# FINANCIAL AND COMMERCIAL EVALUATION OF PROTOTYPE-BASED PRODUCT DEVELOPMENT

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**ABSTRACT**

This paper provides a thorough and useful description of the process of turning a basic prototype into a product that is ready for the market. It highlights how crucial it is to identify real-world issues and comprehend client wants through efficient idea generation and market research. Prototyping then begins, during which preliminary designs are made and tested to assess the product's viability and functionality. Then, through beta testing, actual consumers engage with the product and offer insightful input that aids in improving its functionality.

Moreover, this study examines important operational phases like procuring raw materials, manufacturing, and quality control, highlighting how consistency and efficiency are crucial for large-scale production.It also covers the crucial business elements that help the product succeed in the market, such as pricing plans, packaging, branding, and storage. To guarantee economic viability, a number of financial factors are discussed, such as cost estimation, profit margins, and break-even analysis. Additionally, the need of intellectual property protection is highlighted as a way to preserve innovation and a competitive advantage.

By using structured approaches like New Product Development and the Stage-Gate model, the study shows how a methodical and step-by-step approach may lower risks, enhance decision-making, and improve overall product quality. Overall, it emphasizes that turning an idea into an effective and significant product requires a well-thought-out and repeated process.

**Keywords**- Market ready products, Patent, Material sourcing, Prototype development, Budgeting, Intellectual property, Financial planning, Raw material sourcing, product validation, Estimate Market Penetration, user-experience, supply chain management, quality control.

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## INTRODUCTION

This project paper focuses on the process making a market ready product from the prototype stage .

Following are some points you will come across in this paper :

## PROTOTYPE

The first working model made based on the idea of product. The process of making the prototype is called prototyping. This process helps us analyse the practicality of our Idea. It is one of the most crucial step during the process of making and launching a product.

Many steps are involved in order to make a successful prototype. Those steps are:

- Idea generation: Identification of consumer pain points and identifying the problems.
- Market Research: It includes surveying, internet and market research and taking samples. The solutions of the problems are identified.
- Product Sketching: Designing the product based on the research. [1]

## BETA TESTING

Beta testing is the process in which the product is tested in real world situation to identify the problems in the product's usage. In this ,customers from the targeted market use the product and give their opinion on their usage and real life practicality. [2]

## RAW MATERIAL SOURCING

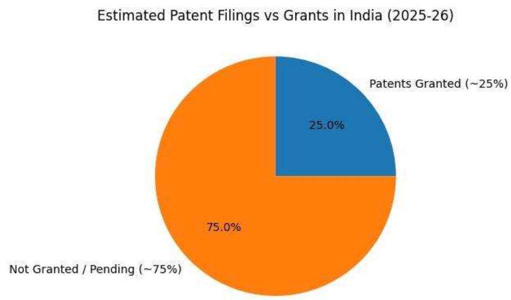
In this process , the raw materials required in the making of product are sourced from the market. Sourcing is done on the basis of cost efficiency and quality of the raw materials and the most suitable ones are then selected for the making of product. Finding suitable raw materials affects the sales of the product. Finding both quality and quantity in the least possible capital requirements is the main purpose of raw material sourcing .[3]

**PATENT**

A right buyed by the company which ensure that no other company or person can make a similar product until and unless the buy the right to do so. It is granted by the government by filling an application with national patent offices. [4]

In India during the year 2025-26, around1,40,000 patent filings were done and only 30000-35000 were granted.

**PRODUCTION OR MANUFACTURING**




The process in which final product is made from the raw materials with the help of machinery, Labour and other tools is called production or manufacturing of product. The quality checks are done in which Defective products are removed by doing visual and functional checks.[5]

**PRICING**

The making cost of product is calculated and in accordance to that the selling price of the product is set by the company. The price of the product should also be in accordance with the targeted consumers.[6]

**PACKAGING AND BRANDING**

The product is packed in a safe packaging and the brand identity is added to it. It is very important to choose the correct packaging and labelling to ensure that the product reaches the customer with any damage and also because the first impression of the product is very important .[7]

**STORAGE**

The finished products are then stored in a clean space under a preferable environment so as to maintain it's quality and retain it from deteriorating. It is very crucial to have a good storage system to reduce the wear and tears or any other type of change to the product to increase it's shelf life and to decrease the wastage .[8]

**MARKETING AND ADVERTISING**

Promoting the product through ads, posters, promotion and content creation. This is done to let more people discover the product which will lead to increase in sales of product. This helps in more engagement of the product.[9]

Finally , after going through all these steps, the product can finally be released into market for sales.

