

PRODUCT PLANNING AND DESIGN

Products and Processes

Product planning and product design are important for operations management. Product planning is concerned with the introduction of new products, modifications of the existing products and phasing out the old products. Its primary aim is to ensure a steady flow of products that the customers want.

In practice, product design and the process to make it are inter-twined. The features of the product depend on the process used to make it. An assembly line meal is much different from a customised meal prepared by a mother. There are many services where it is not possible to separate the product and process — a courier company and the process used to deliver couriered articles.

It is nonetheless important to know the focus of an organisation — it could be a product focus or process focus. Product focus organisations see themselves primarily as making a product, whereas process focus organisation see themselves primarily as using a process.

A bottling plant of beverages company has a process focus. A plant that makes bottled apple juice has a product focus. Elite restaurants have a process focus — they cook meals. Pizza outlets have a product focus — they sell pizzas. A telecom company has a product focus, whereas a communication company has a process focus.

The distinction has significant influence on operations. A process focus organisation finds it easier to adjust production if the demand declines. An organisation having stable sales and demand is better organised around the product.

Product Life Cycle (PLC)

Customer demand keeps on changing and that is the main difficulty in product planning. Customers require the woollens in the winter and light clothes in the summer. There was a demand for cordless phones, but these days cell phones have overtaken them. Customers show different consumption patterns — may be due to fashion changes or the new environment. That results in demand fluctuations. Some changes in demand can be explained logically — the demand for pain balms and cough syrups in cold season. A demand pattern can be understood through the product life cycle (PLC) which traces the overall demand pattern from a product's introduction to its phasing out. There are five stages in a typical product life cycle as shown in Fig. 2.1.

(1) Introduction: Here a new product appears on the market. As people have to try it before adopting it for constant use, its demand is low. Blue discs are an example of the newly introduced product.

(2) **Growth:** Here new customers adopt the product. The demand keeps on rising. Internet banking is an example of a product in the growth stage.

(3) **Maturity:** Most of the potential customers know about the product and they continue to buy it steadily. Demand stabilizes and remains constant. Colour TVs have shown a stable demand.

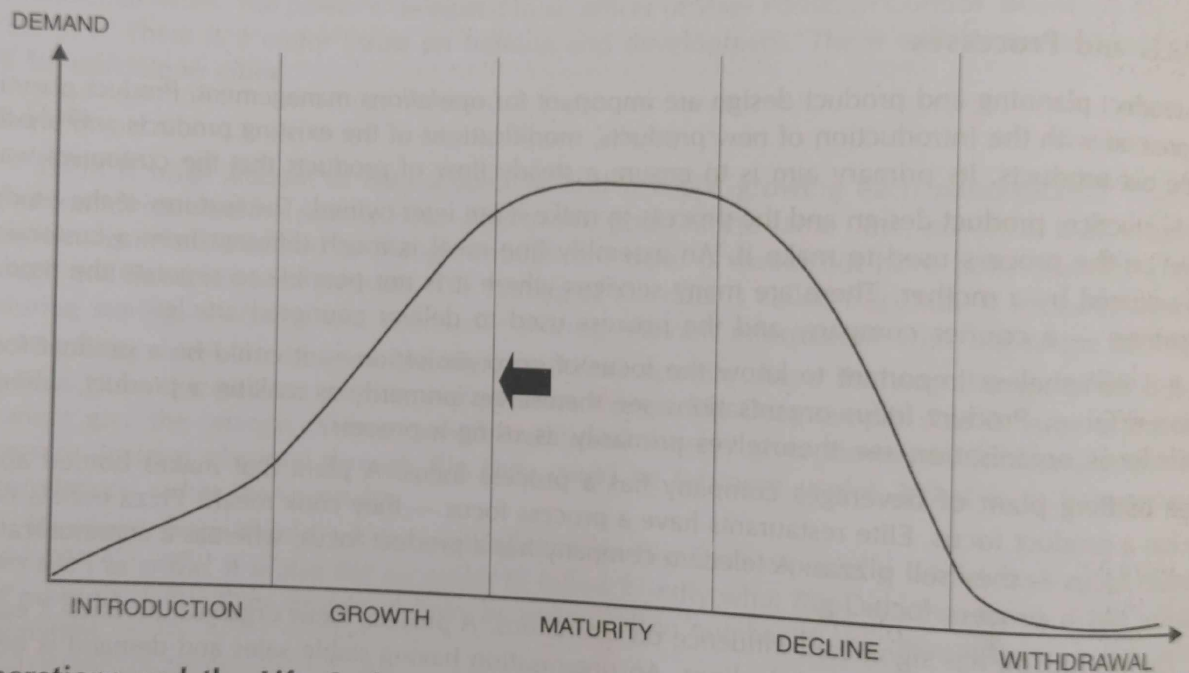
(4) **Decline:** As alternative new products appear on the market, customers take to them, and abandon the older ones. As a result, sales fall. B&W TVs are in decline.

