Textile Product Design and Development
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Lecture – 2
Design Procedure

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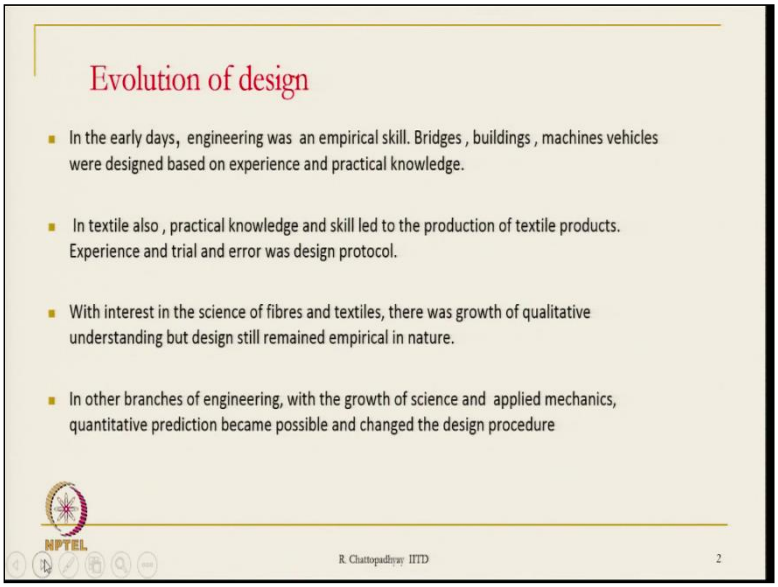

We will discuss the design procedure in this lecture. Let us begin with the evolution of design both in general and specifically in textiles. In the early days, Engineering was largely an empirical skill. Bridges, Buildings, Machines, and Vehicles were designed based on experience and practical knowledge. In textiles, various products were produced primarily with practical knowledge and skills. In the early stages, the design was mostly based on experience and intuition, and by trial and error, this was the design protocol. As interest in the science of fibres and textiles grew, there was tremendous growth in qualitative understanding. However, design in textiles still remained empirical in nature. As science developed, advanced research was conducted in the areas of fibres, yarns and fabrics.

Although there was significant progress in understanding textiles, the design techniques remained very traditional and empirical. However, in other branches of engineering, with the growth of science and knowledge in mechanics, quantitative predictions became possible, leading to changes in the design procedures. However, textile designers have not

adopted the application of science and mechanics. In this regard, textile design lagged behind.

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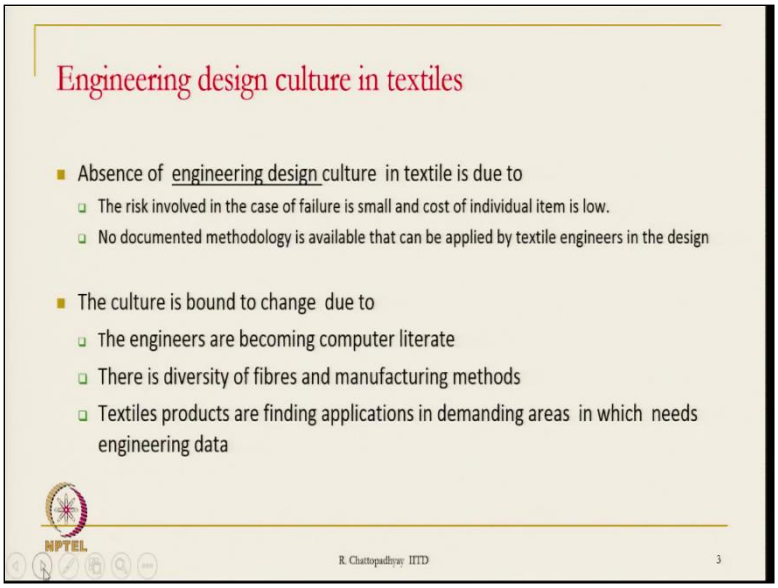

In textiles, there is an absence of an engineering design culture. In India, people have designed beautiful sarees that are renowned across the country. Similarly, other countries have also produced remarkable textile designs that have significantly impacted trade. However, the engineering design culture was absent. This raises the question of why this was the case. One of the reasons is that the consumption of textile products on a daily basis is maximum, and the risk involved in case of failure is negligible.

Additionally, the cost of the individual items was relatively low, and this remains true even today. Because of that low risk, there was no pressure on designers to guarantee the success of a product, particularly in applications where the risk to life was not a concern. Another thing is the lack of a documented methodology that textile engineers could apply during the design process. Because of these reasons, the designs mostly remain experience-based and intuition-based. But this culture is bound to change. Due to several reasons, including the development of computers, the approach to textile design is evolving.