**METHODOLOGY**

**Converting a Prototype into a Product**

**New Product Development (NPD)**

This is the process of turning an idea or prototype into a marketable product or is the process of identifying a need in the market, creating a product to fulfill that need, testing it, and finally launching it for customers. [10]

**Stage-Gate Model**

It explains that a product is developed step-by-step and after each stage it is evaluated before moving to the next stage to ensure the product is ready for the market. In short, the process is divided into stages and after each stage there is a 'gate' where the product is evaluated before moving forward. [11]

- Idea Identification.
- Market Research
- Prototype Development
- Testing and Validation.
- Product Improvement
- Financial and Production Planning
- Commercialization

**Minimum Viable Product (MVP)**

- Used in modern innovation and startup methodology
- A basic version of the product is created first to test with customers before making a full product. [12]

**Prototype Development Cost**

- Prototype Development Cost refers to the total expenses involved in creating a prototype. This includes costs for materials, labor, design, and any additional overheads.
- Before going into full production, budgeting and determining whether the prototype is financially feasible are made easier with an understanding of these expenditures.
- Exact estimation guarantees the ability to control costs and make well-informed choices on future development. [13]

**Intellectual Property (IP) Management:**

- **Protection:** Secure your patents, trademarks, copyrights, and trade secrets to prevent other from using them without permission.
  **Monitoring:** Regularly check for unauthorized use or infringements of your IP and take necessary legal actions.
  • **Utilization:** Use your IP to gain a competitive edge, such as through licensing deals or strategic partnerships.

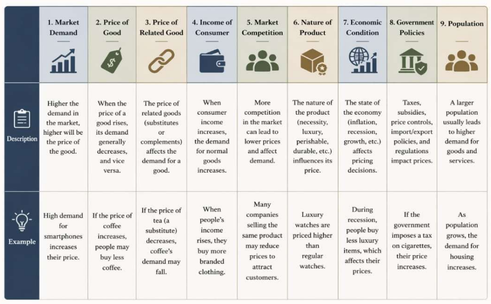
- Proper IP management safeguards your innovations and boosts your business. [14]

**Market Size:**

It's the total number of potential customers in the market.

- How many people might buy your product.

➢ **Factors that can affect market size: [15]**



| | 1. Market Demand | 2. Price of Good | 3. Price of Related Good | 4. Income of Consumer | 5. Market Competition | 6. Nature of Product | 7. Economic Condition | 8. Government Policies | 9. Population |
|---|---|---|---|---|---|---|---|---|---|
| Description | Higher the demand in the market, higher will be the price of the good. | When the price of a good rises, its demand generally decreases, and vice versa. | The price of related goods (substitutes or complements) affects the demand for a good. | When consumer income increases, the demand for normal goods increases. | More competition in the market can lead to lower prices and affect demand. | The nature of the product (necessity, luxury, perishable, durable, etc.) influences its price. | The state of the economy (inflation, recession, growth, etc.) affects pricing decisions. | Taxes, subsidies, price controls, import/export policies, and regulations impact prices. | A larger population usually leads to higher demand for goods and services. |
| Example | High demand for smartphones increases their price. | If the price of coffee increases, people may buy less coffee. | If the price of tea (a substitute) decreases, coffee's demand may fall. | When people's income rises, they buy more branded clothing. | Many companies selling the same product may reduce prices to attract customers. | Luxury watches are priced higher than regular watches. | During recession, people buy less luxury items, which affects their prices. | If the government imposes a tax on cigarettes, their price increases. | As population grows, the demand for housing increases. |

**Why 5x specifically?**

- The 5 times multiplier used in calculating the patent value is a common method for estimating the future economic benefits that the patent could bring. This method is frequently used in intellectual property valuation to take into consideration a number of variable, such as the future revenue, the patent's lifespan, market conditions and the innovation's strategic worth.[16]

**Financial Calculations - Converting Prototype into Product**

**Cost of Production**

The cost of labor, material and other expenses are added to determine the overall cost of producing one unit of the product.

