CHAPTER 2

TECHNOLOGY DIFFUSION – THEORETICAL AND CONCEPTUAL BASE
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2.1 Introduction:

The study of diffusion theory is potentially valuable to the field of industry for three reasons. First, firms will be better able to explain, predict and account for the factors that impede or facilitate the diffusion of their products by better understanding the multitude of factors that influence adoption of new technology. Second, new technology is inherently an innovation based discipline. Many of the product produced by instructional technologists represent radical innovations in the form, organization, sequence, and delivery of instruction. An industrialist who understands the innovation process and theories of diffusion will be more fully prepared to work effectively with clients and potential adopters (Schiffman 1991). Third, the study of diffusion theory could lead to the development of a systematic, prescriptive model of adoption and diffusion. A systematic model of diffusion could help to guide the
process of adoption and diffusion in a similar manner and perhaps with similarly effective results.

The most important fact to consider in discussing diffusion theory is that it is not one, well defined, unified and comprehensive theory. A large number of theories, from a wide variety of disciplines, each focusing on a different element of the innovation process, combine to create a Meta theory of diffusion.

Theories discussed by Rogers are among the most widely used theories of diffusion, namely (a) Innovation Decision Process (b) Individual Innovativeness (c) Rate of Adoption and (d) Perceive Attributes.

(a) Innovation Decision Process:

The Innovation Decision Process theory states that diffusion is a process that occurs over time and can be seen as having five distinct stages. The stages in the process are knowledge, persuasion, decision, implementation, and confirmation. According to this theory, potential
adopters of an innovation must learn about the innovation, be persuaded as to the merits of the innovation, decide to adopt, implement the innovation, and confirm (reaffirm or reject) the decision to adopt the innovation.

(b) **Individual Innovativeness:**

The individual innovativeness theory states individuals who are predisposed to being innovative will adopt an innovation earlier than those who are less predisposed. Figure 2.1 shows the bell shaped distribution of individual innovativeness and the percentage of potential adapters theorized to fall into each category. On one extreme of the distribution are the innovators. Innovators are the risk takers and pioneers who adopt an innovation very early in the diffusion process. On the other extreme are the laggards who resist adopting an innovation until rather late in the diffusion process, if ever.
(c) Rate of Adoption:

The third widely used diffusion theory discussed by Rogers is the theory of Rate of Adoption.

**Figure: 2.1** Bell shaped curve showing categories of individual innovativeness and percentages within each category

**Figure: 2.2** S-curve representing rate of adoption of an innovation over time
Rate of Adoption theory states that innovations are diffused over time in a pattern that resembles an s-shaped curve. Rate of adoption theorizes that an innovation goes through a period of slow, gradual growth before experiencing a period of relatively dramatic and rapid growth. An example of how rate of adoption might typically be represented by an s-curve is shown in Figure 2.2. The theory also states that following the period of rapid growth, the innovation's rate of adoption will gradually stabilize and eventually decline.

(d) Perceive Attributes:

The Theory of perceived attributes states that potential adopters judge an innovation based on their perceptions in regard to five attributes of the innovation. These attributes are: trialability; observability; relative advantage; complexity; and compatibility. The theory holds that an innovation will experience an increased rate of diffusion if potential adopters perceive that the innovation: 1) can be tried on a limited basis before adoption; 2) offers observable results; 3) has an advantage relative
to other innovations (or the status quo); 4) is not overly complex; and 5) is compatible with existing practices and values. The Theory of perceived attributes has been used as the theoretical basis for several studies relevant to the field of instructional technology. Perceptions of compatibility, complexity, and relative advantage have been found to play a significant role in several IT-related adoption studies.

However the oldest and most influential four theories of technology diffusion have been explored by Paul Stoneman which have been discussed in this chapter, namely

1. Epidemic Models
2. Rank Models
3. Stock Models
4. Order Models

1. Epidemic Models:

According to this theory, initially, potential adopters have little or no information about the new technology and are therefore unable or disinclined to adopt it. At the start of the diffusion process there will be a
given number of users of the new technology. Users and non users mix socially and make contact over time.

In this simplest form the approach assumes that on making contact with a user of the technology a non-user becomes a user. Thus, when a non user meets a user the non-user also becomes a user. Over time the number of users increases and with constant mixing of the population there is a greater chance of a non user meeting a user and becoming a user. However, over time, the number of non-users will decrease and thus the number that can convert to become users will decline. The growth in the number of users over time resulting from an increasing probability of contact and a declining numbers of non users will generally map out an S-shaped curve over time of the number of users as a proportion of the total number of potential adopters.

