



TECHNOLOGY MANAGEMENT

Module 4



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Objectives

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Technological Diffusion

The success of a technological innovation depends on the diffusion of the innovation to those who can make best use of it. The term diffusion refers to the spread of a new idea (product, technology, service, or method) from the time of its invention or creation to its ultimate adoption by an increasing number of users, in different circumstances.

Diffusion involves special types of communication methods or system, which helps to diffuse changes in practice, as well as changes in knowledge or attitudes. Thus, diffusion is the process of closing the gap between what people do not know and what they can effectively put to use. The process is complete when:

- A sufficient number of customers are using the innovation to pay back the amount used to develop it.
- It starts to make a profit
- A system is in place for assessing the need for changes to ensure the longevity of the technology.

We have studied about invention, innovation, technology, and technology transfer in some of the earlier units of this course. Technology diffusion is closely related to innovation and transfer to technology. It facilitates process of technology transfer by acceptance of innovation on wider scale, for better returns, to the owner or supplier of technology. Diffusion of innovation or technology is more relevant to publicly funded R and D organizations and academic institutions, which are generally engaged in basic and applied research and which, by themselves, are not in a position to commercialize the innovations. These innovations may be in public interest in the widest sense of the term. Also, there are highly innovative research companies or small firms in advanced countries who sell their innovations/technologies to large corporations, which have adequate infrastructure and capability to

commercialize the same. Large corporations do not generally diffuse their first generation technologies or innovations until the latter have not matured or have become practically obsolete in their native markets. They think of diffusion only after adequate returns have already been obtained on the investments.

Why is Diffusion Required?

Making the most of technological innovations should be an explicit goal of each corporation a goal reflected in a continuous set of action steps. Broad diffusion of a technological innovation does not just happen; it must be managed. Companies that sell technology to one or two types of customers must take time to diagnose the needs of other potential customers. In addition, companies must attempt to diffuse their domestic technology into foreign markets by adapting them to different needs. For instance, a company that makes telephone switching equipment for temperate climate and conditions of stable power supply should adapt the technology for tropical climates and unstable power supply conditions.

A technological innovation can have a long life if management views it in the proper way. A technology that becomes obsolete in one market may still be considered new in another. For example, some of the technologies that Pakistan has been obtaining from abroad in high-tech areas like computers and communication are technologies that have outlived their life in their own markets but are still found to be attractive here. Several models for diffusion of innovation have been proposed by various specialists/experts in the field (Nawaz Sharif, 1983). These include Coleman Model, Dodd Model, Mahajan-Schoolman Model, Sharif-Ramathan Model, and Polynomial Model. All these models involve certain assumptions of varying degrees and advanced mathematical computations. A deep study of these models is beyond the scope of this unit. It may however be mentioned that these models are highly theoretical in character. Their practical utility is doubtful even for R and D organizations or firms in the developed countries.

Implication of Diffusion

There are several perspectives on diffusion, some of which are discussed below:

Traditional perspective

Technological innovation and diffusion have traditionally been viewed as separate processes. This view treats diffusion as the marketing efforts required to expand the acceptance of the technology beyond the markets initially targeted. This limited orientation prevents management from perceiving what employees can do at each stage of the total technology development process to affect the eventual

diffusion of the technological innovation. Successful diffusion requires a comprehensive perspective on the technological innovation/diffusion process. This perspective can then serve as the basis for a cohesive strategy.

Adoption perspective

The adoption perspective is most often used to describe the diffusion process. This perspective focuses on how the various channels and modes of communication (media, interpersonal etc.) can be used to influence a diverse group of potential customers to adopt a technological innovation. The issues may include how best to prepare the message about the technological innovation for these diverse groups, how to select the appropriate media mix and how to obtain feedback about customer needs. For example, this perspective is often helpful in diffusion of technological innovations like a new method of cultivation or irrigation in rural India where a major task would be determining how to convince people in adopting the new technology.

Technological perspective

This perspective focuses on the technical skills and tools required to implement/use the technological innovation. The technological perspective also looks at how well the provider of a technological innovation understands the environment of the user and the user's ability to apply the technology and also the ability of intermediate agencies like the government. (Many technology transfers in India like that of the technology for EPABX have taken place at the initiative of the innovating organization to the user (through the government)).