- Cost of material = ₹80
- Labor cost = ₹40
- Other expenses (packaging, electricity, etc.) = ₹30
- Total cost = 80 + 40 + 30

Total cost = ₹150 per product [17]

**Selling Price**

The product's selling price is determined after rival pricing and market demand are examined

- Selling price = ₹200 per product [18]

**Profit Calculation**

The cost of production is deducted from the selling price to determine profit.

Profit = Selling Price – Cost of Production

Profit = 200 – 150

Profit = ₹50 per product [19]

**Profit Margin**

Profit Margin = (Profit ÷ Selling Price) × 100

Profit Margin = (50 ÷ 200) × 100

Profit Margin = 25% [20]

**Break-Even Point**

The number of supplies needed to recover the initial investment is indicated by the break-even point.

Initial investment = ₹ 5000

- Profit per product = ₹50
- Break– even point = initial investment × profit per product

Break-even point = 5000 / 50

Break-even point = 100 products

This implies that in order to recover the initial expenditure, the business needs to sell 100 products. [21]

**Demand Estimation**

Demand estimation aids in estimation the potential number of buyers.

Example:

- Total people surveyed = 50
- People interested in buying = 30

Demand percentage = (Interested people /Total people) × 100

Demand = (30 ÷ 50) × 100

Demand = 60%

Thus, over 60% of consumers expressed interest in the product. [22]

**Revenue projection**

Revenue is the total amount of money received from the product's sale.

Formula:

Revenue = selling price × number of units sold

Example:

- Selling price = ₹200
- Units sold = 100
- Revenue = ₹20,000 [23]

**Estimated total profit**

Formula :

Total profit = profit per product × Number of products sold

Example:

- Profit per product = ₹50, Unit sold = 100
- Total profit = 50 ×100 = ₹5,000 [24]

**Market Penetration Rate**

A predicted percentage that shows how much of a target market is anticipated to adopt a product or service is called the **Estimated Market Penetration Rate**. Instead of using real data, it is computed using forecasts, market research, or predictive models. Even in situations where precise numbers are unavailable, this approximation aids in the computation of possible market share and strategy planning. [25]

**Market Penetration Rate = (Number of Customers ÷ Total Target Market) × 100**

• **Factors that can affect MPR are:**


## LITERATURE REVIEW

**Christer W. Elverum, Torgeir Welo, and Sigmund Tronvoll** state that prototyping is important for product development. It ensures teams validate product ideas and their functionality to align with customer desires. In design thinking, prototypes foster innovation and accelerate learning. Early prototypes are basic, quick, and inexpensive to create. These early models let teams experiment and improve designs before the big final production.[26]

**Maria C. Yang** explains how prototypes allow designers to validate and iterate product concepts before the real product is built. Prototypes facilitate design experiments and alternatives. Her study shows that less-complex prototypes result in superior design success. More time spent on a project does not correlate to success. Early and low-complexity prototyping leads to successful designs.[27]

**Nagendra K. Maurya, Vikas Rastogi, and Pushpendra Singh** define rapid prototyping as a process that creates physical products directly from 3D CAD models. It reduces the time and money spent on product development. Prototyping enables product validation and allows for enhancements before scaling up production. The technology constructs items in layers, simplifying the creation of intricate geometries. You'll find it used a lot in engineering, medicine, and cars but honestly, it's best for prototypes or small production runs, not big numbers.[28]

**Andrew Wodehouse, Abigail Hird, and Konstantinos Petrakis** discuss how prototyping is not only relevant to industry but also fundamental to design education as it enables students to visualize, validate concepts and understand product functionality prior to final output. Moreover, creativity is enhanced by prototypes, design processes inform decision making and collaboration is also enhanced by prototypes. Students receive feedback, notice problems and twist their designs by testing and building.For better project outcomes and better understanding, early prototyping is essential.[29]