This model can be mathematically expressed as follows:

Let the number of potential adopters be ‘N’ and the number of adopters at time ‘t’ be (mt). Allow that contact between a user and non user is linearly related to the proportion of users in the population of
potential adopters, such that in a period individuals will make contact with ‘δM (t)/N’ users of the technology. Letting ‘γ’ be the probability that contact will lead to adoption, the addition to the number of users in time ‘t’ is given by

\[ \frac{dM(t)}{dt} = \delta. \frac{M(t)}{N}. \{N - M(t)\} \] ..........................(a)

where \( \delta = \delta. \) (the probability of effective contact). Equation (a) is a first order differential equation which can be solved as

\[ M(t) = N/(1 + \exp\{-\{t - \delta t\} \}) \] ..........................(b)

which is the standard expression for a logistic curve. In (b) the value of ‘\( \delta \)’ defines the starting date of the diffusion process, N determines the end level of use and \( \delta \), commonly referred to as the diffusion speed per se, determines the speed of approach to the end point. The logistic curve is symmetric in that the growth rate of the number of users starts low, then increases up to a point of inflection at 0.5 N, after which it slows to approach zero asymptotically at N.

This formulation illustrates two main points about the epidemic model. First, in the epidemic model the diffusion process is self-perpetuating. Use of the technology, through the contact between users
and non-users leads to further use. The process is thus self-propagating and once started will only finish when all potential users have the technology.

Second, this is a disequilibrium model. In this model the equilibrium level of the users is $N$. Along the diffusion path, therefore, the actual level of use is always less than the equilibrium level of use. The diffusion path is in fact the path of adjustment from an initial disequilibrium point of the equilibrium or end point. The speed of adjustment is determined by the frequency of personal contact and the amount of contact required to switch a non-user to being a user. (Stoneman 2002).

The epidemic model has been subjected to many criticisms over years. These may be classified into ‘sins of commission’ and ‘sins of omission’. The sins of commission largely relate to the modeling of the process of interpersonal contact. This process assumes that the population of potential adopters is homogeneous and unitary. Of there are non
mixing subgroups in the population the information spreading may stop before diffusion is complete.

In terms of sins of omission there are many criticisms. The model as constructed assumes that interpersonal contact is the only source of information. Clearly this is very limiting. Such other source, especially advertising by suppliers, may be an important source of information about a technology. In the literature on technology transfer there is also considerable emphasis on how knowledge is embodied in individuals and as individuals transfer from one firm to another so information spreads.

There is no explicit theory of technique choice. If there are informationexternalities as illustrated in the epidemic model, then a rational theory of technique choice would indicate that potential buyers would rather wait until others have purchased before purchasing themselves. Such considerations do not appear in the epidemic theory (Kapur 1995).
There is no explicit consideration as to the factors that determine the number of potential adopters. As a result the number of potential adopters, \( N \) is usually taken as predetermined and fixed (Chow 1967).

However, one might instead note that the core of the epidemic model that information and self propagating information spreading processes may have some role to play in the diffusion process, should not be discarded completely. Although one may well wish to model these things in a different way this basic insight is a useful one.

One might even argue that the epidemic approach may be quite appropriate to the diffusion of a short lived technology that is diffused very quickly, say a fashion. It seems unlikely. However, that it is going to provide a full explanation of the long term diffusion of an important industrial technology.

The following section therefore consider alternative modeling frameworks. These frameworks differ from the epidemic approach in a
number of ways. The various models discussed further are largely differ in terms of how the benefits from adoption are determined.

2. Rank Models:

Rank models are premised on the idea that heterogeneity among firms explains observed diffusion patterns. An individual considering acquisition of the technology will compare gross benefit against the cost of acquisition, so that different members of the population would get different benefits if they acquired the technology. Any theory of technique choice will predict that the acquirer will buy the technology if the gross benefit is greater than the cost.

To produce increasing use of technology levels it is necessary that the cost of acquisition falls and/or the benefits increase over time. If the cost of acquisition rises over time then the level of use may fall. Thus the speed of diffusion will depend upon both the rate of change of benefits and costs. We may also note that, if all users have the same cost of acquisition at a point in time, then the early users of the technology are the ones that would get the greatest gross benefit from its use whereas the
later users are the ones that get the least gross benefit. One may also note that, different technologies or the same technologies in different populations will show different diffusion curves if the benefit distribution are different or the time path of acquisition costs is different. Consider now why the gross benefits of adoption may differ across firms. In general the reason is that firms are different with regard to some critical variable that affects the net return on adoption of the new technology and thus will be able to get different profit gains from a technology.

