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## UNIT 2      PRODUCT SELECTION

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### Objectives

After going through this unit, you should be able to:

- recognise that all outputs of any organisation are services
- appreciate Product Selection as one of the key strategic decisions of any organisation, wherein the organisation attempts to match its production with changes in environment, changes in consumer taste and changes in technology
- learn the concept of producibility and its effect on product selection
- identify the various stages involved in the product selection process
- have a brief idea of the new product mortality curve and the message it conveys about reducing research costs
- know the issues involved in screening a new product idea
- identify the trade offs involved in product design
- understand the impact of product design on process design.

### Structure

- 2.1 Introduction
- 2.2 The Product Selection Process
- 2.3 Selection of the Products
- 2.4 Product Development
- 2.5 Product Design
- 2.6 Summary
- 2.7 Key Words
- 2.8 Self-assessment Exercises
- 2.9 Further Readings

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## 2.1 INTRODUCTION

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We have looked at operations as the process of converting inputs into outputs and thereby adding value to some entity. This concept of value addition is very important for effective management of the operations function. Although the 'conversion' takes place inside the organisation, the addition of value occurs only when it is perceived to have done so by the customers of the product or service in the market place. This concept changes the orientation of an operations manager from totally inward looking to one who is alert to the needs of the customers. As we go on to discuss the strategic decisions in operations management in the next couple of units, this issue will come up again and again and it is not out of place to remind ourselves once more that it is not enough to produce a product or service but it has to be produced so that there is an added value as perceived by the market.

Although we differentiated a product from a service above, this differentiation becomes very hazy and confusing. For example, if we are selling a computer, we are selling a product of course. However, instead of selling the computer if we start leasing it to our customers-what are we selling now-a product or a service? On the other hand, so far as the customer is concerned-he is using the computer exactly in the same manner in both these cases. The difference is only in terms of payment and the legal ownership of the asset. Similarly, even when the computer is sold outright, we are also selling after-sales service and other customer support services along with the computer. Thus, we start seeing that so far as the customer is concerned he is only buying some benefits in all these cases and these benefits are services. Services are bundles of benefits, some of which may be tangible and others intangible, and they may be accompanied by a facilitating good or goods. If there are no accompanying facilitating goods, e.g. getting a haircut, we will refer to these services as pure services.



All outputs of an organisation are services and in this unit we would take a deeper look at output selection: Thus, although we have titled the unit as product selection we would like to pursue it as output selection keeping in view the service nature of any organisation that we presented above. In what follows, the term product is thus used in its generic sense and is meant to include services.

### **A Strategic Decision**

Product selection is a strategic decision for any organisation. Such decisions are long term decisions and the organisation commits itself to the product/products selected for a long time to come. What products to produce-in what form and with what features-is very important because many other decisions-for example, the technology used, the capacity of the productive system, the location of the production facilities, the organisation of the production function, the planning and control systems, etc. are dependent on this. The competitiveness and profitability of a firm depend in part on the design and quality of the products and services that it produces, and on the cost of production. The design of a product or service may make it expensive to produce and a change in design may make it possible to produce the same in a less expensive way. Similarly, one design of a product or service may require large and expensive additions to capacity of some process whereas a change in design may make it possible to produce the same with existing capacity.

Product selection is a strategic decision, thereby involves other functional areas like marketing, research and development and as well also the top management therein. The operations management function provides vital inputs regarding the production of the product or service in these decisions making.

### **Producibility**

The product selection process is a highly integrative process. Thus product function, cost, quality and reliability are some of the inputs to this decision. The producibility of a product/service measures the ease and the speed with which the output can be produced.

The specialised equipment, specialised skills and specialised toolings, facilitate in switching production from one product to another etc. and are thus important factors to assess producibility. It is also important to look at the complete range of products produced because a new product may either use the capacity of processes/sub-processes already established or may require the establishment of capacity of some processes/sub-processes. A family of-similar products is much simpler to produce than a family of dissimilar products.

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## **2.2 THE PRODUCT SELECTION PROCESS**

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Product selection is an ongoing process in any organisation. In fact, as the environment changes, as new technology is developed and as new tastes are formed, the product should benefit from these developments; otherwise what is perceived to have added value today may not be perceived as such tomorrow. For example, jute has been in use as a packing medium for a long time. However, with changes in technology and consumer taste, the same product is no more perceived to have added value and therefore, its demand has reduced.