Today's engineers are increasingly familiar with computers and becoming computer literate, which enables them to use advanced tools and software for designing textile products. The development of computers has transformed textile design. Visualization software allows designers to simulate and view designs before production, enhancing

accuracy and efficiency. Previously, the fibre domain was limited to natural fibres like cotton, wool, silk, and linen. Today, there is a broader range of fibres, including synthetic and high-performance fibres, which provide more options for textile design and application.

In earlier years, natural fibres like manila, hemp, coir, and jute were primarily used for industrial products as technical or industrial-grade fibres. Over the years, many synthetic fibres have been developed, and manufacturing techniques have evolved significantly. Textile products are increasingly being applied in demanding areas that require engineering data for design. As textiles expand into new areas, technical textiles are becoming highly popular. These unique textile products are finding applications such as composites development in various engineering fields, including civil and mechanical engineering.

Textiles are now being applied in biomedical engineering, medical science, and agriculture. As the use of textiles expands into these more demanding applications, it becomes essential to design them to meet the specific performance requirements of those applications. Hence, a proper engineering design culture has to be developed in textiles.

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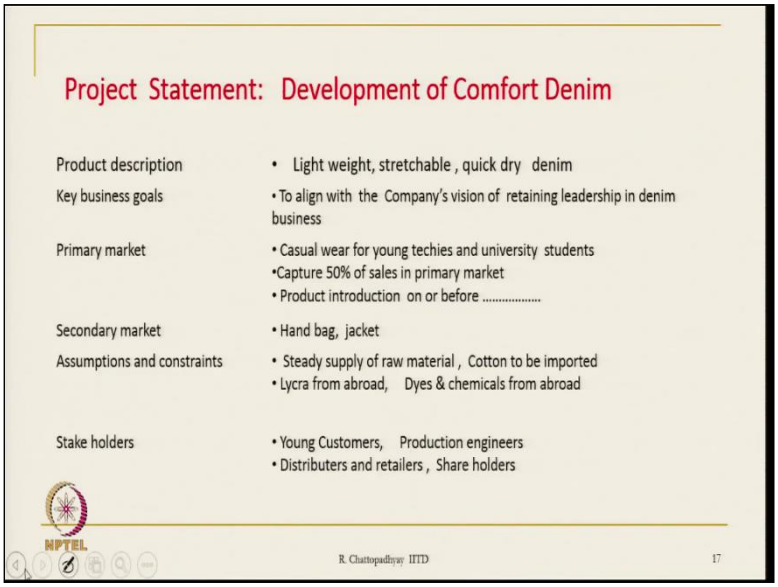

Now, we discuss the generic product development steps. When you are designing something new or developing a new product, the following steps should be followed for

product development. These steps are applicable to all branches of engineering, including textiles.

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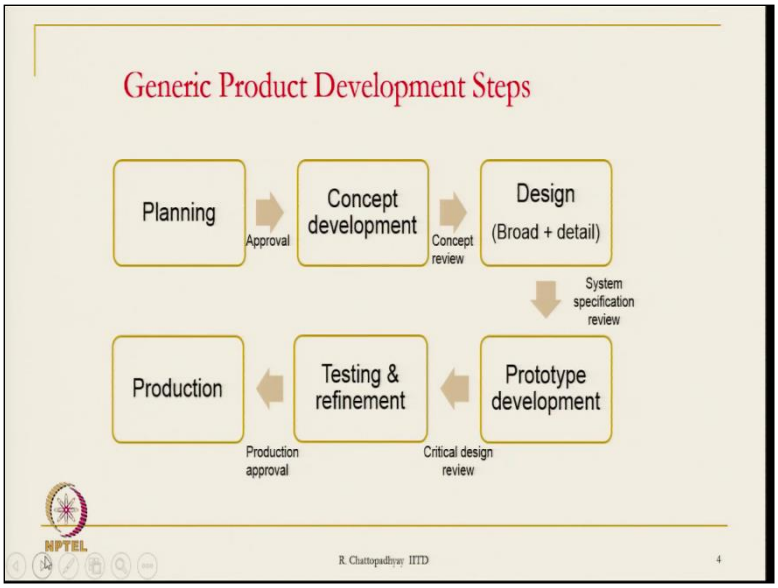

These product development steps are common and applicable to any product, whether it is a textile or not. The first step in the process is planning. Without proper planning, it is impossible to move forward effectively. For example, all students plan for their careers. Without a plan, the desired outcome cannot be achieved. Therefore, planning must always be done in advance. Once the plan is created, it must be approved before moving forward. In an industrial setup, especially when an organization or industry is involved, management approval is mandatory before any commitment is made to developing a new product.