(5) **Withdrawal:** Demand declines to such a point that it is no longer worth making the product. Telegrams and typewriters are the examples.

The length of the life cycle is different for different products — a daily newspaper has a cycle lasting for a few hours, fashion clothing for a few weeks, consumer durables for a few years, and commodities for a few decades. Some products have extremely short life cycles, and some extremely long ones. Many products tend to remain at the mature stage for several years. Some products decline and rejuvenate again. A new product life cycle can start again. e.g., cinema attendances fell and then rose again after multiplexes came on the scene.

Fig. 2.1

Stages in a Product Life Cycle (PLC)



Operations and the Life Cycle

The PLC concept does influence operations:

- products at various stages of their PLC affect the operations and use different types of operations.
- at each stage, the financials of profits, costs and revenues change.
- organisations keep on introducing new products and withdraw the obsolete products.
- organisations make a range of products to smoothen the overall production.

Different Types of Operations During the Life Cycle

To innovate, an R&D department is maintained. The early research inputs are provided by the operations managers. At the introductory stage, the product is new and its demand has yet to build up. The operations are, therefore, small-scale. The initial design undergoes modifications in response to customer feedback. There should be enough flexibility in the operations to accommodate these changes. To build up the market share, a product must be of a specific quality and must follow a delivery schedule.

As product moves to the growth stage after some time, the product design becomes stable. Further improvements in the product are possible through process improvement. The typical change is to move

from a manual process to an automatic one. The objective is to meet the demand, and be competitive by maintaining quality and price. Products form the finished product inventory which is used for satisfying orders as and when they come. Demand forecasting thus becomes important. The resources must be planned and scheduled accurately. The sourcing should be streamlined.

The maturity stage product has a stable demand. Production planning becomes routine. Some early competitors are no longer in the market. There are a few competitors who compete on the basis of price. Operations managers aim at cost reduction and efficient production. The process uses more automation and standardisation.

During the decline stage, many vendors drop out of the market. There could be excess capacity. The organisations try to revive the PLC by changing the product design and process. When this is not worthwhile, there would be termination procedures to stop the production.

Financials During the PLC

R&D costs are very heavy for the new products. The newly introduced products have to recover these costs and so they are priced higher. As the initial production runs are smaller, the per unit costs are higher. However, profits are made on account of premium prices. At the growth stage, revenues rise. As fixed costs are recovered, the profits are made. Revenues keep on rising, till the product reaches the maturity stage. Competitors make similar products by now. Demand does not show a surge. The unit price and revenue continue to fall. As product enters the decline stage, the demand is smaller and the capacity is higher. Profits fall. As the company has learnt production efficiency, there is higher productivity which offsets the decline. But as profits and demand continue to fall, the company decides to phase out the product. A company tries to revive the PLC by greater marketing and promotional efforts, finding new uses applications for the products, modifying the products, and entering the new geographical markets.

In electronics, the PLCs are very short. A handset manufacturer of mobiles can keep the prices low by having the best turnaround time, say either 2-3 months. It keeps the overheads low. The longer turnaround time keeps the resources blocked for just one model. It adds to the costs.

Range of Products Made

There are single product organisations where operations are routine and standardised. The employees become skilled. The production runs are long and this reduces equipment set up time. The inventory remains low and manageable. However, as there are customers who want differences in products, organisations make a range of products each of which have a different PLC. The overall demand is thus smooth. A narrow range makes the standard operations possible. A wider range satisfies a large number of customers. However, the organisation loses the efficiency that comes with standardisation.

Organisations do make different products, but they are similar to those they already make but are different enough to create new demands. However, conglomerates can make completely different types of products. e.g., Tata Conglomerate is in the trucks, cars, telecom, steel, finance, chemicals, salt. These areas are organised as distinct businesses and are run independently.

However, the trend is to stick to one's knitting, and concentrate on core competencies. The unrelated businesses are hived off, and only the core businesses are retained.

