

To ensure the ease of maintenance, the following measures have been incorporated. Segmented design of secondary cooling segments for their easy instalment. Provision of quick change stand (A unit comprising mould, mould oscillating table and segment “o”) which can be removed from CCM and replaced in shorter time. Provision of segment removal rails for wasy removal/replacement of various segments. Provision of roll gap checker for measuring the roll gap, roll movability and wear within tight tolerances. Breakout pre-detection system in mould based on thermocouples and signalling facilities.

At Bokaro Steel Plant, sulphur printing is utilised to evaluate internal quality of CC Slabs. The distribution of sulphur in the solidified cross-section is prominently displayed by reaction of MnS (or FeS) with dilute sulphuric acid and bromide crystal of silver on photographic paper. Sulphur printing is being used for the detection and analysis of centre segregation, inclusion distribution, internal radial cracks(also known as half way cracks), triple point cracks, black spots (Power entrapment). These aspects of slab quality have been controlled more than satisfactorily by producing clean steel, maintaining low super heat and proper shrouding of steel stream during casting. Majority of the sulphur prints have shown top rating for cleanliness and centre segregation.” Thus adoption of CC Technology has removed obsolescence, improved quality in terms of product and services and better customer satisfaction.

THE IMPACT OF INFORMATION TECHNOLOGY

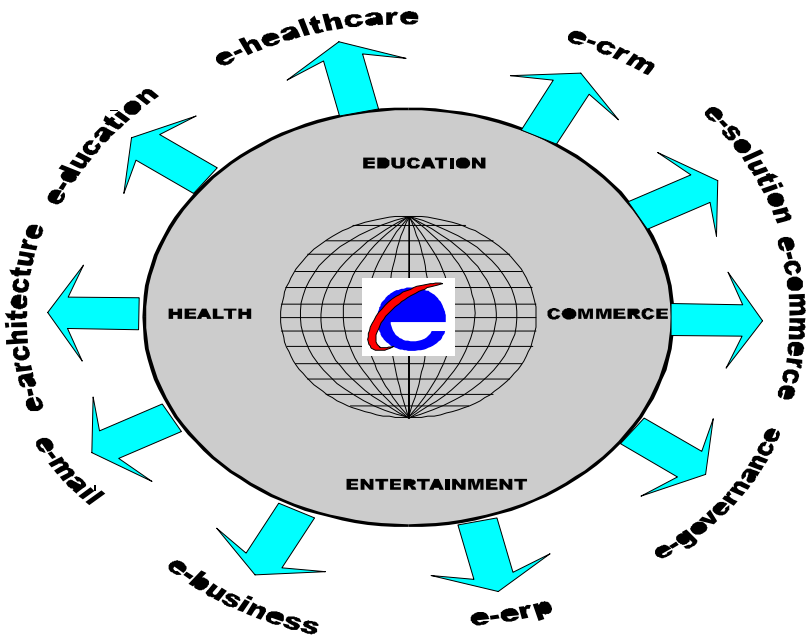
The information Technology is transforming as the conglomeration of all existing Technology. The Internet in its new form of a tool with myriad of killer application is proliferating to each and every corner of the needs of the society. Besides the prognostications for the future reveal an expected $7 trillion e-commerce revenue by 2004 which will be 20% of the global economy. By 2005, the web-gaming business alone will reach a mammoth height of approximately $ 29 billion and if the trend scrolls smooth around 2010, the web enabled devices will reach to a huge

35 billion which will be on an average 6 devices per person on the planet. It seems there is no end to this list and more we think of the Internet more we are engulfed today to its mesmerising tantrum. Ultimately, the web is leveraging as the single most pyramid in transforming the society and the net with provision of wide variety of applications is poised as the pivot of the new economy of the future.

This huge impact on society by the new Technology is statistically related to many of the inherent benefits those are encompassed with the net. Many of these Technologies need serious consideration in deploying and developing to enhance organisational efficiency. The high speed Internet age as on today has added e-flavors to many things, the glimpse of which shown in figure-1.In near future the modern Internet will scroll over almost on everything with its super e-prefix generation in all parts of the society.