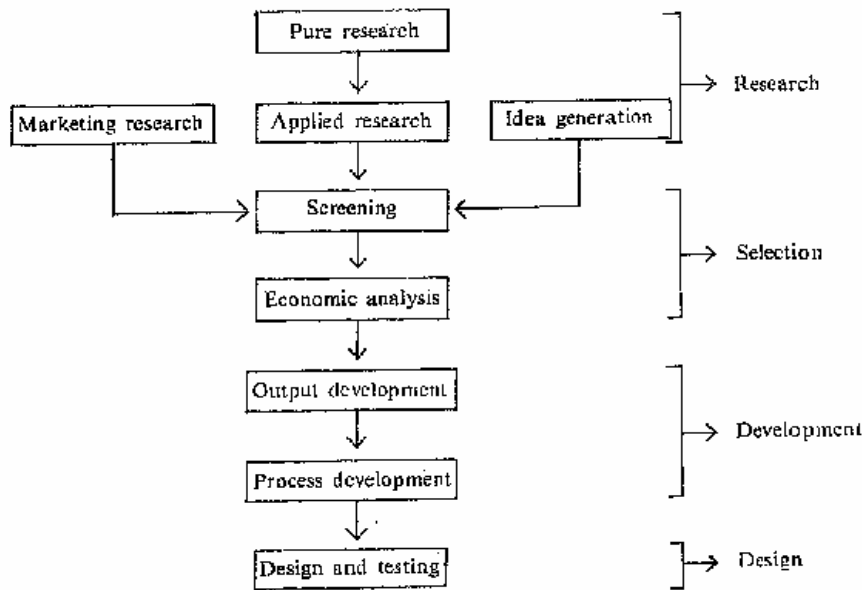
### **Product Selection Stages**

The process of creating, selecting, developing and designing the output of an organisation is shown in Figure I. We will follow the same sequence in our discussion as well. Output possibilities are generated from many sources:

- a) From the field itself through market research. This can take the form of consumer surveys, dealer surveys, opinion polls etc.
- b) From research laboratories. This can be due to a breakthrough achieved by pure research or applied research in developing new knowledge.
- c) From conscious and formalised attempts to generate new ideas for products or services. These ideas can be generated by using techniques like brainstorming, panel discussions, scenario building, technology forecasting etc.



Figure I : Stages of Bringing A New Output to Market



Source : Adapted from Meredith & Gibbs, 1984, *The Management of Operations*, John Wiley, New York, p. 55.

The output ideas thus generated are then screened where their match with corporate objectives and policies is studied and their market viability is established. A detailed economic analysis is then performed to determine the probable profitability of the product or service. For non-profit organisations, this takes the form of a cost-benefit analysis. This is followed by development of the product or service from a concept to a tangible entity and finally by design and testing.

### No Smooth Sequence

Although Figure I depicts product selection as a sequential process where one stage follows another, in reality, the process may not be so smooth as shown. Thus, economic analysis may have to be done after output development if reliable cost estimates are not available at the earlier stage. Similarly, new product features may be added at any of the above stages, thereby initiating a whole new cycle. Finally, as product selection is an ongoing process, there is no finality to the process since as some new product ideas are being processed, still new ideas enter the output selection process and this may go on and on. The product selection process therefore ensures a continuous match between what is demanded and what is produced.

In some cases, the production process has also to be designed along with the product or service. This has to be done, for example, when the market viability of the product depends on low cost and so the production process has to be decided along with the product design. Or take the case of another product where it is felt imperative to obtain a large market share right from the initial launch. It may become necessary to establish a large capacity for the production process right from the beginning. The production process has to be designed along with the product in such a case.

