TECHNOLOGY ABSORPTION

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ABSTRACT

The paper examines technology behaviour patterns relating to **absorption by all stake holders,** brings out consequences of not absorbing it and recommends methods to ensure that technology is **optimally utilized**.

Shangai Case. Using a unique firm-level survey dataset collected by one of the authors, 250 firms established in Shangai have been examined to address the questions of diffusion and technology absorption.
Indian Corporate. Case of Trident, Ambuja and Wilson Groups has been studied as to how they successfully transformed work culture to suite new technologies with and without external consultants. New class of hydroelectric Power stations high light the problems in public sector.
Armed Forces. India Armed forces have to keep up with rapid technological changes. The matter assumes special importance as there are no runners up in War. Centurions of Israel destroyed case of Egyptian Army where their new T-62 Tanks.
Three-Mile Accident. Now famous nuclear accident was due to lack of technology absorption. It throws up important questions.
Problems associated with new technology. Problems relate not only to the manufacturer but that of users, value chain associates and stake holders. Typical problems will include retrenchment and layoffs. Environment of USA, India and China has been studied to bring out lessons.
Recommendations
The suggested modules while taking into account all stake holders include those for private Sector, Public sector and organisations like Armed forces. Socio technical systems (STS) and use of external agents to create atmosphere have been discussed.

GENERAL

Ever since the dawn of civilization, integration of technology and human resources has been a cause of concern. During the agriculture revolution and the phase thereafter the progress was extremely slow thereby the technology could be passed on from one generation to another. During the industrial revolution and thereafter technology has followed a Fifty years cycle. As brought out by Simpkin (1989) in "The Race to the Swift", it takes Twenty-Five years for the technology to fully mature and then gradual decline sets in as it is replaced by newer technology causing a overlap. Such a cycle also gave adequate time for people to fully grasp and understand processes involved and make optimal use of it. In the era of Third revolution, technology explosion has taken place where a process is outdated before even it is fully absorbed. In such an environment, it is imperative that human resources are able to anticipate, fully absorb and utilize the technology before it is ready to be discarded in favour of newer models. However, last quarter of Twentieth Century and beginning of the present century has seen spurt of new technologies with changes so fast that they become obsolete even before maturing. In such cases, optimal performance without absorption of technology is unthinkable.

Users of technology are not restricted to those who use it for manufacturing alone, but all those who are in the value chain, customers, users and stakeholders, all are affected by absorption. Managers at all levels as decision makers have to understand capabilities and limitations while the technocrats have to know niti grities. Users on the other hand if not familiar with the new technology would not be able to use the item optimally. Servicing and maintenance of such equipment poses different set of problems. Many users were dissatisfied with their BPL frost -free refrigerator because most service stations were not familiar with the technology. The Indian customer is not in the habit of going to a regular dealer for servicing of home appliances but to their trusted roadside repair units. Because of that, many users were in trouble as their machines once opened were not able to perform at all. They did not understand simple fact that computer controlled machinery and the timer will complete its cycle even if setting is changed in between.

Therefore, there is a need to study full implications of technology absorption and its impact on all stakeholders in order to recommend measures for its optimal utiisation.

Objective of the Paper

The paper examines technology behaviour patterns relating to **absorption by all stake holders,** brings out consequences of not absorbing it and recommends methods to ensure that technology is **optimally utilized**.

Thrust

After studying the technological cycle**,** the paper examines in detail **Shangai case, Indian** scenario and **Japanese** methods of absorption. Problems related to Socio Technical system have been brought out in relation to above-mentioned cases and those faced by Armed Forces, as they are pioneers in the field of use of technology.

Recommendations include processes for managing change, training and development programs, over learning, behavioural changes and structural requirements to absorb the technological changes.

Scope

The Layout is as follows:-

- Case Studies.
- Problems faced.
- Recommendations.

CASE STUDIES

Indian Cases

Textile Sector.