Different variables that might affect the returns from adoption would be as follows.

1. Location: Some geographical sites are preferred to others and may suit certain technologies better than others for example, for water power, sites with fast flowing streams are preferred. In addition factor prices for inputs say wage rates may differ across locations.

2. Previous Investment: Some firms may have older existing technology, some may have newer. The potential gain from the latest technology may be less for those who have only recently
changed technology than for those with much older capital
equipment. Some firms may also have technologically
complementary technologies in place that enable them to better
exploit the new. Some firms may have experience in the new
technology others may not (Salter 1960).

3. Other Inputs: Some firms may have better management than others
and are able to work the new technology more productively. Other
inputs into the firm (such as skilled labour) may also be better. Firms
that do research and development and acquire much information
may be better able to use new technology (Cohen and Levinthal
1989).

4. Market Factors: Some firms may be operating on buoyant or
growing markets some may be operating on declining markets. The
former are likely to generate greater returns.

5. Organizational Factors: Some firms may be more bureaucratic than
others. Some may have a more appropriate organizational form.
6. Expectations: The concept of ‘annual profit gains’ is forward looking and as such firms with buoyant expectation may see larger profit gains than firms with pessimistic expectation. Similarly, as the annual expected profit gain will depend on the performance of the technology at the date it is installed, firms may have different estimates of the expected profit gains to be realized from installation at different dates depending on their views of how the technology will improve.

The firms are heterogeneous across these variables, they may be ‘ranked’ according to their net return on adoption. For some firms the net return on adoption will be negative. Over time, however, the net return on adoption rises for all or some firms, so that more and more firms chose to adopt. The net return on adoption is hypothesized to increase over time for any number of reasons including:

i) External Economies of Scale: Production costs may fall as a result of, among other things, the growth of pools of trained labor and upstream suppliers that complement the new technology.
ii) Learning by doing: Adopters refine and perfect the new technology.

iii) Fall Search cost: The costs of acquiring information about the new technology and uncertainty about it fall over time.

iv) Depreciation of Existing capital.

However in the literature one factor stands out as of major importance that is firm size. It is usually considered that larger size yields greater returns. There are two potential concepts of size that are relevant. The first is size immediately prior to adoption of the technology and the second is size after the adoption of the technology, it being possible that by adopting the new technology the firm takes market share from its rivals and becomes larger. However, this particular modeling approach rules out any feedback from adoption by the firm on its own characteristics and thus profit gains and as such only size at the rate of adoption is considered.

Product Differentiation:

Technology is available in many different forms, that is for product differentiation. For example, with household technologies there may be
washing machines available with different spin speeds, different load capacities, with and without dryers and so on. For the firm at a moment in time there may be computers with many different configurations available. This factor explains how such differentiation is going to impact on the diffusion path. Economics distinguishes two types of product differentiation (Ireland N. 1987) (a) Horizontal product differentiation (b) Vertical product differentiation.

(a) Horizontal Product differentiation:

In a heterogeneous population two products are considered horizontally differentiated if at a common price some buyers prefer one variant whereas other buyers prefer the other variant. The different preferences may reflect characteristics for firms. Assume that each buyer places the same value upon a product as every other buyer when that product exactly matches his own preferences or requirements. However, as different buyers have different preferences or requirements different product variants are valued differently by different buyers.
At this stage it is useful to consider an analogy. Think of potential buyers of a uniform type of ice cream who are equidistantly placed around a lake as shown in the figure below.

**Figure: 2.3**

*Horizontal Product Differentiation*

Each has the same implicit valuation of ice cream but the further they are from a supplier the greater is the distance to be traveled to acquire and ice-cream. The full cost of buying an ice cream is thus the purchase price plus the travel cost. The analogy is that potential purchasers of a new technology consider the cost of buying a particular
variant upon the market as the price to be paid plus the valuation of the extent to which the variant does not completely meet their needs. Alternatively one might think that buyers of a technology will adopt that technology to meet their needs. The costs of adoption would be equivalent to the travel costs. Let a single product variant be available upon the market in location A (Figure 2.3) at a price $p(t)$.