Operations Strategy

Operations strategy is a package of plans and policies to utilise the resources of the organization to further the long-term competitive strategy. In other words, operations strategy is integrated in the overall corporate strategy. The strategy takes care of the changing environment by suitable adaptation.

Operations strategy touches upon the decisions of the *process design* and the *infrastructure* to sustain the process.

Process design consists of the choice of an appropriate technology, measuring the process over time, locating the process and logistical support of the process. The infrastructure refers to the planning and control systems, quality assurance and control, compensation methods and operations organization.

Operational objectives are correlated to the overall organizational objectives. Since the overall objectives change in response to the changing environment, so does the operational objectives.

Most of the US firms post-war were volume-driven to satisfy a large demand, whereas the Japanese firms were quality-driven. As such, we can say, priorities do change in formulating the operations strategy from country to country, and firm to firm. We have to appreciate the priorities and their consequences and the trade-offs involved.

The priorities generally include cost, quality, reliability, delivery speed, new product introduction speed and other criteria.

It should be appreciated that an operation could not excel at one and the same time on all performance measures, and hence the management changes the performance criteria critical to the success of the organization and concentrates its resources on these.

To illustrate, an organization committed to speedy delivery may compromise on product variety. A low-cost organization may not offer a premium quality. There are thus trade-offs of cost and quality.

An organization can have a plant within a plant where each facility carries separate product lines and unique operations strategy.

In these days of globalisation, there are companies who excel internationally and are called world-class manufacturers. They adopt a global perspective towards both operations and marketing.

The most important priorities for survival in business are conformance quality, product reliability and delivery dependability. The other priorities in 90s include low price, fast delivery, performance quality and speed to introduce new products. In the 90s, innovativeness and price-consciousness have acquired added importance.

These days customers want to derive *value* which means buying different benefits a product offers as against the cost thereof. Value improves when benefits are increased or cost is lowered or do both.

An organization has to identify its operations capability (producing right-hand or left-hand drive cars) and core capabilities or competencies. Core capabilities distinguish a firm from its competitors.

Product Selection

Conversion of inputs into outputs by adding value to them makes operations management an important function. Though the conversion process is taking place internally, the value added by it to products and services is perceived outside in the market by the consumers. Therefore, the operations manager has to be outward-oriented, conscious of consumer needs rather than inward-oriented, placing emphasis on the production process only.

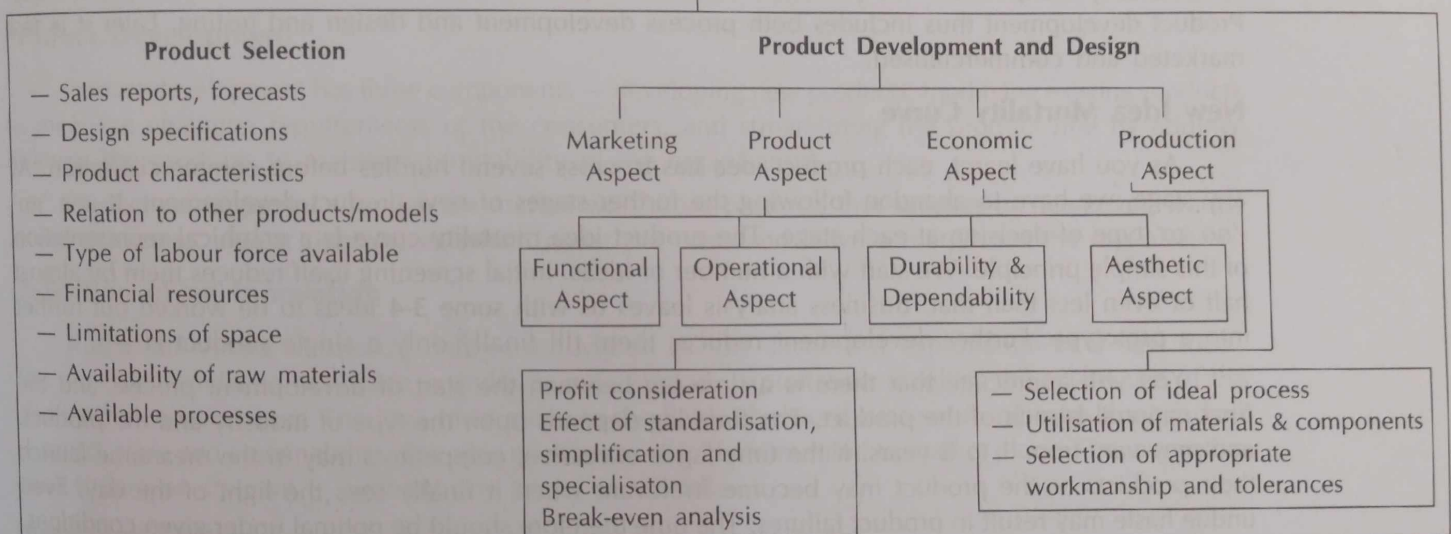
To begin with, we talked of products and services. But these days the term product is used in a very comprehensive sense and includes services also. In fact a product is considered as a bundle of benefits that it offers to the customers. Thus a lipstick is not only a combination of a few chemicals, but is something that imparts beauty to the customers. Similarly, a tonic is not a mix of some vitamins, but something that promises health to an invalid, indisposed person. When products are thought of so broadly in terms of customer benefits, several services also become a part of products. Thus, when a computer is sold, we also sell a solution to customer, to his problem of handling data for information needs. Thus, it involves systems analysis and design, the hardware of adequate computing power, the software packages to help the customer for his information needs, the installation of the system and its maintenance as an after sales service. Part of the product is tangible, and part of it is in the form of intangible services. Similarly, a service centre like an orthopaedic hospital sells medical care and tangible products like artificial limbs. Thus, to a customer, a product is a bundle of benefits, a solution to his specific problems.