The second Technology in the net which is already flourished is Voice-over Internet Protocol (VoIP) popularly known as net telephony. This will bring people of the globe more nearer since the communication is speeded up with affordable cost to every body. The future will witness more significant development to this and probably will be in the form of full motion video-over IP with wireless media to bind people any where at any time.

Another mind boggling offer of the net is collaborative computing where proportionate job distribution can be automated among the sharing computers over the globe to solve a complex problems quickly which is otherwise difficult for any individual entity. This metamorphosis may further advance for altogether a new paradigm with contribution of biological, quantum or chemical computers joining the Internet band wagon which are at present in a nascent stage in R&D houses. This may make the net a more superior problem-solving toll than human being. Then the truth of "all the world is a family and all the people of the world are my brothers and sisters " may be felt virtually in the sphere of the coming net-enabled world.



e-volution

Figure-1

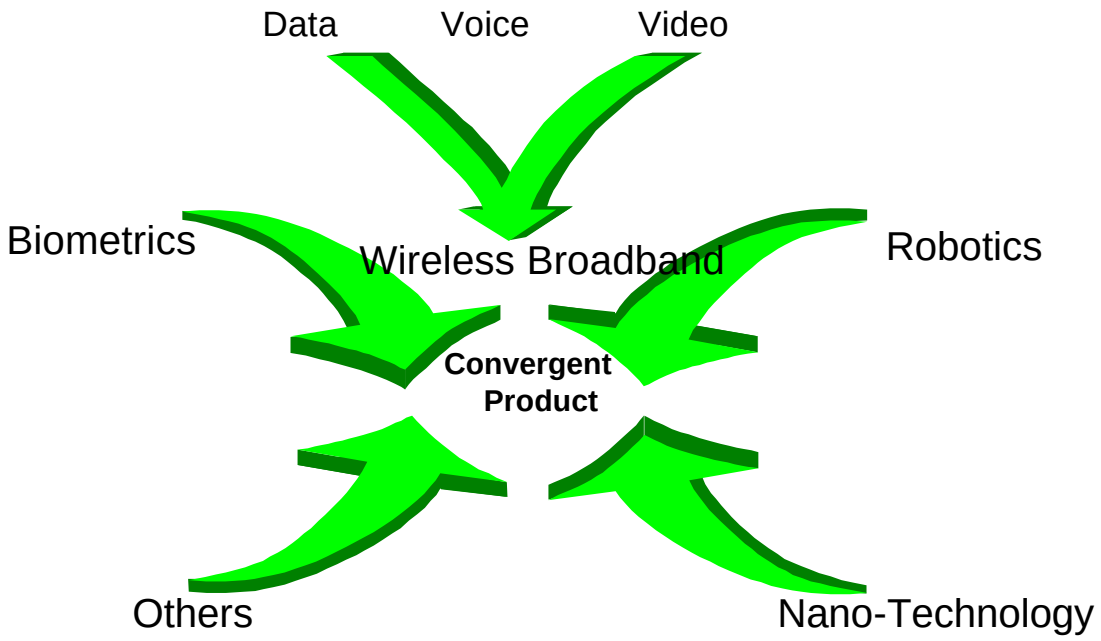
Finally, the gigantic form of the net and its advantage will be felt with upcoming new incarnation as convergence. Convergence at this initial stage means that the content would be independent of any specific delivery platform and services or products could be delivered as per the choice of the customers.

The present information Technology will be able to sustain all such demands in future with conglomeration of data, voice, video all channelled to gigabit pipes. The trend focuses Integrated High speed video, voice and data on a single wireless device as a luxury on every table. This may further expand its arm to merge wireless broadband, nano-Technology, robotics, biometrics etc. The eventual convergence of such hi-tech platforms will bring today's science fictions to reality for the benefit of the society in the future as shown in figure-2.

Apart from these technological offspring IT also helps in upliftment of society in general and organisations in particular through IT-enabled services. IT enabled services like call centres, data centres, medical transcription, digitization of maps in Geographic Information Systems, back office operations, content creations for web-based application are few of the tested and trusted philosophy in this main stream.