At this time price some potential buyers (in the arc BAC) who have preferences or requirements close to those of the variant on offer will buy the technology. As the price falls those with preferences less close to the model variant (in the arc DAE) will also become buyers in a manner similar to that considered above. Let there now be two product variants upon the market located at A and F both offered at price $p(t)$. At this price number of buyers will be double that when there was only one variant, for those buyers with preferences or requirements around F (in the arc GFH) will find that the total cost of purchase ($p(t)$ plus travel cost) is less than when only A was on the market. Clearly it is not only the price of technology that affects the demand for the technology but
also the extent to which the technologies available match preferences or requirements.

It can be thus be argued that if there are many differentiated products on the market there is likely to be a higher demand for the technology. Also, if diffusion process, more differentiated variants of the product are launched this differentiation is likely to advance the extent of use of the technology.

(b) Vertical Product Differentiation:

Two products are considered vertically differentiated in a heterogeneous population if all members of the population have the same quality ordering for these products. In many ways the modeling above has assumed that overtime as technology improves it improves in a vertically differentiated way. This year’s technology is considered by all to offer higher quality than last year’s technology. However, one can use the concept of vertical product differentiation to illustrate further. If two vertically differentiated products are available on the market it will be
agreed that one is of higher quality than the other. The high quality one will be of higher price than the low quality. Potential purchasers may have different incomes or preferences that cause some to demand the high quality product and some the low quality product. If only the high quality product, say, were on the market, some purchasers may not demand that product because of preferences or too low income. The addition of the low quality product increases the demand for the product class in total. One can see again that the more quality variants on the market the greater is the demand. Diffusion will extend if over time more differentiated products are being placed on the market.

By way of an example one might think of firms buying computers. If the only machines available were very expensive, large and of military quality only large firms with considerable resource or vital computing need would acquire them. However, if smaller, cheaper lower quality machines were to become available, other firms may well acquire such machines and as such the usage of the technology will extend. The point is that the lower quality machine need not offer a lower quality adjusted
price, it may have a higher quality adjusted price. It is that the lower quality machine is more suited to the needs and preferences of different buyers.

Rank model is built upon rational profit maximizing or utility maximizing behaviour. It includes an explicit theory of technique choice. The model is not self-propagating. Instead, it is a model in which at each point in time there is an equilibrium number of owners of new technology, that equilibrium is assumed to be established at each date, but over time exogenous factors change this equilibrium number and trace out the diffusion path.

The analysis above has shown that factors that impinge on the diffusion path are firm characteristics widely defined to include size, location, history and so on, price, technology and market expectations, the number of products variants on the market.

The diffusion process would impact in two ways on the rank model. First, as the benefits that the firm will obtain from new
technology may well depend upon its output levels, such benefits will be related to output levels after adoption. Secondly, the firms output level will be dependent on the adoption behaviour of other firms. In determining the gain from adoption the relevant comparison therefore is necessary between the firms profits having adopted new technology and the firms profits without the new technology.

Rank model hypothesize, if a firm is operating in an industry when other firms are adopting the new technology and it is not, that firms profits may well be falling over time rather than staying at a constant level.

3. Stock Models:

Stock models are premised on the idea that the net return on adoption for any firm depends on the total stock of firms that have adopted with the net return on adoption declining as the stocks increases. Stock effects are hypothesized to arise when the adoption of a new technology by a subset of firms in the industry lowers their average
production costs to such an extent that output prices fall. Lower output prices in turn, reduce the net return on adoption.

When a firm installs a new process technology one might expect that technology to impact on its costs. That reduction in costs may lead to a change in the price charged for its products and thus in its output levels and also the output levels of other firms in the industry.

Three variety of modeling approaches have been developed in this case:

a. **The Reinganum Model:**

Reinganum model assumes that prior to initiation of the diffusion process all firms are the same in terms of output, characteristics and costs and that all firms have perfect information regarding the technology (Reinganum 1981). Reinganum approach explains how the new technology reduces the costs of the firm with the help of following diagram.
In the above figure DD is the industry demand curve and SS is the industry supply curve. Industry price will be established at $p(t)$ in time $t$ where demand and supply intersect. As firms in the industry adopt the new technology and generate lower costs the industry supply curve will shift downwards. Thus the position of the supply curve is dependent on the extent use of the technology in time $t$, $M(t)$ increases the industry price will fall. This change in industry price with increasing use is the key to understanding the stock model.
b. **Schumpeter Model:**

The stock model of diffusion has many parallels to the seminal discussion of diffusion by Schumpeter (1984). According to Schumpeter, an entrepreneur observes a profitable opportunity for the use of new technology and pursues this opportunity by innovating. The innovation leads the entrepreneur to generate excess or entrepreneurial profits. These profits then act as a signal to other potential users of the technology who follow the lead of the entrepreneur in the search for profit gain.