The above discussion points out the importance of deciding correct definitions of our products and organizational missions, which give a strategic dimension to our output selection decision. Thus when we say we are in the entertainment business, we not only think in terms of producing movies only, but also video-movies if the customer demands them for his entertainment needs.

Product mix is a selection of products we desire to produce, keeping our business mission in mind. It is a strategic decision. While deciding our product mix, we take into account our marketing and technological strengths, the potential demand, the history and traditions of our organization and the financial capability we have. Competition also shapes our product mix decision. Product selection is not a decision that could be taken by the operations management department alone, but requires interface with departments like marketing, finance, research and development, materials etc. It involves participation and support of the top management.

Once a product mix is chosen, we have to pay attention to the economics of producing each product, the design of the individual product, the quality and reliability of the products intended to be produced. We also consider *producibility* which means the ease and the speed with which the output can be generated. This is closely related to the plant and machinery and its sophistication level, engineering operations necessary, and flexibility with which we can adapt the facilities from producing one product to another product. Of course it is easier always to create a family of similar products. Dissimilar products may need creation of either facilities *de novo* entirely or in some sub-processes.

Main Factors to be Considered in Product Selection, Development and Design

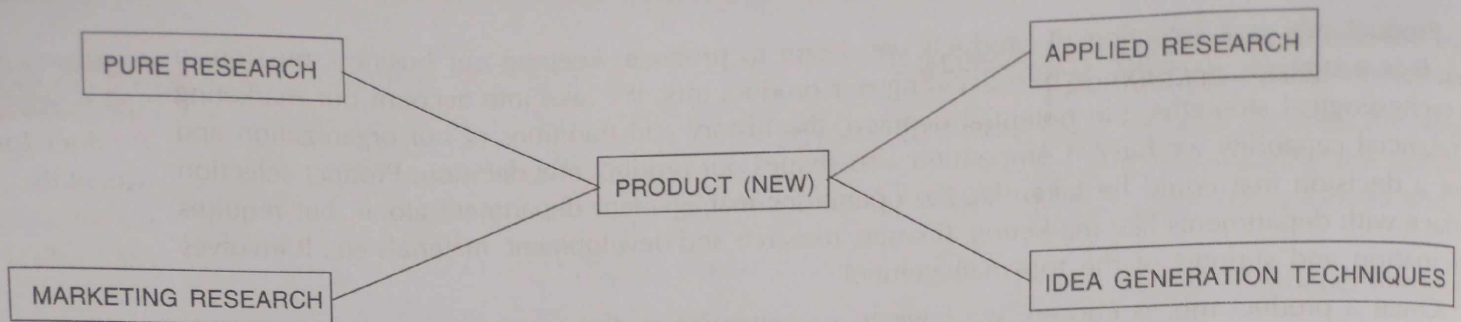


Product Selection Process

It is a part of product planning process which is a continuous activity in an organization involving marking out and supervising the search, screening, development and commercialisation of new products; the modification of existing lines and phasing out of the marginal or unprofitable lines. The most important part in product selection process is that of idea generation. Each new product, and this includes modification of an existing product, is developed from an idea. These ideas come from many sources. They come from unorganized sources like the wife of a chairman or for that matter even a salesman. They come on golf courses, at cocktail parties, in cafes and accidentally. The ideas may come from organized sources through consumers, scientists and technologists, research laboratories etc. They come in other words through pure and applied research. The ideas are also generated by the competitors, salesmen and distributors, consultants, bankers, patent office and foreign sources. These are special techniques of idea generation like attribute listing method, morphological analysis, brainstorming sessions, Delphi method and problem inventory analysis. The following diagram makes this discussion clear:

Ideas are not immediately converted into new products as shown in the above diagram. They are subjected to a screening process first.

