**Chapter Seven**

**Innovation, Technological progress and**

**Performance of A firm**

**8.1 Concepts of Innovation**

Innovation is one of the several strategies through which a firm could change its situation in the market in pursuit of its objectives. It is an instrument, which the firm uses to enhance its competitive power. It provides the basis for greater degree of diversification and growth of the firm.

New products, new methods of production, new market and new form of industrial organizations etc, which are elements of innovation or technological change, make firms and industries to run efficiently over time. Innovation is a common feature in almost every economic system whether capitalistic or socialistic or something else. Science and technology are instruments for rapid progress of a society. An individual wants to be more creative, a firm or a corporation strives for the progressiveness of its business and a government works for collective security and welfare of masses. Innovation is an important weapon for all of these.

**8.2 Process of Innovation**

To understand the process of innovation in a clear perspective, we have to define its terminology first.

**Invention:** Is creation of new technology By ‘technology’ we mean “ any tool or technique, any product or process, any physical equipment or method of doing or making, by which human capability is extended. It is an intellectual act which involves a perception of a new image, of a new connection between old conditions, or of a new area for action.

**Innovation:** Is the process of adopting an invention in a practical use It is a multi dimensional concept. If the existing product line is changed by a firm, if a new method is initiated to produce existing products then it is process of innovation. Similarly, one may have innovation in marketing strategy. Organizational practices, financing and any other aspect of business conduct. The entrepreneur or manager that performs the act of innovation is called innovator. He invests resources for innovation and takes risks involved.

**Diffusion:** Is a situation when an innovation is copied by others. We call it diffusion of the innovation. Such diffusion may be rapid or slow depending on the market situation.

The three terms inventions, innovation and imitation are the successive stages of the process of innovation or technological change. Let us examine them in some detail for full understanding.

**The first stage (*Invention*)**: Invention is carried on by individuals or corporate bodies like research institutes, universities, government bureaus and companies. In a broad sense, we may call invention as output of the research industry. If so, an invention will be a goal – oriented activity. A government or corporation will be making invention for solving some social problem or for the sake of extra profits or money.

To achieve goal of invention a series of steps will be taken beginning from the definition of the problem, the alternative routes to its solution and finally output in the form of invention. It is an orderly sequence, a matter of applying conscious intelligence to the solution of the problems. The output of the process may not come during the stipulated time. There may be frustration, delays, failures etc, but the process of invention goes on.

Use of penicillin to kill some bacteria culture, vulcanization of rubber, electrostatic records, some use of radiation, are few examples of such invention which have been developed in the past

**The Second stage *(innovation)***: Is logical extension of inventions when an invention is made, its fruits are made available to the society through innovation. An entrepreneur or corporation comes forward, made the required investment.

As mentioned earlier, innovation may be in product or process of manufacturing or any other activity of the corporation it involves risks and uncertainties. An innovator bears them and it is precisely on this ground that economists justify the existence of excess profit.

**Types of innovation**

**Product innovation:** Its necessity arises when relative price of factors of production change. If labor becomes costly, the firm may think of costly of saving by adoption capital intensive technique and vice-versa. In such case there will no be any R & D expenditure. Further, if technology changes this means a new production function causing a shift of the isoquants. In this situation the need for process innovation is obvious. The input proportions to produce a given level of output will change if there is technological change giving rise to process of innovation.

**Process innovation:** is necessitated because of product change, change in consumer preference and cost of production. If a product is costly for the firm and at the same time its price declines because of unfavorable circumstances, it will be less profitable and hence, is likely to be replaced by a new one.

**The third stage (*Diffusion*)**: The innovation, initiated by an innovator, spreads in the market. The rate of diffusion depends on market structure. If there are rigid patent practices and government assistance in technological progress is negligible, then we expect a low rate of diffusion of the innovation. On the other hand, if technology is freely available, there are no rigid patent practices and investment requirements for the new technology are not alarming, then the rate of diffusion will be fairly high. From social point of view diffusion or spread of innovation is desirable but from an individual firm’s point of view it is not, as the firm would not be able to maintain its gains through innovation when it is imitated by rival firms.