After the planning stage, the next step in product development is concept development. But, before moving to concept development, the plan must be approved by management. Once the plan is approved and management commits to the project, one can proceed with the development of the concept. This development phase requires manpower, time, material resources, and equipment. A team of people will be involved in the design and development of new products, and therefore, the overall scenario has to be approved before proceeding.

Once the approval is granted, the design team will move forward and go to the next step, which is concept development. This involves developing a concept for the product. Each

step in the process will be discussed in more detail as we progress through the course. After developing the product concept, the next step is concept review. The design team presents, discusses, and debates various concepts during this stage. The presented concepts are further reviewed.

Once the concept review is complete, the process moves to the actual design stage, which consists of two parts: broad design and detailed design. This initial broad design phase involves defining overall parameters, components, and their specifications. After the broad design is established, the focus shifts to detailing. After completing both the broad design and detailing, the next step is another review exercise. This review focuses specifically on the detailed specifications of each component used in making the product.

During the review process, mistakes or errors that have been missed or not considered is identified. So, a review exercise is particularly important in the development process. After the specification review is completed, specifications are temporarily frozen, and the prototype development process begins, i.e., a prototype of the product is fabricated. Once the prototype is developed, a critical design review is conducted to evaluate its appearance and performance. At the critical design review stage, the prototype undergoes evaluation and testing. Initially, testing is conducted in the laboratory to assess the product's performance.

Once in-house testing is satisfied, the product is taken to field trials. Field trials may also be performed to test the product under real-world conditions, depending on the product. Based on these test results, design and specification refinement is done. Once these refinements are complete and the product performance is satisfactory, production approval comes from top management. After this approval, large-scale production of the new product begins. Product failure in the market significantly impacts a company's reputation.

Companies aim to protect their reputation and avoid negative impacts on their brand. Therefore, before proceeding to mass-scale production, companies ensure that the product has been thoroughly tested and refined because a lot of financial investments are involved in mass-scale production. Hence, at the final stage, production approval is obtained from the top management. Once approved, it moves for mass-scale production and is eventually available for sale. These are the steps involved in designing any product.

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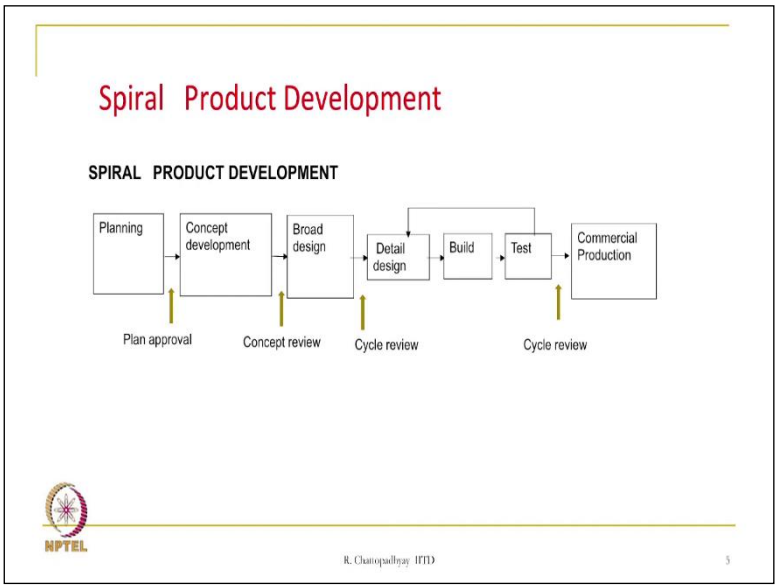

The next concept is spiral product development. We will discuss what this spirality means. The first three steps are the same as earlier. Between broad design and commercial production, there are three blocks: detailed design, build, and test. In spiral product development, if testing shows that the product's performance does not meet expectations, the process involves revisiting the detailed design phase. This includes assessing different components chosen, identifying the right component, and considering better materials if needed.

After testing, the detailed design aspects are critically reassessed. Changes are made if necessary. This iterative cycle continues until the design meets performance expectations. After a few iterations, the performance is checked again, and once approval is given from the top management, it goes to commercial production. In a spiral product development diagram, the process of detailed design, building, and testing is repeated several times. This iterative cycle ensures that the product's performance meets or exceeds expectations before finalizing the design.