Screening means critical evaluation of product ideas to select those that are suitable and viable and to reject others. The product ideas should satisfy consumer needs, sales volume criteria, profitability criteria, and company image criteria. They should be consistent with the overall marketing objectives



and organizational objectives of the company. Screening is done by check-list method, rating method of different kinds. Once the screening is over, we undertake a detailed business analysis of the ideas. Mostly this is financial analysis consisting of break-even analysis, cash flow (discounted) analysis, Bayesian Decision Theory and Risk Analysis.

Product development is the next stage at which the product idea takes a concrete shape, with all the attributes which the consumers desire it to possess. First, of course, on a small-scale, a prototype is developed. This is preceded by careful engineering aspects like development of drawings and designs or laboratory compounds. The prototype is so developed till it comes close to consumer preferences. Product development thus includes both process development and design and testing. Later it is test marketed and commercialised.

New Idea Mortality Curve

As you have learnt, each product idea has to cross several hurdles before commercialisation. At any stage, we have to abandon following the further stages of new product development. It is a 'go' - 'no go' type of decision at each stage. The product idea mortality curve is a graphical representation of this simple principle. We start with a number of ideas. Initial screening itself reduces them by almost half or even less than that. Business analysis leaves us with some 3-4 ideas to be worked out further into a prototype. Further development reduces them till finally only a single product is left.

You will appreciate that there is a time lag between the start of development process and the final national launch of the product. The time lag depends upon the type of industry and the product, and may vary from 1 to 8 years. If the time lag is excessive, competitors may in the meantime launch their products or the product may become irrelevant when it finally sees the light of the day. Even undue haste may result in product failures. The time therefore should be optimal under given conditions. Each developmental stage costs us in terms of money and other resources. So when the product is finally in the market, the market has to bear this developmental cost. Many organizations work simultaneously on different product propositions and may be at different stages of development. Thus when some product ideas are generated and screened, another set of ideas might have reached prototype stage, and yet another set of ideas might have reached the commercialisation stage. This is a sign of an innovative organization, where product development is a continuous process. The students may kindly note that the few successful products have to absorb even the cost of their less fortunate brothers — the unsuccessful products.

Product development continues after the commercial introduction of the product throughout its life-cycle consisting of the stages of introduction, growth, maturity, and decline. Modifications and extensions at the stage of maturity in case of existing products lengthen the product life cycle, and prevent its decline. Of course, an organization also modifies the me-too products introduced by others as a part of developmental effort. On the innovative scale, the extreme point is that of a major technological breakthrough like the introduction of nylon, transistor, micro-processor, radio-transmission, laser, lithotripsy for kidney and gall-stones, oral polio vaccine etc. Such breakthroughs may bring about an altogether new industry. We await now major breakthroughs in the field of genetic engineering and bio-technology, super-conductivity, cancer therapy, AIDS therapy, organ transplants etc. All this is a result of basic and applied research, and later on development on commercial scale. There is a major thrust to technology advancement in recent years, and we are all in for a future shock. What is more important? Research or development? Perhaps, the decision is a trade-off and is a strategic decision.