**8.3 Measurement of innovation Activities**

Like any other economic activity we need precise measurements of innovation in order to estimate its extent in reality at firm or industry level, and to establish its behavioral relations quantitatively with its determinants. There is no unique method for this some of the basic measurement are stated as follows:

***statistics of R&D expenditure***

 The absolute or a more proportion of total annual budget of the firm on R & D, the more will be the activities in innovation, particularly at stage of basic research leading to some inventions. This method ignores the significant contribution by an individual or department of the firm which do not come under R & D unit.

**Number of scientists and engineers in the R&D department**

The greater the number of **scientists and engineers** the more will be R & D activities of the firm or research organization. The method has some limitations; as such, does not capture contribution from non – scientists & non engineer, ignore efforts of individuals who are working independently

**Number of patents issued**

The major problem here is to find the basis for determining a major or minor inventions and /or innovations.

It only reflects the side of product invention. It does not take into account changes in process of manufacturing and saving costs arising as result of innovation.

Which measures id the best?

There is nothing much on the basis of which we can discriminate methods. Normally, as found empirically by – Mueller, carter and Williams and Mansfield, what ever goes in to incentive process (i.e. inputs) will be closely corrected with an output ( i.e. patents) of the process. So, if we choose inputs to R & D or number of patents as an index for measuring innovation is not a matter for serious debate on the subject. Both are equally appropriate.

**8.4 The Theory of technological innovation**

An invention without commercial exploitation for personal or social uses can not be viable. Given this proposition of need which backs up inventions, that is, makes them goal oriented, we have to identify the conditions which are conducive or which accelerate the pace of invention and innovation in the economy. Hence, here we will examine determinates of R and D intensity as follows.

***Competi­tive pressure school****:* As we know, perfect competition and monopoly were taken as two extreme contrasting situations to analyze the link between innovational motivation and market power. At present there are two antagonist schools over link between innovational motivation and market power.

***Monopoly profit school****:* argues that in a competitive situation, with its strong tendency for a uniform normal rate of profit, there will be great pressure and hence inducement for making cost – saving innovations. Such pressure diminishes as market power of the firm increases implying that the rate of innovation will be inversely related to the degree of market power. According to them the condition for sustained R & D activities are best provided by the monopoly markets. Through R & D activities a firm gains and acquires monopoly power over its rivals. The firm would like to perpetuate its monopoly power by undertaking innovational activities. Thus, there is a positive relationship between the rate of innovation and the degree of monopoly power as conceived by them.

**Oligopolistic competition:**  As we stated monopoly and perfect competition are the extreme form of market structure. Both of them, because of different reason may not provide significant incentive for innovation. Most of the authors now take an intermediate form of market structures oligopoly; as realistic market setting for effective innovation activities.

Firms in oligopoly market structure may be unable to compete through manipulation in prices. So R & D together with advertisement provide alternative mode of competition. Each will try to have either process or product innovation. Through process innovation the cost of production can be reduced and hence a firm can maintain higher price cost margin. It can keep its innovations secret and protect it through patent right. Because of lower cost of production such firm will be in a position to reduce its product price. In this situation the competitors of the firm will also reduce their price in order to keep the market shares. However, in the absence of innovation the price – cost margin will be lower than of the innovating firm to keep the margin high, they will be forced to cost reduction.

The innovation activities should not confined to cost reduction only these firm may also adopt product innovation, so that there will be all kinds of innovational activities in oligopolistic market structure.

**Scientific and technological bases of industries:** Scientific and technological bases of industries to a great extent determine the threshold levels of R &D expenditures. Science based industries such as aircrafts, chemicals and petroleum, electrical goods and electronics, machinery and vehicle etc are likely to have a higher rate of technological innovation than industries with conservative technology such as textile, sugar, garment manufacturing , furniture etc.

**Price elasticity of demand:** As we know marginal revenue (MR) in terms of elasticity & demand (ed) computed as follows:



Thus, there will be more innovation when price elasticity of demand for the product of the firm or industry is elastic

**Diversification**: The base for this relationship is that a more diversified firm will be in a better position to exploit unexpected research output than the one having a narrow base operation. If the firm contemplates diversification of its operation then it may contemplate simultaneously to have R & D unit for being technologically independent.