The textile Sector has undergone a lot of modernisation in the recent years as the stress is being laid on automated plants replacing semi skilled workers to some extent. In a modern plant the raw material is automatically sorted out , giving a correct ratio for feeding in the loom. The looms can be programmed for particular designs and colour mix. Packing techniques have also been automated. Together with the plant modernisation most of the companies have opted for paper less offices. A study of Trident, Vardhman, Wilson and Nahar Industries would reveal following:-

- Workers do not take to technology easily. They have to be mentally prepared and trained to handle the new machines.
- More sophisticated the technology more it is prone to stoppages and faults. It not only increases down time in case the handler does not exercise care, but also complicates repair. If the technology is fully understood by the handler it will have far less faults and have less down time.
- The inbound logistic chain has to understand different combinations of raw material required and also labelling system.
- Some industries experimented with Organisational development consultants while others tried in house experiments. Trident Group tried OD but failed. Thereafter they tried to conduct training themselves but failed. Now again they have gone in for a massive OD Program Others have tried on their own but have been partially successful
- Paperless concept takes much longer to be implement
- Just in time concept of inventory control requires technology which can facilitates fast movement of material. In case there is anyone who is not familiar with the methods a bottle neck would be created leading to traffic jam.

Case of BPL

In 1990s, BPL Company came up with latest technology in home appliances and electronic goods. In fact these products were advanced from the Indian consumer's point of view. They also had adequate support for after sale services. However, the user was not educated to be fully aware of the capabilities and also repair problems which may come up. This fact coupled with the Indian consumer habit of getting appliances repaired from their trusted servicing people rather than ask the company to send support ruined the chances of success of such appliances. The user may get perturbed by defrost cycle of the refrigerator without understanding the computer controlled system and call his trusted servicing person who is familiar with old technology. He would open up the controls and that would be the beginning of troubles thereafter. Promptly consumer would opine that BPL appliances are useless causing trouble so stay away from them. This would be the case with everyone unless the user has or made to absorb new features in the product.

Hydro and Nuclear Power stations

Latest power stations like the one at Uri and Joshimat are fully automated with the entire shift being operated by four engineers sitting on a computer console. Site visit is only required in case of fault. In such cases chances of accident increase if the operators think they have understood all the nuances but actually they have not. In this case it is prudent to examine the case of Three Mile Island in USA.

The accident at the Three Mile Island Unit 2 (TMI-2) nuclear power plant near Middletown, Pennsylvania, on March 28, 1979, was the most serious in U.S. commercial nuclear power plant operating history,(1) even though it led to no deaths or injuries to plant workers or members of the nearby community. But it brought about sweeping changes involving emergency response planning, reactor operator training, human factors engineering, radiation protection, and many other areas of nuclear power plant operations. It also caused the U.S. Nuclear Regulatory Commission to tighten and heighten its regulatory oversight. Resultant changes in the nuclear power industry and at the NRC had the effect of enhancing safety.

The sequence of certain events -- equipment malfunctions, design related problems and worker errors -- led to a partial meltdown of the TMI-2 reactor core but only very small off-site releases of radioactivity.

A week earlier, during a maintenance procedure, operators closed block valves (known as EFW-12 A and B) that blocked the flow of water from these emergency feed water pumps. They were never re-opened, as they're required to be during plant operation, and none of the operators knew they were closed. An indicator light for one of the valves was covered by a yellow paper maintenance tag attached to a nearby switch, and operators simply didn't look at the others, never expecting them to be closed because they were always open during operation.

The result of this is that the pumps, running at full speed, could deliver no feed water at all. As the operators began their checklist, the first item was "Verify emergency feed". Faust didn't see the valve indicator lights, and assumed the valves were open as they were required to be, and always had been before. The valve didn't close this night, even though a poorly-designed indicator led operators to believe that it had. The light, which one operator described as perhaps the brightest light on the entire panel, indicated only what the valve had been commanded to do, not what it was actually doing. It remained dark, because the valve was commanded to close.