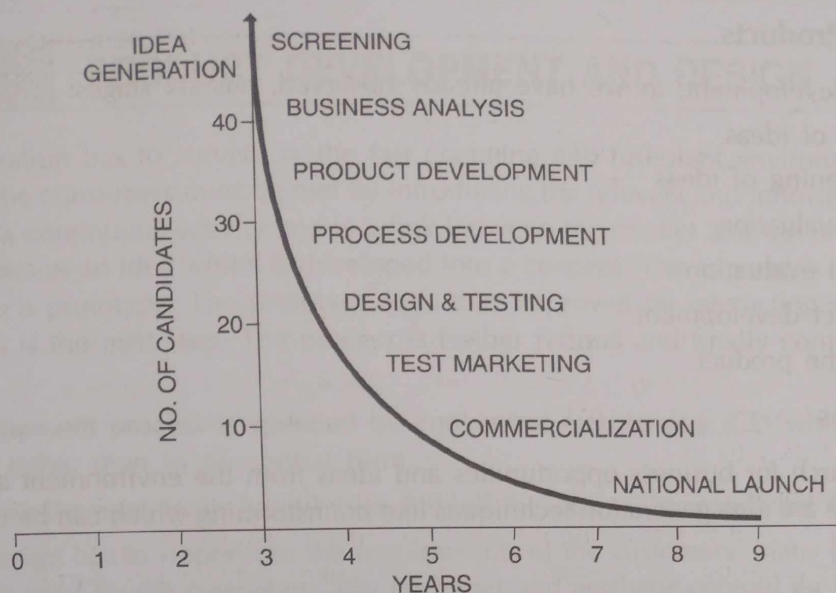


Fig. 2.2

Product Idea Mortality Curve (After Meredith and Gibbs, 1984)

Product Development

Product development has three components — developing new products, modifying existing products to meet the changing requirements of the consumers, and streamlining the product line by adding/deleting the products to maintain profitability of the organisation.

Product development supplies the market with those products that satisfies its needs and wants, at the right time, and at right prices which cover the costs and leave a margin for the organisation.

Definition of an Innovation

Raghu Nath Anant Mashelkar defines innovation as 'the successful exploitation of a new idea.' The new idea could be new here in India or new abroad. Exploitation involves the actual use of the idea by the end customer. The idea must move to the field. The word successful indicates three factors — speed, scale and sustainability. The idea must move quickly from mind to market place. The innovation must sustain on its own — without any props or subsidies.

Innovation Culture

According to R.A. Mashelkar, the innovation culture must be promoted in India by believing that the 'I' in India stands for 'innovation'. Secondly, innovation must be directed to the national goal of inclusive growth by creating 'access equality' despite the 'income inequality'. Thirdly, the Indian innovation must move quickly from mind to market place. There are bottlenecks here. We must recognise that research labs need funding, and produce output. They thus convert money into knowledge. The real challenge comes after the research output is available again for conversion into money. Thus, we have to create monetisable knowledge. The skills in patenting too must be mastered. Fourthly, we must recognise the innovative potential of each Indian. Fifthly, we must build a national innovation ecosystem.

Introduction of New Products

A company has an existing line of products which is improved on a continuous basis to revive the products and to stimulate demand. However, in order to meet the competition effectively and stimulate further growth of the company, new products are introduced for which different ideas are explored. Here the company takes the advantage of the existing research elsewhere, or in-house, and the special skills available with the company. New products also satisfy the new requirements of the customers.

Developing New Products

New product development, as we have already observed, has six stages:

- (i) generation of ideas
- (ii) initial screening of ideas
- (iii) technical evaluation
- (iv) commercial evaluation
- (v) final product development
- (vi) launch of the product.

Generation of Ideas

Organisation search for business opportunities and ideas from the environment and from within the organisation. There are idea generation techniques like brainstorming which can be used to generate ideas.

Initial Screening of Ideas

As we have observed already, the ideas are screened to reject those which have flaws. Some ideas are not feasible. Some have been tried already, but have proved to be unsuccessful. Some ideas are beyond the organisation's present capabilities. Some ideas are similar to an already existing product. Ideas may not fit into the current operations. They may not have a good market potential. Some ideas are too risky, or financially unviable.

Technical Evaluation

Ideas after initial screening are converted into concepts and then tested. The usual considerations are whether the concept can be converted into a product. The legal and safety considerations are also taken into account. The technical feasibility of the proposed design, the producibility with available technology, the compatibility with current operations and the competence available to convert it into a product — all these considerations are examined.

A prototype is then made, and its trial is taken. It can be modified in the light of these trials. The process design is also considered.

Commercial Evaluation

Market and financial feasibility is studied. The projected profit and loss account is made. If the product is promising, further development is continued. The technical and commercial evaluation together form feasibility study.

Final Product Development

Those products which pass the feasibility test move to the design and testing stage. The final designs are made by using inputs from customer surveys and other relevant information. This stage gives the product offering meant for the consumer. It also spells out the process to be used to make the product.

Launch of the Product

Once the product and process designs are finalised, the product is ready for launching. The launch timing is considered carefully. It could be a national launch or a selective limited launch. As we have seen, very few initial ideas survive all the stage — hardly 1-2 per cent.

Even after launch, very few ideas become successful products.

The whole process of product development has been treated in detail in an appendix at the end of the chapter.