**Growth of the firm:** R &D activities are committed intensively where the growth prospects are good and positive profit is likely to be high. However, there may be an upper limit for such positive relationship. During maturity stage the life cycle of the product – with no more growth prospects, R & D activities will be undertaken in search of new product or products to replace the old one. The relationship therefore may not hold true after such stage is reached.

**Expected return**: Greater expected return from R & D investment more will be the current volume of investment, committed to R & D activities. It is undertaken either to increase profit of the firm or stabilize position of the firm in the market.

**8.7 Diffusion of New Technology**

This is an important aspect o the innovation process. A new technology invented by a firm is likely to be less diffusible as its adoption by the rival firms will be restricted through patent right.

 There are some interesting studies on technological diffusion. In this pioneering study Salter examined the diffusion process in USA blast furnaces where the average productivity of plants was only half the best practice technology i.e. that of new plants and it took 15 years for average productivity to reach best practice level. In his study, Salter developed a simple theory of technological diffusion for a competitive industry with static demand and free information about the new technology. The efficiency of the new technology is judged through saving in labor cost of production.

Mansfield used a model of learning process to study the diffusion of new technology in coal mining, iron and steel brewing and rail road industries. The model is based on the hypothesis that the number of firms that will adopt a new process in subsequent period of time, expressed as proportion of all firms not using the process is a linear function of the proportion of firms in the industry.

Factors affecting diffusion of new technology i.e when a technology is developed by government research institute, for common use, the rate of its diffusion or adoptability may be slow or fast depending on certain economic factors which are listed below:-

Reduction in cost of production

Improvement in the quality of output of the technology

Capital requirement

Skill needed

Malleability / case of disposing existing obsolete capital stock

Demand elasticity of the new product

Growth of the market

Size of the firm & structure of the industry

Royalty / license cost

**8.9 Performance of a firm**

**8.9.1 Concept of performance of a firm**

Performance of a firm refers to social efficiency mainly defined by the extent of market power ( Greater market power or low efficiency) the performance of a firm is highly influenced by the structure of the firm that means lower concentration leads to lower market power.

**8.9.2 structure-conduct-performance**

The primary approach of examining market performance relationship has been known as structure – conduct – performance (SCP) paradigm which postulates that certain market attributes such as barriers to entry and market concentration affect company behavior which in turn affect company profitability in the market.

The pioneer of the SCP paradigm is Bain (1956) suggesting that barriers to entry and market concentration are essential to the relationship between industry structure and performance. Barrier to entry involve economies of scale, capital requirements and product differentiation and serve to separate firms in the market from potential entrants. Firms operating in the market with blockade of entry will be able to reap higher profit than firm operating in the market with relatively lower entry cost. Moreover, higher level of concentration makes leading firms more aware of market power and interdependence.

Many attempts have been made to see pattern of relationship between performance, market structure and firm / industry conduct:-

Comanor and Wilson (1967) – product differentiation barrier to entry reflected by extent of advertising Firms already in the market are expected to gain from advertising as against new entrants. Thus, new entrant’s advertising per unit of sale should be higher.

Scherer and Ross (1990) contend that customer loyalty can be built through heavy advertising, making entry by new comers costly and therefore less likely. This indicates that there is positive impact of advertising on profitability.

Generally the effect of market share on profitability is complex. Early studies dealing with firm level data suggested that both market share and concentration are equally important in determining profitability. However, later studies challenged this notion.

Extensive summary of impact of market share on profitability by Feeny and Rogers (1999) in their study of large Austrian firms disclosed that significant positive relationship between market share and profitability which dominate concentration profitability relationship.

Schere and Ross (1990) claimed that concentration profitability affect profitability via market share leading to higher profitability for firms in highly concentrated industries. Raven scraft (1983) stated that consistent negative effect on profitability while market share had positive significance implying that average industry profitability is lower in more concentrated market