In an area of rapidly changing Technology and increasing reliance on the IT, lasting customer relationships are critical to thrive in market. Reorganising the activity has become a competitive mandate not an option. The growing influence of the Internet is a vehicle for enhancing customer satisfaction which leads a transition from much talked Customer Relationship Management (CRM) to e-CRM. The e-CRM enables companies to understand customer needs and buying habits better to leverage new products or services. Today, business is in flux, rapidly evolving, almost everything can change at once, the only rudder in this uncertain reality is "customer" and the constant battle for their attention, acceptance and continuing patronage. Therefore, e-CRM must be integrated seamlessly to other business processes in order to retain and enhance customer base with high degree of satisfaction. Business houses have realised that relatively sophisticated customer service applications, supply change management and distribution system can be crafted simply once IT enabled services becomes part of a company arsenal of productivity tools.

Therefore, in a world of globalisations of products and services, competitive advantages in the form of quality can be achieved adopting IT and thus enhancing market acceptability. Strict adherence to quality namely reliability, stability and maintainability is the hall mark of any IT enabled service. Hence organisations need to adopt IT policies in all activities in order to win over their counter part. With such enormous benefits IT solutions are mandatory as appears in one side, but careful implementation and sailing through IT enabled services are equally important and binding else the new dimension does not contribute much and at times proves to be futile as things may go hay-wire. The consequence will be doom instead of boom. Therefore, everything may not flourish smoothly when IT is adopted. IT has inherent high rate of Technology obsolescence because changes are rapid and fundamental to it. Hence choosing right IT enabled services or products and managing them is as challenging as any dynamic processes where reformation is a continuous pursuit. While choosing a product care should be taken that the system has enough functionality for adopting new Technology in the future. Also not only users but also the top executive of the organisation must be continuously made aware of the Technology trends that leads towards future development of products and services. Organisation that thrive in cyberspace are those that learn about the Technologies that they adopt and deploy in their business. Hence while thinking of IT, it takes time to asses the impact of Technology that are about to be deployed after which efforts should be made to focus on applications of the Technology.



The Process of Convergence
Figure-2

HRD FOR TECHNOLOGY MANAGEMENT

Training is crucial for development of human resources in an organisation. Adoption and successful implementation of any new Technology depends upon total commitment by the people in the long run. The training may include the operation and maintenance of the equipment, problem solving skills, team building , planning, scheduling etc. Organisational culture and top management commitment has been identified as the critical issues for faster implementation of any new Technology. Sharma and Upadhyay [4] suggest that the managers today are continuously looking for ideas to run the organisation completely open for learning and sharing. They actively seek solutions from others minds, to experiment with and learn in a boundary less environment and to make things which are right for the customer. This calls for individuals or teams transcend traditional hierarchies/ boundaries to reach required solutions. These are based on having faith on the people, who can deliver superior results and unleash people to be able to deliver the best.

CONCLUSION

In today's competitive business environment, selection and implementation of appropriate Technology plays a vital role in the organisation. Therefore Technology management assumes a very important aspect of the total organisational system. Technological lockout, Adoption of new Technology in the organisation, Competitive advantage though Technology, HRD for Technology Management and impact of Information Technology discussed in detail in this article represent a holistic view of the Technology management. Increasingly, organisational analysts realise that a partial view of the role of Technology management may temporarily help

tide over the problem but it may not solve the problem for good. Therefore, adoption of Technology in the organization should be viewed in totality.

REFERENCES:

1. Melissa A. Schooling, Technological Lockout: “An integrative model of the economic and strategic factors driving Technology success and failure”, Academy of management review, Boston University, 1998, Vol.23, No.2, 267-284
2. Panda M R and Upadhyay S K, “Challenges in effective implementation of Systems”, International Conference on System Dynamics, IIT, Kharagpur, India, December, 1998
3. Water Goldsmith and David Clutterbuck, “The Winning Streak, Mark-II”, Orion Business Books, 1997
4. Thomas H. Davenport, “Putting the Enterprise into the Enterprise System ”, Harvard Business Review, July, 1998
5. Sharma V K and Upadhyay S K, “System Dynamics and Learning Organization”, International Conference on System Dynamics, IIT, Kharagpur, India, December, 1998
6. Maani K E, Cavana R Y, “ Systems Thinking and Modelling”, Prentice hall, 2000