### New-Idea Mortality Curve

The previous section highlighted the fact that an output possibility has to cross several hurdles before it enters the market as a commercial product or service. The new idea mortality curve presents the same in a graphical manner. Figure II shows the mortality curve for a hypothetical group of fifty chemical product-ideas. Although the product ideas are hypothetical, still the stage-wise mortality as well as the time frame shown is quite indicative. Figure II assumes that after three years of research, fifty potential chemical product-ideas are available for consideration. Initial screening reduces this number to about half and after economic analysis, by the end of year four, the number of potential products decreases to nine. The mortality of ideas continues over time and by the end of five-and-a-half years, at the completion of the



**Cost of New Product Ideas**

The new idea mortality curve also points to another fact by implication. The cost of pursuing different new product ideas till their abandonment is also to be borne by the few successful products. This significantly increases the cost of new product development and justifies the rationale of collaborative research. The research and development for a product is carried out at one place and later on the knowledge gained is made available to the collaborating organisations, which are then free to make independent product developments of their own. A similar concept holds for our industrial research institutions in the government sector. For example, in the early stages of development of the television industry in India, Central Electronic Engineering Research Institute, Pilani (CEERI) developed an indigenous design of a black and white television set and made it available to television manufacturing organisations for a fee.

**Activity B**

Generate at least three new output ideas for your organisation.

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**2.3 SELECTION OF THE PRODUCTS**

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At the research stage, the priority should be generation of new ideas. In fact, it is better not to start the screening process till a reasonable opportunity has been provided to generate all new ideas. This is because different thought processes are required for generation of new ideas and for a rational analysis of the same. Consideration of one new idea may generate a better idea whereas an evaluative analysis introduced early in the process may hamper the creative process of idea generation. Some techniques for idea generation, for example, brainstorming, explicitly prohibit any analysis or criticism (based on analysis) of suggested ideas at the idea generation stage.

Once a number of potential new product or service ideas have been generated, the process of screening them to evaluate and select the 'best' idea is set in motion. This can perhaps be discussed in two phases—a qualitative phase where the new product idea is studied in terms of its match with the corporate objectives and the corporate strategies of the organisation. The second phase is more quantitative in the sense that potential costs and revenues (or benefits) generated by new product are quantified and an economic analysis is performed to establish the economic viability of the new product or service idea.

**Screening**

The new product or service idea is assessed to establish its market viability as well as to find out if it is in the larger corporate interest of the organisation to add this new product or service to the current outputs of the organisation.

A product or service has to have sufficient demand or else it may not make much sense to produce it at all. Of course; what is considered sufficient by one organisation may be considered to be grossly insufficient by another. Also the demand for a product or service is dynamic and although the current demand for a product or service may be assessed to be low, an organisation may still decide to



retain the new output idea for further analysis if it assesses that the demand will grow in future. For example, vacuum cleaners are still in the introduction phase of their product life-cycle in India and an organisation may select this as its product if it assesses that sales will grow in the near future.

**Activity C**

Identify some products of your organisation which are in the growth stage. What are the criteria followed in your organisation to decide about new product/service introductions.

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Each organisation has some corporate strengths and weaknesses. New product or service ideas should capitalise on the strengths and should attempt to reduce the weaknesses to the extent possible. On the other hand, if one of the determinants of success for a new product or service idea is already perceived to be a corporate weakness, such a product or service does not have a good 'fit' with the strength and weakness profile of the organisation. For example, if strung design capability is identified as a corporate strength of an organisation then adding heat exchangers to its list of products-which have to be custom designed and built is trying to exploit a corporate strength. On the other hand, another organisation which has identified design capability as one of its weaknesses would perhaps select centrifuges which are standard products and offered off-the-shelf,

It is important to realise that strengths and weaknesses are relative and also perceptive. The same feature can be perceived to be a strength by one organisation and as weakness by another. For example, low investment in capital assets can be considered to be a strength since this gives the organisation greater flexibility in product selection and adjusting to changes in demand whereas the same can be perceived to be a weakness when capacity cannot be hired from outside or the quality . of jobs got done from outside is unsatisfactory. What is important is to ensure that .there is a close match between the strengths and weaknesses of the organisation and the requirements for the product or service to succeed.

In product selection, many organisations try to get synergistic results by exploiting one or more of the following four factors:

- i) Familiarity with similar products or services
- ii) Familiarity with the same or similar production or transformation process to produce the product
- iii) Familiarity with the same or similar markets or market segments
- iv) Familiarity with the same or similar distribution channels.