Infrastructure perspective

The infrastructure of the region in which the technological innovation is targeted is an important factor in diffusing the innovation. Infrastructure aspects that affect diffusion include transportation, terrain, weather, availability of energy, communication, etc. Poor infrastructure development can constrain some innovations. Diffusion will occur only if the necessary facilities exist. For example, poor access to maintenance and repair service at acceptable costs constrains the adoption of information technology in maintenance of land records, primary health care centers etc. The application of biotechnology to agriculture will require building infrastructure like distribution and service networks and teaching farmers and others how to use the new techniques. In this case, diffusion will most likely involve some combination of agents, including government, cooperatives, private distributors, and many others- most of whom may be beyond the direct control of the biotech firm. In order to develop a successful

diffusion strategy, the diffusing organization must consider all these aspects in conjunction with the infrastructure that is available.

Regulatory/societal perspective

The regulatory/societal perspective looks at the effects of government policies, regulatory requirements, and bureaucratic processes, and the development stage of the area in which the technology is to be used. This perspective is particularly important for diffusion of technologies in developing countries. Regulatory requirements affect the ability of potential customers to adopt innovations as well as the ability of a diffusing company to compete with other companies. For example, technologies that are capital intensive may not be encouraged by governments, which are interested in pursuing a policy of employment creation through labour oriented methods. Companies may not want to part with their technology to countries that do not provide adequate patent and copyright protection (intellectual property rights).

Similarly, societal issues like consideration of a technology mostly for elitist living can affect the diffusion of a technological innovation (e.g., car phones).

Models perspective

The models perspective looks at the development of models that management can use to predict the behavior of potential users of a technological innovation and, consequently, develop strategies for diffusing an innovation. To model a diffusion process, an analyst works with a few variables to fit a curve that describes the spread of innovation over time. These parameters might represent the size of the population, number of alternate technologies in use, complexity of the technology etc. For example, some investigators have analogized a technological innovation diffusion process to the spread of an epidemic through a population and have accordingly used one or another of several epidemiological diffusion models.

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Comprehensive perspective

The comprehensive perspective uses all the perspectives discussed so far in developing a diffusion strategy. It views the diffusion process as part of a total innovation process. Many people are involved in

the innovation/diffusion process and this view maintains that each person involved with a technological innovation must maintain an interest in it for a much longer time than what is normally spent in developing the technology, and further that he should be available to make the changes that may be required over the life of the technological innovation.

Development of Diffusion Strategy

Developing a diffusion strategy involves a number of activities and many people.

This section looks at each of these activities separately but in a real situation many of these activities may go on concurrently. Some people in the organization will participate only at certain stages, while others will have continuing roles. Thus, the development and implementation of a diffusion strategy requires effective management.

Assess the organizational climate

An important factor related to successful diffusion is an organizational climate that supports diffusion and innovation objectives. To facilitate this, it will be useful to list a set of organizational attitudes and objectives that can support the innovation and diffusion process. These objectives could include the need to orient to the future, for timely action, to anticipate changes, threats, and opportunities, and for all members of the organization to play a role in launching an innovation. In addition to communicating these objectives throughout the organization management must initiate programmes and practices that make these objectives a living force.

Studies of successful diffusion show that one of the most consistent features is the presence of dedicated people who persist in their efforts. Such people are called “technology champions” or “change agents”. How well an organization nurtures such people and understands and supports the process is an important element of the organizational climate. How management structures and controls the organization has a profound impact on the diffusion process. There has to be a balance between a centralized decision making structure and decentralized operations. The number of layers through which a new technology idea must be cleared before it can be implemented has a significant impact on the speed with which the diffusion can take place.

Leadership style also affects the diffusion strategy. If the style is authoritarian, dissenting voices may not be heard and assenting voices may be amplified. However, the organization can take quick action. If the style is too participatory, the action may be slow but major mistakes can be avoided. The ideal would be a leadership style that is clear and gives urgency a high priority.

Understand the role of "technology champion"

The change agent or technology champion must play a bridge role within and outside the organization. Within the organization the change agent should provide communications between the marketing and the R and D organization. In market driven organizations, the main directions for technological innovation come from marketing. R and D's reaction comes in the form of guidance on what is technically feasible and ideas from scientific circles.

A technology driven organization offers a marked contrast, as R and D drives the stimulus and marketing officials must find applications. These efforts can help to create new markets by applying technological breakthrough to largely unperceived needs. In India, technologies and products are mostly market driven while in industrialized countries markets are mostly technology driven. When introducing a new technology to potential customers outside the organization the change agent must explain the need for the technology: Demonstrations, films, or other techniques can help the customer to become aware of the need for the new technology. The change agent must show real interest in the user's problems and prove it in his or her behavior. Should the firm invest in a technology suitable for production of large volume of communication cables when the customer wants to produce a limited quantity of cables only? The change agent should be sensitive to the users' needs and help the user to overcome problems he encounters.