The stuck relief valve still went unnoticed. Although the water level in the primary system was now under control, pressure was dangerously low. Soon, the pressure and temperature conspired to cross the magic line on the engineer's steam table, and the coolant began to boil. Steam bubbles flowed through the loop and reached the main coolant pumps. The immense machines, as large as cement truck and twenty times as powerful, began to vibrate dangerously, and their motors strained as they struggled to pump the frothy mixture of steam and water. Flow rate dropped, temperature increased, and things began to look very bad. Vibration like this could blow the seals on the pump rotors, spilling primary coolant and rendering the pumps unusable.

A frustrating series of human errors followed, complicating the operators' attempts to diagnose the problems with the plant. Zewe, an employee in a sudden burst of insight, suspected that the relief valve might actually be stuck open. He asked a technician for a temperature reading at the valve outlet. A high reading would indicate that the valve was venting steam, but the technician mistakenly read him the temperature of another valve outlet instead -- which was low and normal. The results of not absorbing technology are glaring and consequences can be seen.

Indian Armed forces

Armed Forces are always premier in use of new technology, infact most of the landmark developments take place due to their requirements in peace and war. Development of nuclear technology is only a small case in point. Two examples will be quoted here.

First is change of calibre of the basic weapon from Pt303 to 7.62mm semi automatic in1960s and then again in the 1990s to 5.56mm INSAS. In the sixties, soldiers literally threw their weapons away saying that there are too many stoppages and they are certain to be killed if they use these rifles. It took a great deal of intensive training to prepare them for 1971 War with the new weapons. Again the capabilities to be absorbed during 1990s took a lot of over training.

Second is the modern Aircraft. It will be of interest to note that maintenance manual of an Aircraft like F-16 or Mirage 2000 runs into three lakh pages. Need less to say that in case the maintenance staff has not absorbed full implications of their task, result can be catastrophic. They require special air conditioned hangers as the equipment is sensitive to temperature variation. Training of pilots to optimally use these aircraft is of highest importance.

Similarly there is whole lot of equipment which has to be used during battle. There is one basic difference in the equipment meant for the Armed Forces and the normal industrial Sector or other users. In the Industrial sector it is important to be leaders either in cost or technology or both but there are number twos and threes. They can survive and create niches in the market for themselves. However, during war there is NO RUNNERS UP. Therefore either the equipment and person handling it performs or both are finished and may not live to tell the tail.

Shangai Case.

Using a unique firm-level survey dataset collected by one of the authors, 250 firms established in Shangai were examined to address the questions of diffusion and technology absorption.

Their results suggest that although government support (mainly in the form of cheap bank loans) can encourage firms to adopt more advanced technology, the government may be unable to solve easily the problem of technology absorption. In fact, pushing enterprises to adopt more expensive and advanced technology can lower project performance given the weak capabilities of these firms.

[2]It is worth pointing out that during the period of the study, the lending by state-owned banks to state-owned firms was largely directed by the government's credit plan. State-owned banks also lacked the expertise of choosing good projects. Therefore, one can confidently rule out the possibility that it is the banks that choose to finance larger and better projects.

Under-utilized capacity with higher absorption costs and lower portability. Our results also provide empirical support for the literature that emphasizes the role of financial development in economic growth

1) firms with larger fixed assets and higher output prior to the project adopt bigger projects.

(2) More profitable firms invest more in imported equipment while labor-intensive firms invest more in domestic equipment;

(3) firms with higher physical capital intensity and profitability prior to the project have higher project profitability; and (4) project profitability and capacity utilization increase over the length of the project. These results suggest that technical capacity and learning by doing also play roles in technology diffusion. Thus, our results are also consistent with the studies that emphasize the importance of technical capacity in technology transfer

Although state-owned firms were inefficient, the political costs of hardening budgets and cutting off funding during this period were still high.