**Mei Cao, Mark A. Vonderembse, and Qingyu Zhang.** Companies keep customers happy by developing better products through product concept flexibility (CF) as well as prototype flexibility (PF). Companies get feedback from their customers and faster model building through PF and a lot of new ideas are explored by companies through CF. Taking a look at the data, from 273 manufacturing firms, customer satisfaction was tested through research and how it impacts them. This unfolds that satisfactions are boosted by both CF and PF in both ways. Firms that develop different ideas, and construct prototypes quickly, react better to what the consumers want and the changes happening in the market [30]

**Nitish M. Devadiga** This paper integrates rapid prototyping into the Architecture Centric. Design Method (ACDM) at Stage 1 to solidify requirements early through iterative throwaway prototypes. This reduces rework, fewer iterations in later ACDM stages, and produces informal architectural docs that speed up formal design. Experimental data showed more time in requirements/design leads to less development time and fewer defects. The approach best suits large, complex projects and helps cut post-delivery maintenance costs caused by misspecification.[31]

**L Rivero, T Conte** say this paper proposes the Web DUE technique for finding usability problems in low-fidelity mockups of Web applications during early design. It uses Web page zones with usability checklists to guide inspectors. A supporting Mockup DUE tool simulates mockup interaction. Empirical studies showed Web DUE outperformed its predecessor (WDP) ineffectiveness and efficiency, and inspectors were satisfied with the tool (avg. 7.7/10), enabling early, cost-effective usability detection before coding begins. [32]

**BW Behm's** Spiral Model is a risk-driven software process model where each cycle involves identifying objectives, evaluating alternatives, resolving risks (via prototyping, simulation, etc.), and planning the next phase. Unlike the document-driven waterfall or code-driven evolutionary models, it adapts to project needs becoming equivalent to whichever model best fits the current risk profile. It incorporates prototyping, reuse, and incremental development as risk-resolution options. Victoriously applied at TRW-STS (badging 50% games of productivity) it suits big, complex systems though experienced personnels are required for effective assessment of risk .[33]

**Nadezhda Kunicina, Anatolijs Zabasta, Antons Patlins, Ivana Bilic, and Janis Peksa** present the Spiral Model as an iterative, risk-driven process, where each round sets goals, assesses options, tackles risks, and plans the next phase. It mixes waterfall, prototyping, and evolutionary development, tailoring itself to each project's risks. Every loop finishes with a review by stakeholders and commits plans and resources, it works for both development and maintenance. It's powerful for complicated systems, though you need risk-assessment skills and it's tough to fit into classic fixed-price contracts.Without diving fully into spiral processes a monthly risk management plan proves to be beneficial for the groups.[34]

**Fei Tao, Fangyuan Sui, Ang Liu, Qinglin Qi, Meng Zhang, and Boyang Song** discuss how digital twin technology links a real product with its virtual model using real-time data. It merges physical and digital systems so information flows all through the product's life.The state of the real world, the needs of the users and the performance of the product is felt better by the designers. Virtual testing is allowed by the framework before production so that problems are identified early and design updation is quicker. With feedback from the user and utilising sensor data, IOT makes the process quicker, affordable and smarter. In conclusion design of the product is more accurate, smart and data driven.[35]

**Yujin Jeong and Byungun** Yoon explain how patent road maps help companies to plan their future patents with technological roadmaps .Instead of creating patents at random, organizations can study their past patent data to understand the trends in patents. Tools like TEMPEST and SCAMPER can be used to review patents according to different criteria to understand how the technology roadmaps relate to the patents. Additionally, there are two main roadmaps that can be created for companies: a roadmap for the technology developments and a roadmap for the patents that will be created. By studying these trends and roadmaps, organizations can understand the inventions that will be required for the future and make plans accordingly. Thus, organizations can become better competitors and enjoy improvements in their innovations overall.[36]