Thus, it is perhaps natural for a firm manufacturing ceiling fans to include heat convectors in its product list, wherein it can benefit from its familiarity with similar production process, similar market segments and even the same distribution channel. On top of it, it can also reduce its weakness of having a highly seasonal capacity utilisation.

The above discussion also highlights the fact that any new idea for a product or service has also to be seen in relation to the effect on the existing products or services. A new product may find a market for itself by cannibalising one of the existing products. A new brand of a biscuit may create its market by a corresponding reduction in demand of another brand from the same firm unless the two are carefully targeted at different segments.



We have referred to the strengths and weaknesses of an organisation as relative, but relative to what? Of course, relative to the competition. If there is no competition, which is very unlikely; there is no need to match the product requirements with the relative strengths of an organisation. For totally new products or services, even if there is no competition presently, very soon competition will perhaps develop and it is the desire to remain ahead of the competition that provides the motivation for continuous inflow of new product ideas. Whatever be the relative strengths and weaknesses of any organisation, it is very unlikely that an organisation can be successful if its strengths are only in marketing, finance and other non-operational areas. In fact for long, term success, it is almost imperative that sound operations management is one of the strengths of the organisation.

Sometimes a new product or service idea having very poor match with the existing strengths and weaknesses of the organisation is consciously adopted. This can happen if the organisation feels that the existing products or services have reached the decline phase of their product life-cycles either on their own or due to some changes in the environment e.g. government policy, introduction of better and cheaper substitutes, changes in prices of some inputs etc. For example, when ITC Ltd. decided to diversify into hotels, this new service idea did not exploit any of the four familiarity factors which could have given some synergistic results.

### **Economic Analysis**

An economic viability of a new product or service idea ties up most of the concepts that we have talked so far in quantitative terms to the extent possible. What this means is that the economic value of the returns must exceed the economic value of the costs incurred to produce the output. For commercial organisations, the measurement of the returns and costs is relatively straightforward and economic analysis in a way becomes synonymous with profitability analysis. The cash flows generated as well as consumed, if the new product or service idea is implemented, have to be estimated for the life of the project. However, since there is a time value of money these cash flows cannot be directly added or subtracted. So, the cash flows are discounted to take care of the time value of money and the net present value of all cash flows is obtained-or else the cash flows are used to find an internal rate of return. The details of how to discount cash flows are discussed in the course **MS-4**.

### **Non-Profit Organisations**

For non-profit organisations, there may not be a cash inflow at all, or else the cash inflows may occur at externally fixed prices. For such organisations economic analysis generally means a cost benefit analysis, which is similar to the cash flow analysis mentioned earlier but now the net present value of all benefits less that of all costs is used as an indicator of economic viability. The benefits imply an addition of real resources to the society as a whole whereas the costs imply using up real resources as a result of implementation of the new product or service idea. These items of cost and benefit are valued so that they reflect the social willingness to pay for the same. Wherever free market conditions exist, the market prices can be used to value the costs and benefits. On the other hand, economic prices are first estimated and then used to value those costs and benefits for which free market conditions do not exist.

Economic analysis is, therefore, much more difficult for non-profit organisations than for organisations having a profit motive.

### **Activity D**

For a non-profit organisation like a hospital, consider the ways in which the services can be costed or priced?

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**Activity E**

Screen the ideas generated in activity B by you, considering the likely demand and the desirability of adding these outputs.