However, as the new technology is used more widely and output expands in the industry there is an increasing demand for inputs in limited supply. The price of such inputs increases reducing the profit of users and also non-users. The increased prices may then cause non-users to leave the market of find the switch to the new technology more attractive.

c. **The Evolutionary School Model:**

Main characteristics of evolutionary approach are a rejection of full information, perfect competition models in which economic actors
are rational maximizing agents. Instead the emphasis is upon satisfying behaviour, limited information and bounded rationality. The evolutionary approach particularly emphasize that firm size are endogenous to the diffusion process. But through the firm size change, diffusion may have its dynamic and thus reflect more of the self generating nature.

In the evolutionary approach, at any moment in time there is assumed to be a number of potential production technologies that the firm may use. Some firms will pick good, profitable technologies, other firms will pick unsuitable, unprofitable technologies and yet other firms will not invest at all. Those firms that pick the good technologies will realize profit gains relative to other firms. The crucial variant that the evolutionary approach adds that realized profit is considered to be a major determinant of investment spending.

Thus, those firms that have picked the good technologies will now go on to invest more than other firms because they have higher profits. They will thus grow at the expense of other firms. Assuming that they invest in the same new technologies, the good technology will spread
across the industry as the users of that technology grow at the expense of
the non users or users of other technologies.

Thus, diffusion in the industry proceeds. Clearly the cost of
acquisition of the technology will play a role in all this but the crucial
addition is that adoption leads to profit, profit leads to more adoption.
Therefore, in this evolutionary approach the diffusion process has its own
dynamic just as seen in the epidemic model.

4 Order Models:

Order models are premised on the idea that the order in which
firms adopt the new technology determines the net return that they obtain
from it, with earlier adopters obtaining higher net returns.

Fundenberg and Tirole (1985) have suggested that early adoption
of a technology, that is being a first user may generate higher profits for
the whole lifetime of the ownership of the new technology. Instead of it
being the case that all users at a point in time get the same gross returns
from a technology, it might be that those users who adopt first, because they were first, get higher annual profits than those who adopt later.

The order effect arises from the existence of a fixed critical input into production such skilled labor for software developers or access to prime drilling sites for petroleum explorers (Ireland and Stoneman 1985). Because of this order effect, initially it will only be profitable for a limited number of firms to adopt. However, over time, the net return on adoption increases so that eventually more and more firms adopt.

The simple way to understand this model approach is to consider that the net present value of adopting a new technology is related to the number of other users at the date of adoption. The greater are the number of other users at the date of adoption the lower will be the present value of adoption. At any moment in time, therefore, given the cost of acquiring the technology, it will only be profitable for firms down to some point in the adoption order to acquire the new technology.
Once that number is established there will be no more adopting until either the technology changes or improves or the cost of acquisition falls. As such changes occur the diffusion path will be mapped out.

In many ways this is similar to the stock and rank models with it being profitable for only a limited number of firms to adopt at a given acquisition cost. However, whereas the rank model produces this result by relying on differences across firms and the stock models rely on increased usage reducing annual profit gains, in this approach it is reduction in gains with movement down the order of adoption that generates the result.

Thus, order model hypothesize that firms adopt at different times because the net return on adoption is negative for firms that are slow to adopt relative to their rivals. However over time the net return on adoption rises so that more and more firms adopt. Further more, order model imply that innovations diffuse at different speeds because of for some technologies the order effect is stronger than for others for example the trained labour is smaller for some technologies than for
others or because for some technologies the net return on adoption increases faster over time than for other technologies.

2.2 Summary:

In this chapter a number of different theoretical modeling frameworks used in the literature on technological diffusion have been explored. The epidemic models emphasize how information spreading and success generates the diffusion path. The rank model, on the other hand emphasize that firm are different and therefore will have different preferred adoption dates. The stock model emphasized how the profitability of adoption is determined by the number of other users and thus for a given cost of acquisition only some firms will find adoption profitable. The order approach emphasizes that the position in the order of adoption matters and for any given cost of acquisition only firms down to some point in that order will find adoption profitable. Whereas the other models emphasize that the diffusion of new technology occurs because the technology, its costs and the benefits it generates will be
changing over time. Diffusion may stop if the technology does not continue to improve or get cheaper.