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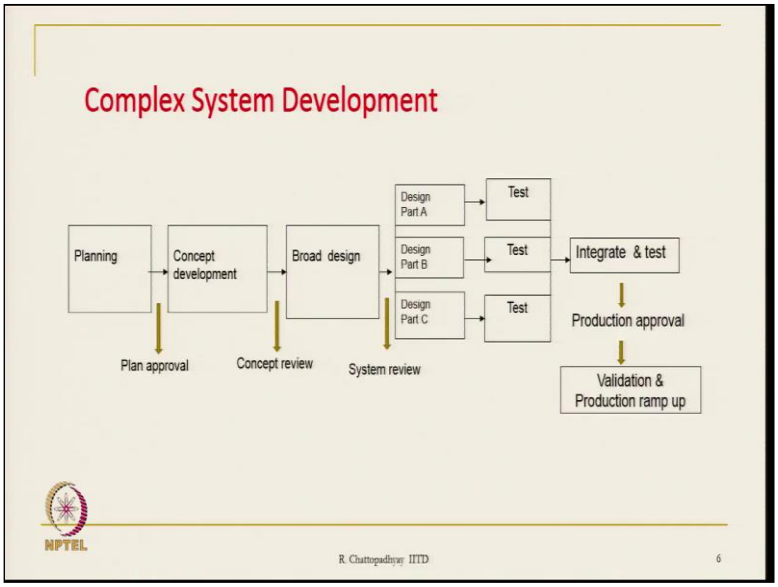

In developing very complex systems, such as aeroplanes or cars, the initial steps (planning, concept development) are the same as in other design procedures. But, in the broad design phase, the overall design is divided into sub-designs. In aeroplanes or cars, the system includes a variety of components such as electronic components, computer or software components, and mechanical and polymeric components. So, in the broad design, the total design task is split into many subtasks, or the total design is divided into smaller designs.

The total design is split into smaller designs, such as the designs of part A, part B, and part C, as shown in the diagram. Parts A, B, and C are separately designed, tested, and checked for performance, and once they are performing as per our expectations, parts A, part B, and part C are all integrated together into the final system. In the development of complex systems, after integrating all components to form the complete product, the entire product is tested as a whole to evaluate its overall performance. If the performance meets or exceeds expectations, top management reviews and approves the design. Following approval, the product proceeds to commercial production.

This happens during the development of complex systems. In complex textile designs, such as a space suit, the development process involves textile engineers and experts from various disciplines. Similarly, there are other products where technology integrates different disciplines in order to develop complex textile products. These are the different ways that can be used to develop the products.

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The first part of the design process is planning. In the planning phase, the initial task is the identification of opportunities. In a commercial setup, before assigning the responsibility to design a new product, the organization must assess whether there are existing opportunities in the market for a new product. In a commercial venture, designing a new product is not just for the sake of innovation but to create something that can be sold and generate profit. Therefore, it is important to identify whether market opportunities exist before proceeding with new designs.

In the planning phase of product design, the following steps are followed: identification of opportunities, evaluation and prioritization of projects, allocation of resources and the time of launch. Determine the resources required and establish a timeline for the project because some product designs range from one year to several years. It varies depending on the type and nature of the products, and these are the four sub-tasks that have to be done while planning.

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The first one is identifying opportunities. Opportunities can be identified by generating ideas for new products that do not currently exist in the market, or they can also arise from adding new features to existing products. These ideas often come from marketing and sales personnel, who are directly in touch with customers and have insights into market needs and preferences. It can come from the research organizations, CSIR labs, and university research departments, and there could be current or potential customers, suppliers or your business partners.

These stakeholders might suggest new opportunities based on industry trends. The other most important thing is documented frustration, i.e., analyzing customer dissatisfaction with existing products to help identify areas for improvement or new opportunities. With information about market needs, customer feedback, and trends, you can determine the need for redesigning or developing new products. This helps to improve its performance, add some new features, and implication of trends in lifestyles or demographics.

The demand for consumer goods is influenced by changes in lifestyle and demographics. For instance, if a country has a younger population, there may be a higher demand for products such as trousers, shorts, or ladies' suits. Understanding these shifts is essential for designing products that meet current market demands. In addition to lifestyle and demographic changes, it is important to study competitor's products. Analyzing what competitors have introduced to the market can reveal opportunities for redesigning your own products or developing new ones. These are the various opportunities.