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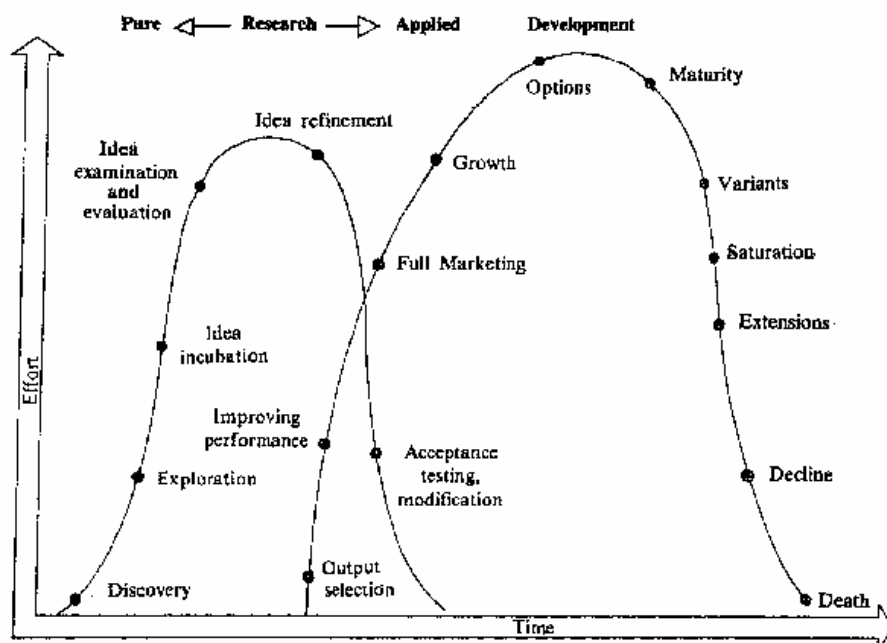
**2.4 PRODUCT DEVELOPMENT**

Product development concerns itself with modifications or extensions provided to ideas so as to improve the functioning, the cost, the value-for-money of the product. Development effort improves the performance of the product, adds options and additional features and even adds variants of the basic product. On the whole, development effort is innovative vis-a-vis research which is more inventive-the thrust being on developing new product ideas, technologies and processes.

**Development Efforts**

Figure III charts the development effort over time for a typical product. The figure also shows the effort made for research to show the relative magnitude of effort as well as the timing of the two. Development starts after research has established an idea which has been examined, evaluated and even refined. The development effort rises initially as the performance of the product or service is improved and as the product itself graduates to the growth phase of its product life-cycle. The development effort still continues to rise but now the result is mainly providing options. As the product reaches its maturity, the development effort has peaked and thereafter gradually starts reducing. In this phase, product variants are developed and offered so as to lengthen the life cycle. This is followed by extensions of the product and Figure 111 highlights the fact that product development is an ongoing process which starts as the product is launched in the market and continues till it is withdrawn from the market.

**Figure III : The Development Effort Through The Product Life-Cycle of A Product**



Source : Meredith & Gibbs, *The Management of Operations*, John Wiley, New York, 1984, p. 66





What is more important—research or development? Development can start only when research has produced a product or service idea which is technically feasible and economically viable. However, greater effort is expended on development as compared to research in most parts of the world today than it was, say 30 years ago. This is partly because the new products e.g. colour television, are more complex and require longer to debug and to improve their performance. This could also be true because research has become very expensive and organisations are under pressure to commercialise research as early as possible, even before the product or service ideas have been refined and debugged. But one possible consequence of this shift away from research is that organisations make themselves vulnerable to technological breakthroughs which can give rise to a whole new generation of the product or service itself. The tradeoff between research and development is an important strategic decision for most organisations.

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## 2.5 PRODUCT DESIGN

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At the design stage, detailed specifications are provided so that manufacturing can produce what has been designed. This means not only providing dimensional specifications but even specifications regarding capacity, horse power, speed, colour etc. are laid down and the task of manufacturing is to convert the design into physical entities.

### Product Variety

There are two distinctly different priorities that can affect the design of a product or a service. The higher the standardisation, the greater will be the ease in producing. On the other hand, customers have different needs and by adding variety, one can satisfy more customers. Standardisation attempts reduction in variety and better use of productive facilities, thereby achieving lower unit costs. If the demand for the product or service is strong when the price is low, organisations will try to minimise unit costs through standardisation and most of the competition will be based on prices. There are other cost-related advantages due to standardisation. It simplifies operational procedures and thus reduces the need for many controls. The organisation can buy raw materials and components in bulk and thus get quantity discounts. It enables steady flow of materials through work centres and thus reduces the number of production set-ups related to change in flow. It reduces the total inventory of raw materials, work-in-process and finished goods. Finally, since the effective volumes become larger as the variety is reduced, high-volume production methods become viable thus giving economies of scale in production itself.