For all types of firms, the primary purpose of technology projects was either to introduce '**new' products or improve the quality of existing products.** ('New' products here mean the products that are new to the firm but not necessarily new to the entire product market.) **To summarize, they found that state-owned firms with better access to cheap bank credits have relatively lower project profitability and capacity utilization rates. This indicates that cheap bank credits induce state-owned firms to adopt too large** projects given their technical capacity. **Those bigger projects increase the costs of adopting and absorbing technology and thus reduce project profitability and capacity utilization. On the other hand, firms, which are more profitable prior to the project, experience higher project profitability. Firms with more fixed assets prior to the project have significantly higher project capacity utilization rates. Finally, project profitability and capacity utilization improve with the length of the**

project.

Between the mid-80s and early 90s, industrial reforms in China had still not progressed to the point at which investment decisions were fully decentralized to firms. Largely reflecting the continued state control over the banking system, we find that access to loans from China's state-owned banks was critical to mobilizing the resources required to carry out technology projects. With better access to bank loans than other firms, state-owned firms carried out significantly larger projects and imported more technologically advanced equipment.

On the other hand, they found that project performance differs significantly across firms. State-owned firms with better access to bank loans realized significantly lower return to technology investment. Their explanation for this is that state-owned firms selected projects that were too large and too technologically advanced to absorb and operate efficiently.

Our empirical results have important implications for the role of financial development in technology diffusion and economic growth. In particular, distortions in the financial sector likely generate a mismatch between technology and firms, resulting in under-utilized capacity with higher absorption costs and lower profitability.

Findings

1. The pace at which modern technology is changing requires continuous absorption and updating of skills not only by the manufacturers of materials but also by all stakeholders, those in the value chain and users.
2. Without absorption of technology, profitability remains poor.
3. Over learning is required to optimally utilize modern equipment.
4. Results of non-absorption of technology in many Sectors can be catastrophic.
5. Top management requires to fully grasp the effects of technology to give right type of decisions.
6. Automation to reduce paper work requires a stronger drive to overcome resistance.

RECOMMENDATIONS

1. **STS.** In order to absorb and fully understand the effect of any new technology, Socio Technical Systems approach is important. Man and machine both have to integrate. Such changes can be brought about internally or with the help of External agents in the form of Organisational development program.. This kind of changes take a long time to absorb therefore have to be a continuous process where the work culture of a firm should be changed for the firm to become a learning organization. A systems approach is recommended.
2. **Over Learning**. The best method to build confidence in the new technology is to over learn. This would create an atmosphere where technological changes will become a habit.
3. **Top Management.** As decision makers, they must understand its uses and all nuances to take a decision. In addition, it will assist them to utilize others brains as technocrats will form part of their command group or advisers.
4. **Users.** Their education should form part of marketing campaign otherwise as if in the case of BPL the firm is likely to suffer. This is of utmost importance for those who follow differentiation as a strategy.
5. **Service Sector.** It includes after sales support and banking sector, which has to fund the projects. Without a clear picture of what exactly is the technology, they may end up in supporting non-profit making ventures. Servicing of equipment may it be electronic or automobiles or any other, must take Indian customer's habit of getting repairs done cheaply rather than from standard approved service stations.
6. **Organisations other than profit making concerns.** Technology absorption affects all may it be Armed Forces or Government organizations. In fact results of accidents like the one on Three Miles Island bring out clearly what can be the effect on may be entire population in a particular region.

CONCLUSION

Technological changes in the present era are taking place at a very fast pace. Fifty years cycle is no longer valid. As a result, technology obsolete even before they are fully understood. With the help of case studies, it has been demonstrated that technology absorption is even more important than the development of the technology. It is not only the manufactures of materials who are affected but also the entire value chain and stakeholders including the users. Government organizations including armed forces are effected.

Recommendations given here can go a long way in improving productivity, increasing profitability optimal use of equipment and other materials.

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