The various competing theories, which yields the best explanation of diffusion phenomena. Unfortunately, most of the literature applies single models to single examples and very rarely is model performance compared. Thus, in general one is unable to say that the rank approach works better than the stock approach or that the epidemic model better explains diffusion than an order model. There is much literature that shows that model A or model B can be successfully applied to a particular example but not that model A is better than model B in explaining this example (Stoneman 2002).

Nevertheless, in many, if not most, respects, these models are not inconsistent with each other. There is no reason why diffusion of a given technology could not be influenced by some combination of epidemic, rank, order and stock effects. In fact, this likely to be the case in the real world (though in certain circumstances one type of effect may dominate). Thus, the most accurate, though perhaps unsatisfying conclusion to this
section on theory is that a broad range of factors are likely to affect technology diffusion.

2.3 Conceptual Base:

A review of the existing literature on the subject shows several major gaps in the existing diffusion literature, specially related to diffusion of industrial technology in developing economies.

Research on diffusion and adoption of new technology by individuals and organizations has grown with the realization of its importance and perception as a critical link in the utilization of technology. It has been found that in many cases the time lag between a commercially viable innovation and its first application has been almost a decade. After that it can take another decade for more for the diffusion process to reach saturation level. Thus for many years the potential benefits of the innovation are not available to society.

Another important reason for the study of the diffusion process in particular is that while there are other intermediate stages between basic
research and productive application of technology for economic benefit. The final stage of diffusion is most amenable to social control.

Many of the critical barriers slowing down the diffusion process are a result of inadequacies of technical infrastructure, social organization, communication network, marketing organization and capital market. While the important for successful diffusion are more responsive to suitably implemented policies.

It is for these reasons, this research focus the present study on the process of diffusion of operative information technology. At this point it will be appropriate to define more precisely some of the terms such as technology, invention, innovation, transfer of technology and diffusion.

**Technology:**

The concept of technology we use is a broad one. It has two parts. The first consists of all kinds of tools, machines, vehicles and buildings. The second part comprises all kinds of knowledge required for the use, maintenance, repair, and production of the first part. We refer to the two
parts respectively as equipment and technological knowledge. Equipment is also denoted by the term ‘hardware’ and technological knowledge by ‘software’. In this turn, technological knowledge is often split into two types, the knowledge of how to do things (know-how) and the knowledge of why certain things have to be done in certain ways (know-why) (Bhagavan 1990).

Invention:

Usher (1955) defines invention in terms of the emergence of ‘new things’, which require ‘act of insight’ going beyond the normal exercise of technical or professional skill.

Innovation:

The innovation process involves both creating new knowledge and drawing on the knowledge pool to generate new products and process. Actually introducing the invention to the market for the first time is called innovation.
Invention & Innovation Distinction:

The distinction in an economic sense between invention and the development process underlying innovation is best summarized in the difference between the two words ‘predictability’ and ‘describability’. Basic invention is truly unpredictable; even the most competent scientist cannot predict when or how it will come, let alone what the solution will resemble. On the other hand, he or she knows in appraising the detailed problems of development that an answer will be obtained and can only not describe what the answer will be. (Scherer F.M. 1984).

Technology Change:

Technology Change amounts to ‘setting up of a new production function’. Production functions stress the crucial role of the state of technology in input-output relationship. With a given state of technology, the obtainable outputs from available inputs have an upper limit. Therefore, technological change is a means to raise the output. All such changes—in physical conditions, managerial know-how, labour skills, etc.
which help in multiplying the outcome of efforts are collectively expressed as technological change.

**Diffusion:**

Diffusion is the process by which new technologies spread across their potential markets over time. It represents the process through which the innovation in technology is made available to potential users and is adopted by them with suitable adoptions as necessary.

**Technology Transfer:**

Transfer of technology may be broadly interpreted to include all items relating to a firm's knowledge of a certain product or process that are passed from that firm to other enterprises, from one country to the other. An accepted meaning for the technology transfer indicates that it is the transfer of the ability to produce an item or a part of the item. The basic structures used in technology transfer are licensing agreements, turn-key arrangements, co-production agreements, and operation or management contracts.
**Diffusion & Transfer of Technology Distinction:**

A distinction is made here between "Diffusion" and "Transfer" of technology. The term diffusion is used to refer to the flow of information between one donor and one recipient, while the diffusion process can have one or more sources and many sinks, with each sink also capable of acting as a source for further diffusion.