Another thing is tracking the status of emerging technologies, which have the potential to develop new products. New manufacturing technologies or advancements can lead to the development of superior products, which always have a better market. Keeping up with these technological developments helps in creating innovative products that can stand out and capture the market.

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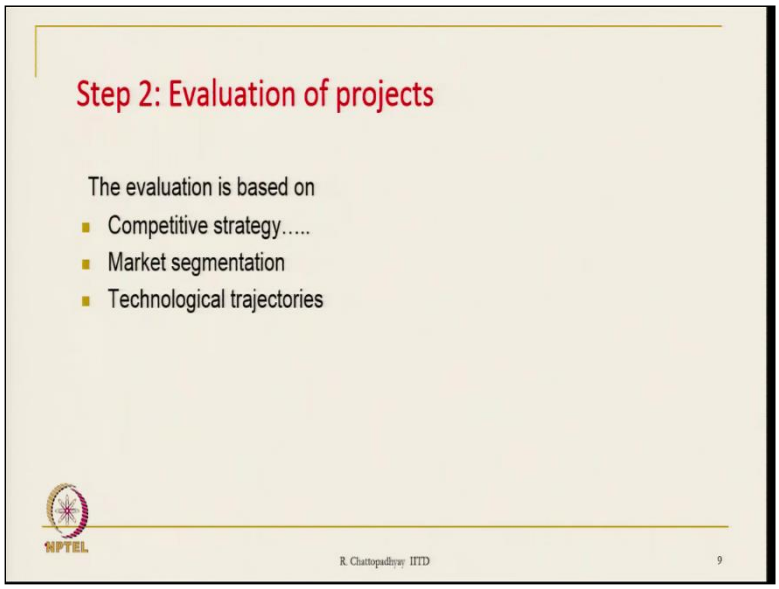

Next, we will discuss the evaluation of projects. This evaluation determines which project is most suitable to pursue. The evaluation should be based on the company's competitive strategy, market segmentations, and technological trajectories.

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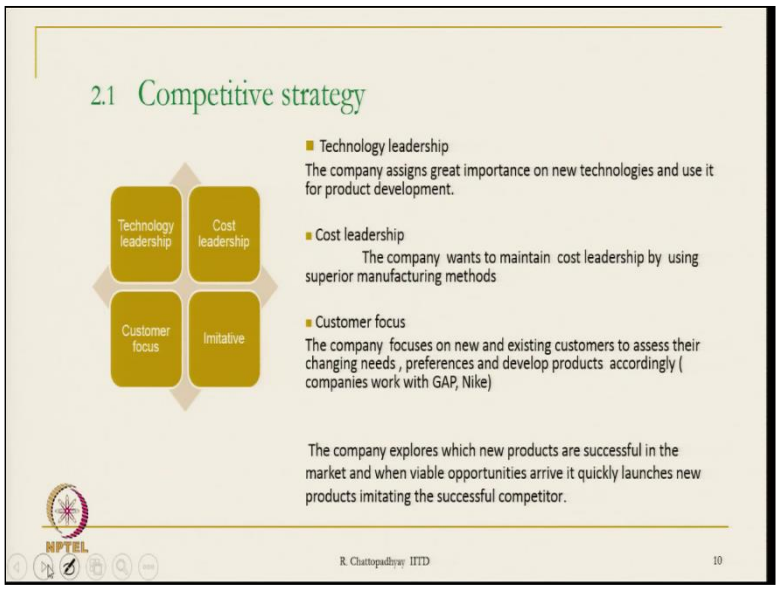

The competitive strategy depends on the vision of the company. The company's strategy could be technological leadership if the company assigns great importance to new technologies to develop the products. It could also be cost leadership, customer focus or imitative. These are the four different aspects of comparative strategy that the company may use to choose. Any idea that offers a technological edge should be pursued, as it can provide technological leadership in the market. The company may aim to maintain cost leadership by using superior manufacturing methods to produce value-for-money products. So, there is a cost-performance benefit.

Another strategy for identifying opportunities is customer focus. The company focuses on new and existing customers to assess their changing needs and preferences and develop products accordingly. For instance, companies may work with large buying houses like Gap to ensure they meet the needs of their loyal customers and address their preferences. Another thing that the company adopts is an imitative approach, where the company explores new products that are successful in the market and when viable opportunities arrive, it quickly launches similar products. These kinds of companies are basically followers, and they minimize risk by replicating products.

These companies observe successful products in the market, and once they are identified, they replicate and sell similar products. These companies are considered followers, not innovators. They often rely on others to design new or different products, and their strategy is to copy successful designs and offer them to customers. Hence, depending on the vision of the company, the strategy, the product, and the project can be chosen.