Standardisation is a very useful concept but production needs have been given the highest priority in this scheme of things. This may be a very good approach to product design as long as cost is the primary basis of competition. Otherwise, one can design a product to suit the diverse needs and tastes of the customer. All watches are meant to display the right time but still a company like HMT has hundreds of models of watches with different movements, dial shapes, sizes and other features. By adding variety, an organisation attempts to satisfy the varied needs and tastes of its customers and competes on non-price considerations as well.

One method used to obtain variety or perceived variety and yet hold down cost is through modularisation. A product is designed using modules or sub-assemblies that are interchangeable and each different combination of modules gives a new variety of the product. For example, two different movements, three dial shapes, two dial sizes for each shape and three different colours will give  $2 \times 3 \times 2 \times 3$  i.e. 36 varieties of watches, yet making large quantities of standard modules.

Design simplification attempts to simplify the design so that the product or its parts become simpler to produce. This might mean combining two or more parts into one so that some assembly operations are eliminated. In some other situation, this might involve replacing screw fastened parts by parts which can be snapped tight in place

without any fasteners. Design simplification gives pay-offs in terms of lower production costs and in some cases by lower material costs as well.





**d) Reliability:** the new design should function normally without failures for the expected duration. This is more important for complex designs involving many elements and the design must provide for redundancies and high reliability of elements so that high system reliability can be obtained.

The other elements which are also important in a product design, perhaps to a lesser degree are:

**e) Appearance:** if the new design can be made more attractive, without sacrificing on the other attributes, that is only likely to improve the demand. The relative importance of appearance varies from product to product and in many industrial equipment, it may have a relatively small effect.

**f) Environmental Impact:** the new design should not degrade the environment.

**g) Product Safety:** the new design should not pose a hazard to the recipient.

**h) Productivity:** the new design should be producible with ease and speed.

**i) Maintainability:** this is particularly applicable to consumer durables and industrial equipment. If a failure occurs in the equipment, it should be easily repairable with a minimum of down time.

**j) Timing:** this is particularly relevant for design of services. The service should be available when desired by the recipient.

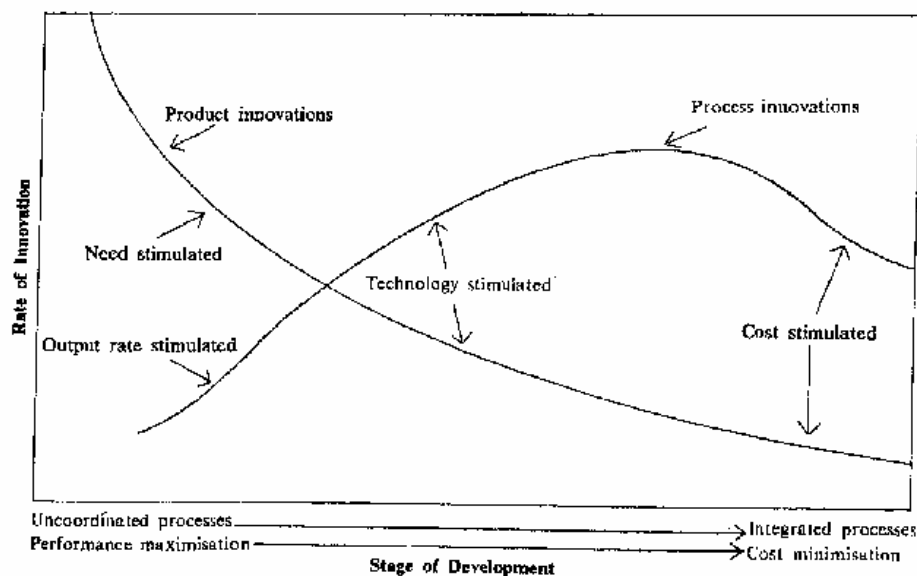
**k) Accessibility:** this element is also applicable to services. The recipient should be able to obtain the service without difficulty. The last two factors are important for design of services since services cannot be inventoried.

In both product and service design, many alternatives usually exist that will meet the basic function of the output. The design task is to recognise the major characteristics of the demand and to carry out a detailed analysis of the tradeoffs available among the various design alternatives, so as to meet the needs of the recipients as closely as possible. Sometimes, when the needs of the recipients are diverse, design will produce different models or versions of the same basic product to satisfy the needs of different segments of the market. This can be seen from the various models of television produced by almost every television manufacturer or the economy and the executive classes of air travel offered by Indian Airlines.