**Iñigo Ezpeleta, Daniel Justel, Unai Bereau, and Julen Zubelzu** created a new method for Design for Assembly, called DFA-SPDP, to improve the assembly of products throughout the design process. Traditional methods like the Boothroyd-Dewhurst, Lucas, Hitachi AEM, and the Modified Westinghouse method can assist with specific phases of the Design for Assembly process, but none of them cover the complete design process. The authors created a method that integrated the features of each of these methodologies to provide designers with assistance from the specification stage until detailed design. This method can help to reduce the time, cost, and complexity of assembly. There are three main stages to this methodology: specification, conceptual design, and detailed design. Each of these stages examines the efficiency of the design, how easily the components will be handled and inserted into the product, the time necessary to assemble the product, and the cost of the assembly process. When applied to a stapler model, the authors found opportunities for improvement in the insertion of the stapler components. Although this method takes some additional time to implement into the design process, it can provide designers with deeper insights and better support in the creation of their products.[37]

**T Maiorana** emphasizes that the tensions within a system are not issues to be eliminated but essential elements of its design. By making tensions part of the design thinking process, through storytelling, mapping out the system, or role play, designers can discover insights about the systems in question. Opening up tensions within a system causes people to have strong emotional responses to the situation. These emotional responses can influence the actions that people take within the system in question. The authors define the four Fs: fight, flight, freeze, and feel. People can fight to defend themselves, flight to run away from the tension, or feeling freeze to feel stuck in the system. The best way is to feel the tension in the system, understand it, and use it to create change in the system in question. It is not enough to analyze a system technically; designers must also deal with the emotional side of tensions within a system to create big changes in society.[38]

**Martin O'Driscoll** identifies the gap between product design and manufacturing capabilities as a major factor contributing to inefficiencies in manufacturing. Producers frequently face setbacks, heightened costs, and difficulties in their manufacturing processes due to developing designs that overlook manufacturing capabilities. O'Driscoll introduces the idea of Design for Manufacture (DFM) as a means to incorporate manufacturing capabilities into product design, potentially leading to enhanced manufacturing efficiency and superior product quality.[39]

**MW Fu and WF Lu** emphasize the necessity of incorporating design requirements into the product development process. Their study of the current requirements in manufacturing and development reveals that designers need to consider both production speed and customer satisfaction. The researchers suggest a system for structuring and disseminating design requirements, potentially enhancing development processes and ensuring successful production of the designed products.[40]

**John C. Mankins** developed Technology Readiness Levels (TRLs) to evaluate the maturity of different technologies. These levels span from the basic research of a technology to its practical implementation. Agencies such as NASA utilize these levels to identify possible challenges in integrating new technologies into their operational frameworks, which aids in guaranteeing that the technologies are dependable and effective in their functions.[41]

**Zhigang Wei, Michael Start, Jason Hamilton, and Limin Luo** conducted research on various methods for validating the reliability of automotive parts. The researchers identified three primary approaches for testing the reliability of these components: life testing, binomial testing, and degradation testing. The researchers suggested a framework for these tests that featured a damage-cycle diagram, enabling the incorporation of each testing method into a unified framework. This framework can assist in evaluating the reliability of components, resulting in economical testing methods.[42]

**Rushil Khurana and Steve Hodges** examine the difficulties involved in moving a product from prototype to full-scale production. While contemporary tools greatly simplify product prototyping, achieving the same level of consistency and efficiency during large-scale manufacturing frequently poses difficulties. By interviewing specialists in the area, the authors discovered that insufficient technical knowledge, production preparedness, and professional connections are the primary obstacles to increasing manufacturing capacity. The research suggests that improving the tools, strategy, and collaboration during the prototyping stage will facilitate the shift to manufacturing production for these items.[43]

**Senthil Kumar Ramakrishnan, KR Vijaya Kumar, and J Hameed Hossain** investigate the influence of cost reduction on the process of developing new products. The writers discover that maintaining a balance between cost-effectiveness, quality, and market competitiveness is crucial in the development process. Moreover, they discover that cost is frequently taken into account during the initial phases of development, highlighting the significance of cost factors right from the beginning of a product development process. Aligning a company's cost strategies with its corporate objectives will ultimately enhance efficiency and profitability.[44]