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Another thing is Market segmentation, which involves dividing customers into different groups based on various criteria. These segments include age (children, youth, middle-aged people or old people), income (common man, middle-class, rich) and region (north, south, east, or west). So, market segmentation could be another important idea when choosing a project.

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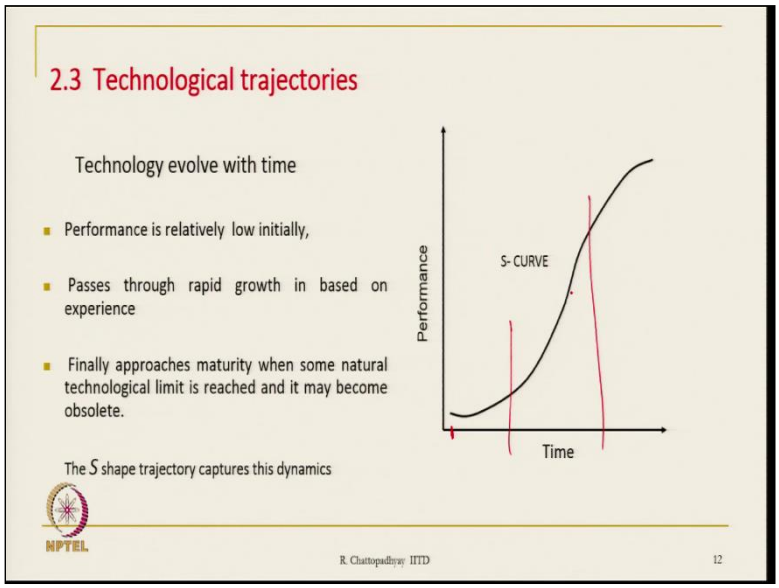

The other aspect of the evaluation of projects is technological trajectory. It refers to the evolution of technology over time, often represented by an S-shaped performance curve shown on the right-hand side. This curve shows that when a completely new product arrives in the market, the performance is low initially, and then the performance quickly

rises with time. The performance versus time plot of a technology typically follows an S-shaped trajectory. Initially, the performance of a new technology is low, but it rises rapidly as the technology matures.

Eventually, the performance levels off as it approaches its natural technological limits. Over a period of time, the technology may become obsolete as new advancements emerge. There are significant opportunities for change and improvement in the early stages of a technology, S-shaped performance curve. During this phase, adopting the technology can provide substantial benefits as performance rapidly increases. However, once the technology reaches maturity and performance gains are minimal, investing in further development or relying on it becomes less advantageous.

When choosing and improving a product, one key consideration is using emerging technologies while rapidly advancing. By enhancing the product during this phase, a company can capture the market advantage early on. However, as the technology matures and more competitors enter the market, the competition intensifies, and profitability may decrease.

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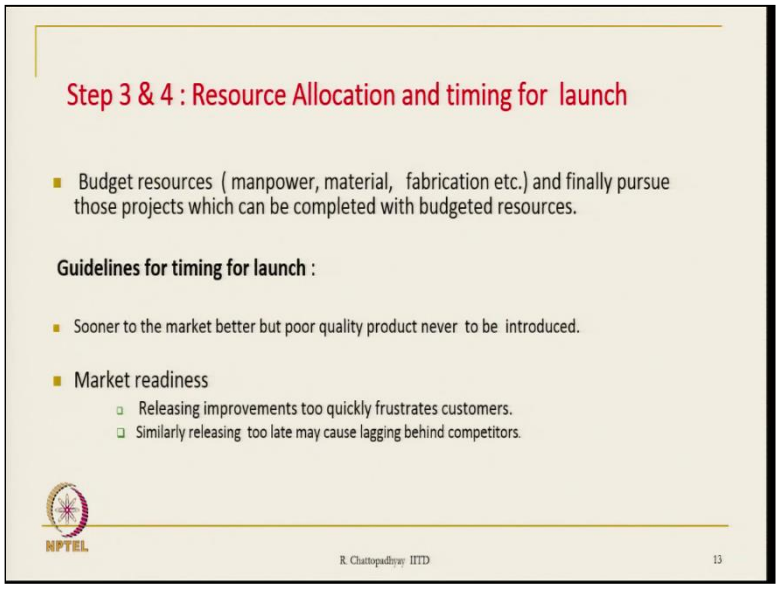

The last two steps are resource allocations and timing for the launch. The resources such as manpower, material, fabrication cost, etc., have to be budgeted. Understanding the financial requirements of the particular project and ensuring that the projects can be completed within budgeted resources. This is also a part of planning, and a plan has to be

made in advance to get an idea of the total cost of the development. The other thing that has to be considered is the timing of the launch and the guidelines for the launch of the product. When a product is introduced into the market, there should not be any compromise on quality, i.e., poor quality products should never be introduced.