### The Impact of Product Innovation on Process Innovation

The design of a product or service has very close linkages with the design of the process required to produce it. In some cases, the product design itself becomes feasible only because of technological innovations. Throughout the product life-cycle, the process of product development goes on and we have looked into this aspect in section 4.4. It has been found that similar innovations take place in process design as well and this is shown in Figure IV below.

Figure IV : Product And Process Innovations in the Life-Cycle of a Typical Product



Source : Buffa E S, *Modern Production/Operations Management*, Wiley Eastern, New Delhi, 1983, p. 107



Figure IV shows that in the first stage, product innovations are primarily need-stimulated and the emphasis is on maximisation of product performance.

The process is typically uncoordinated in this stage and process innovations are primarily output-rate stimulated. Product innovations are gradually decreasing while process innovations pick up at this stage.

In stage two, both product and process innovations are technology-stimulated. The productive system design emphasises cost minimisation as competition in the market begins to emphasise price. Process innovations start dominating over product innovations as they yield greater reduction in cost.

The product or service has reached maturity and saturation by the third stage and innovations are stimulated primarily by cost considerations. The productive processes become highly integrated and product-focused operations try to achieve economies of scale by having integrated plants of large capacities.

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## 2.6 SUMMARY

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We have looked at the processes of bringing new product and services to the market in this unit and the role of operations in that process. We identified all outputs of an organisation as services, sometimes along with a facilitating good and sometimes without that. Product selection is a strategic decision for the organisation and the top management as well as functions like marketing, R & D and engineering have a role in the making of product selection decisions.

We looked at the stages involved in bringing new output from an idea stage into a tangible entity in the market. New product ideas are generated through market research, research laboratories themselves or conscious, formalised attempts. These ideas have a very high mortality and the new idea mortality curve showed that hardly 1 or 2 per cent of all new ideas are carried through to the market.

New product ideas are first screened for market viability and their fit with corporate strengths and weaknesses. These are then subjected to an economic analysis. New product ideas are then developed, features are added or dropped, variations introduced and the product is finally designed and tested for a commercial launch.

Product designs attempt to introduce a product having characteristics as close to what is desired by the customers as possible and this involves tradeoffs between elements like the function, cost, quality, reliability and others like producibility, maintainability, product safety, environmental impact, etc. Finally, we found that product innovations and process innovations are closely linked to the life-cycle of the product itself.

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## 2.7 KEY WORDS

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**Producibility** of an output refers to the ease and speed with which the output can be produced.

**New-Idea Mortality Curve** shows in a graphical form the number of output ideas surviving after each of several hurdles till the ideas get converted to outputs and enter the market.

**Product Development** refers to modifications or extensions provided to ideas so as to improve the functioning, the cost, the value-for-money of the product.

**Standardisation** attempts reduction in variety and better use of productive facilities, thereby achieving lower unit costs.

**Modularisation** involves designing the output using modules that are interchangeable and each different combination of modules gives a new variety of the output.

**Product** is used here in its generic sense and is meant to include services; same as output



**Output Ideas** refer to ideas regarding possible new outputs which, after refinements and modifications, could result in some outputs offered in the market.

**Screening** the process of establishing the market viability of a new output idea as well as to find the desirability of adding the new output to the outputs of the organisation.

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## 2.8 SELF-ASSESSMENT EXERCISES

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- 1 There are many stages involved in bringing a new output to the market. Why can't the stages be performed in a smooth sequence?
- 2 Give examples of some organisations where you feel the new-idea mortality rates would be low. Why?
- 3 Can services be standardised? Should they be standardised?
- 4 How should an organisation balance the different design characteristics in a new product?
- 5 What are the important factors to be considered while finding the 'fit' of an output to an organisation?
- 6 Explain the Product Selection and stages involved therein.
- 7 What is producibility? How does it affect product selection?
- 8 "Product development and design is basically a research and development activity". Elaborate the statement with suitable examples.
- 9 Explain Product design. How does it influence the Process Design?

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## 2.9 FURTHER READINGS

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