Define the profile of the technological innovation

Different types of technological innovation require different diffusion efforts. If the technology is new to both the market and the company, adopters of the technology have to be educated on its use. Diffusion efforts may have to overcome resistance to the complexity of the technology (as with fiber optics) or social or cultural barriers (birth control devices).

In contrast, if the technology is a modification or improvement of an existing technology (Example: energy saving process), diffusion efforts must stress the superior attributes of the new technology:

Use opinion leaders

An important part of the diffusion strategy is the identification of opinion leaders, assessment of their orientation (towards acceptance or rejection), assessment of their scope of influence, and development of ways to influence them. Such leaders influence opinions and actions in informal ways.

They are people or institutions whose information and opinions are sought on subjects in which

they are considered experts. They are technology gatekeepers and feel qualified to evaluate a technology and market gatekeepers who feel qualified to describe what people want to buy.

Their influence is often extensive because they tend to have a large number of acquaintances and because they play the role of bringing people of related interests together. A good example is the position that various individuals and organizations took towards C-DOT's switching technology. Change agents must develop strategies for reinforcing those opinion leaders who favor the innovation and technologies and reducing the opposition of those who are negative. Assessing the ratio of positive to negative opinion leaders and their relative influence is also important.

Develop a communication strategy

Developing a communication strategy is one of the major tasks of the diffusion process. To achieve successful communication, the organization must relate the innovation's attributes to customer needs. If an analysis of the user's situation and capabilities indicates that service may be a problem, then communications should describe how service will be provided. The change agency must show, through its communications, that it wants to be useful by meeting customer needs and that it is willing to learn from its customers. The company's messages must also prove its reputation for reliability, honesty, and thoughtfulness in fact, what the company communicates about itself is almost as important as what it communicates about the innovation. For example, Motorola, a US based semiconductor and communication company, which is trying to introduce cellular technology in India, considered elitist (in some quarters), has been advertising extensively in the media portraying it as a technology for development of rural Pakistan.

Communications

Two areas of communication are within the organization (internal communication and with agencies outside the organization external communications).

Internal communication

Successful communication leads to action and many factors affect success in the communication process. The innovator or the innovating group must describe the innovation in terms that enable others to work on its behalf. Thus, facilitating communications between R and D and marketing is a continuing management task. The message to internal corporate decision-makers should include realistic estimates of the initial resource requirements, staff, time, and money required to launch the innovation.

A company's system for processing innovations can smooth and speed the flow of the diffusion process during the internal stage. Such systems use standard criteria to judge innovations, give feedback

to the source, and identify the product champions who will nurture the innovation to successful commercialization. If the originator understands how the development process works and is aware of the problems usually encountered at each stage, he or she can often help overcome the difficulties or suggest ways to capitalize on the strengths of the innovation.

External communications

Once a technological innovation is transformed to a prototype or a sample for field trial, the focus of the diffusion effort changes from internal to external communication, for getting the word to potential adopters. The content of the message is largely guided by the:

- Attributes of the innovation, and
- The characteristics of the target market of the technological innovation.

Attributes of the innovation

It is widely recognized that five general attributes of innovations are useful in preparing messages:

- relative advantage
- compatibility
- complexity
- testability
- visibility

Characteristics of the target market

To reach business prospects, the message must relate the important attributes of the technological innovation to both executive management and the group in the customer organization that would actually use it. Discovering the attributes desired by the dominant decision making group in the customer company may well be an important prelude to designing communications to hasten adoption. While including concern for the needs of the actual users at the initial stage may prolong the adoption period but it will increase the endurance of the innovation.

Communication channels

Two principal modes of communication for message about innovation are the mass media (radio, TV, film, newspaper, magazines) and interpersonal channels (word of mouth, trade shows, demonstration etc.) The mass media are relatively quick in beaming the message to many people. However, since it tends to be one way, the lack of feedback about customer reception makes the media

less effective than interpersonal communication in molding attitudes to the new technology. This may be suitable for simple technology like food preservation/processing with potential for large number of customers spread over a wide area.

Interpersonal communication has an important influence in promoting diffusion. Particularly in the areas of high technology where there has to be a dialogue between the innovator and the potential customer, a strong relationship exists between understanding a technological innovation and being influenced to buy.