Another thing is market readiness. It is ensuring that a product aligns with market conditions and customer expectations. Frequent changes to models or products can frustrate customers, as seen in industries like mobile phones and computers, where rapid model updates can render older models obsolete quickly. Introducing new product models too quickly can lead to customer frustration, especially if they feel their recent purchase is quickly rendered obsolete. Customers expect that their investment should provide value over a reasonable period (e.g., three to five years). Rapidly introducing better models with new features can lead to feelings of being cheated, as customers may perceive that their earlier investment is devalued prematurely.

Therefore, we have to see how quickly the market expects a change in a new product or the addition of new features to existing products. Similarly, releasing too late may cause lagging behind the competitors. So, it is important to align with expectations and competition in the markets.

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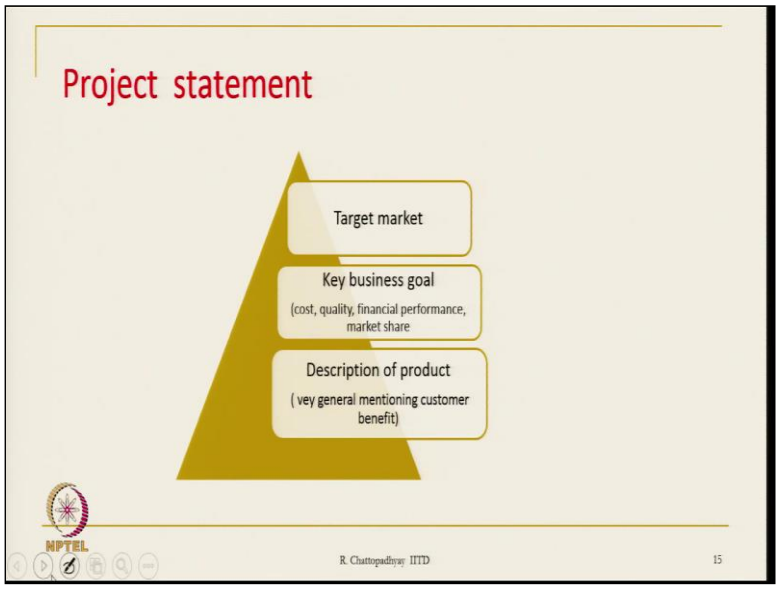

Next, we will discuss the project statement. While writing a project, it is necessary to give the title of the project and make a statement. The statement must include the target market

and key business goal, i.e., in terms of cost, quality, financial performance, or market share. Next is the description of the product. It provides a general description of the product and mentions the benefits it offers to customers. The project statement includes the project title, target market, key business goals and the general description of the product, highlighting the benefits it offers customers. These things should be written in the project statement.

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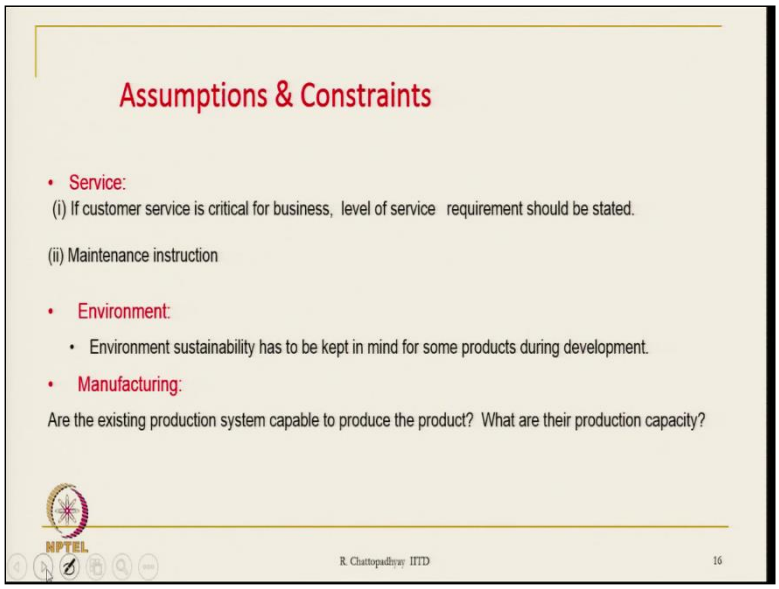

In project planning, it is important to state any assumptions and constraints. For products where customer service is crucial, such as certain services, the level of service requirements should be clearly defined. For textile products, particularly apparel goods, servicing is generally not required, as these products typically do not need post-servicing. It is crucial to state the service requirements and provide maintenance instructions. If customer service is critical to the business, clearly define the level of service required. For electronics products, detailed maintenance instructions have to be provided. For example, an electrical product like a TV typically comes with an instruction manual outlining how to maintain and operate it.