**Michele Peruzzini** believes that human-centered design is crucial for developing effective products. By understanding the needs, actions, and experiences of customers and users of a product, manufacturers and designers can ultimately develop a product that is both easy to use and pleasurable. By integrating aspects of ergonomics, psychology, and a grasp of user experience (UX) into their creations, designers can develop products that meet the needs of their intended clients. Peruzzini notes that human-centered design has achieved significant progress in the past but suggests a requirement for more structured approaches to human-centered design processes.[45]

**Albert Sanders and John Klein** advocate for employing systems engineering to tackle challenges concerning product design, manufacturing, and supply chain management. Neglecting these concerns during the product design phase and following a linear method, where these issues are only tackled at the conclusion of the process, may lead to increased production expenses for the business. The authors suggest employing an industrial V-model to tackle product design as well as manufacturing and supply chain challenges, aiming to create a more effective and cost-efficient manufacturing method.[46]

**Rogers, Lambert, and Knemeyer** examine the procedure of developing and marketing products in the realm of supply chain management. The piece examines how businesses collaborate with their suppliers and clients to effectively develop and market their products. Different roles in a company need to be synchronized to effectively market a product. By outlining the various sub-processes involved in a product's commercialization, businesses can effectively introduce their products and thrive in the market.[47]

**Andrzej Sioma** addresses the significance of vision systems in upholding the quality of products produced during manufacturing. The article explores the use of imaging and image analysis technology in ensuring the quality of manufactured products and highlights the importance of these systems in quality management processes such as TQM and MES. The rising adoption of advanced imaging technologies featuring higher resolutions and three-dimensional functions has enhanced the precision of quality control procedures throughout the manufacturing process.[48]

**Baylor and Tillman** talk about the steps involved in obtaining regulatory approval for products in the biotechnology and biomedical fields. Different regulatory bodies guarantee that biotechnology and biomedical products meet the necessary standards to safeguard public health and safety. Different standards must be satisfied throughout the approval process for these products. These standards are established to guarantee that the products will be safe and advantageous for the consumers.[49]

**Gans and Stern** explore various approaches that can be utilized in the commercialization of innovative technologies. Technology startups and entrepreneurs can utilize these strategies to guarantee that their innovations successfully enter the market and fulfill their intended purposes. The writers examine the creation of a marketplace for ideas and investigate the possibilities of collaborating with or competing against current organizations within the sector. Market conditions influence these strategies, along with the probability of success for the firms engaged in the creation of the innovative technology.[50]

**William Odom, Ron Wakkary, Youn-kyung Lim, Audrey Desjardins, Bart Hengeveld, and Richard Banks** examine the shift from research prototypes to research products. The authors explain that research prototypes are frequently inappropriate for extended use in the mentioned applications. Rather, the research output should be more thorough, beneficial, and autonomous. Various key aspects are examined, including design based on research, achieving correctness ultimately, ensuring functionality, and maintaining independence. This method enables research to occur in the domain of human-computer interaction and opens up possibilities for future advancements in computer system design.[51]

**Conclusion**

In conclusion, turning a prototype into a profitable product that is ready for the market is a difficult process that calls for both innovation and demanding execution. This study emphasizes the idea that the process contains several interrelated stages, each of which contributes to the end result, rather than just creating a workable model. Every stage is essential to guaranteeing the product's efficacy and relevance, from comprehending consumer wants and carrying out market research to creating, testing, and improving the prototype.

The report also highlights Although the importance of practical factors like obtaining high-quality raw materials, maintaining effective manufacturing procedures, and putting in place extreme quality controls. Business-oriented elements including pricing tactics, packaging, branding, and storage also have an impact on the product's performance.

Additionally, the product's position is strengthened and unauthorized usage is prevented when the innovation is protected by intellectual property rights. Throughout the development cycle, using organized methods like the Stage-Gate model and the Minimum Viable Product strategy improves efficiency, lowers risks, and directs decision-making. All things considered, an orderly, methodical approach empowers inventors to successfully transform their concepts into useful, competitive, and profitable goods in the actual world

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