When buying gadgets for the kitchen, there is an instruction manual available. Information such as maintenance, operation, various parts, contacts, etc., are mentioned. So, service requirement has to be stated. Environmental sustainability must be kept in mind during the development of some products because sustainability is becoming increasingly important worldwide. Sustainability is increasingly becoming a key selling point in product

development. It is important to emphasize the sustainable aspects of the product, such as energy efficiency and reduced environmental impact, as these can be significant selling points.

Incorporating sustainability into the design process by considering factors like energy consumption, pollution reduction, and the use of eco-friendly materials. The other aspect is manufacturing, i.e., the existing production systems capable of producing the product and water production capacity in a given industry and ensuring that the new product can be manufactured using the current technology and equipment in the plant.

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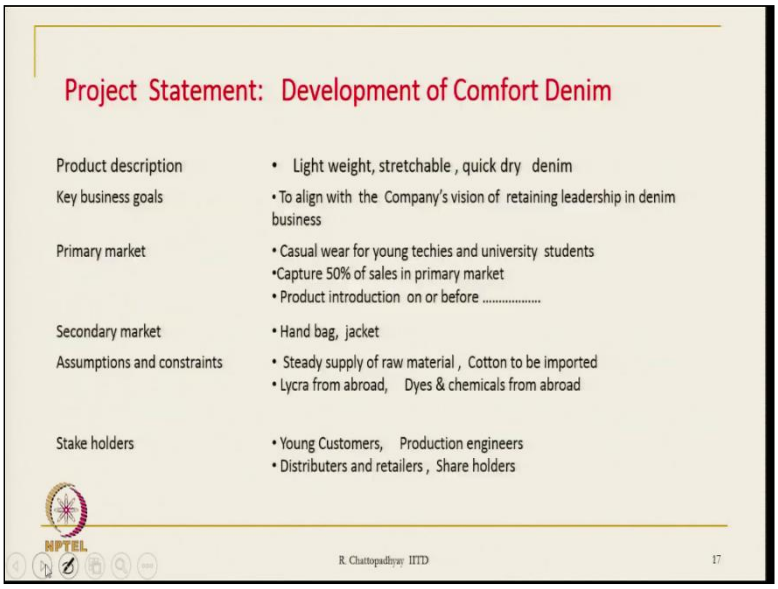

What is the total capacity of production? This information is also relevant. For example, consider writing a project statement titled “Development of Comfort Denim”. The product description would be “lightweight, stretchable, quick-dry denim”. This description can be presented in a table format or as a paragraph. The key business goals are to align with the company's vision of maintaining leadership in the denim industry. The primary market for this product is casual wear for young professionals and university students, with a target to capture 50% of sales in this segment.

Expectations include launching the product on or before a specific deadline, such as October, to coincide with the festival season in India, which features a series of festivals throughout the country. One can decide to launch the product by September. This timing ensures that it will be available for purchase before the festival season. In addition to the

primary market of casual wear, the secondary market could include handbags and jackets. By using the same denim fabric, we can explore creating additional products, such as handbags and jackets, expanding the range of items made from this material.

In addition to handbags and jackets, other products can also be made from the same denim fabric are also considered. It is important to identify the assumptions and constraints regarding the steady supply of raw materials. For instance, we assume that cotton will be imported, which is a constant part of our planning. Similarly, while lycra is now available locally, there might still be a need to import certain raw materials that are not available in the domestic market. Whenever we import materials, there are inherent constants to consider, such as time lag and dependency on the availability from another country.

So, these are the kinds of constants that exist. The stakeholders involved in this process include young customers, production engineers, distributors, retailers, and shareholders. This statement summarizes our discussion on developing a product. We have covered various design steps involved in product development and the importance of planning within an organizational setup. Effective planning is essential to minimize the risk of errors. In an organization, planning in advance reduces the possibility of failure in future by avoiding problems later in the process. If something has not been considered, then it will not work. To avoid such problems, effective planning is essential. With this, we conclude the session. Thank you.