

Unit 08

Entrepreneurship in Digital Age



After completing this lesson, you will be able to:

- understand what is prototyping and why is it important
- Create, test and iterate a prototype for a business idea



SMALL BUSINESS



8.1 Introduction to Product Development

Many people keep on thinking about which business to choose from, but startups are easy to create especially for young professional who are yet to start their career. Entrepreneurship therefore requires skills, qualities and traits to undertake the risks to launch business and takeoff with success.

The field of product development is dynamic and offers a range of opportunities for those who are passionate about creating impactful and user-centred solutions. Whether you choose a career in technology, healthcare, entertainment, or any other industry, the principles you've learned here will serve as a solid foundation for success. Embrace the journey ahead with enthusiasm, and continue to learn and grow in the exciting world of product development.

8.1.1 Definition of a Product or Service

In the world of business and innovation, a product or service is the fundamental outcome of a complex process designed to meet a specific need or want of consumers. Products and services are tangible or intangible offerings that are created, developed, and delivered to address a particular problem, enhance convenience, provide entertainment, or fulfill any other customer requirement.

Products are typically physical items that can be seen, touched, or held. They range from everyday goods like smartphones, clothing, and automobiles to industrial machinery and consumer electronics.

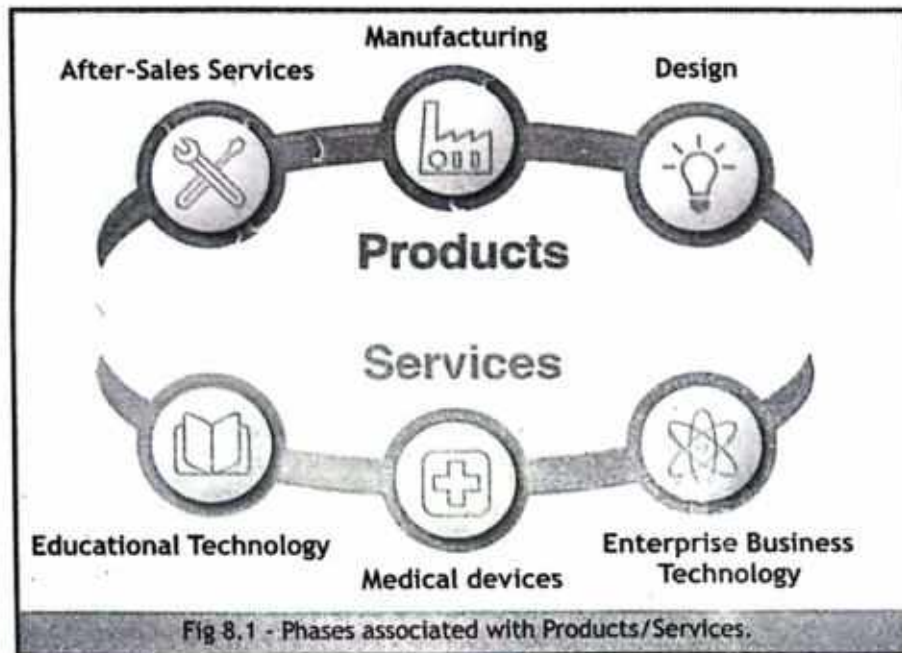


Fig 8.1 - Phases associated with Products/Services.

Services, on the other hand, are intangible and often involve a specific action or task performed by individuals or organizations. These can encompass a wide array of offerings such as healthcare services, consulting, education, and entertainment streaming.

8.1.2 Importance of Successful Product Development

Successful product development is a cornerstone of business sustainability and growth. It is not just about bringing a new item to the market; it's about doing so effectively and efficiently. Here's why it's crucial:

1. **Competitive Advantage:** A well-developed product or service can set a company apart from competitors. It can offer unique features, better quality, or a more appealing price point, making it the preferred choice for customers.
2. **Revenue Generation:** New products and services can open up revenue streams, expanding a company's customer base and increasing profits.
3. **Customer Satisfaction:** By addressing the specific needs and wants of consumers, successful products and services enhance customer satisfaction and loyalty.
4. **Innovation and Adaptation:** Product development keeps a company at the forefront of its industry, encouraging innovation and the ability to adapt to changing market dynamics.
5. **Market Expansion:** Developing new products or services allows a company to explore new markets and demographics, further diversifying its business.

8.2 Understanding Prototypes

8.2.1 What is a Prototype?

In the realm of product development, a prototype is a tangible or digital representation of a product or a part of it, created during the design and development phase. It serves as a preliminary model that allows designers, engineers, and stakeholders to visualize, test, and refine the concept before committing to full-scale production. Prototypes can vary in fidelity, complexity, and purpose, but they all share the common goal of providing valuable insights and feedback to improve the final product.

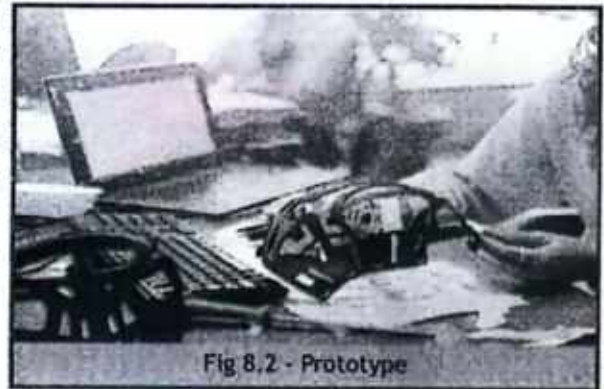


Fig 8.2 - Prototype

Types of Prototypes

1. Low-Fidelity Prototypes:

Sketches and Wireframes: These are simple, hand-drawn or digital representations that focus on the basic layout, structure, and flow of a product. They are quick and inexpensive to create and are ideal for early-stage ideation and concept validation.

2. Medium-Fidelity Prototypes:

Paper Prototypes: These involve creating physical, interactive models using paper, cardboard, or other easily manipulable materials. They offer a more detailed representation than sketches and are suitable for user testing and gathering initial user feedback.

3. High-Fidelity Prototypes:

Digital Prototypes: These are interactive, computer-generated simulations of the final product. They closely resemble the user interface and functionality of the actual product, making them valuable for user testing, usability studies, and investor or stakeholder presentations.

4. Functional Prototypes:

Proof-of-Concept Prototypes: These demonstrate the core functionality and technical feasibility of a product but may lack the full aesthetic design. They are used to test technical aspects and validate the feasibility of a concept.

5. Working Prototypes:

Alpha Prototypes: These are advanced, functional versions of a product with most features and components in place. They are typically used for internal testing and refinement.

Beta Prototypes: These are near-final versions of a product that are made available to a select group of users or testers. Beta testing helps identify any remaining issues or bugs before the product's official release.

8.2.2 Importance of Prototyping in the Product Development Process

Prototyping is a crucial and integral part of the product development process for several reasons:

1. **Visualization and Communication:** Prototypes provide a tangible way to communicate ideas and concepts to stakeholders, team members, and potential users. They make abstract ideas concrete and help everyone involved understand the vision.
2. **User-Centered Design:** Prototyping allows designers to gather feedback from end-users early in the development process. This user-centric approach ensures that the final product addresses real user needs and preferences.
3. **Risk Reduction:** By creating prototypes, developers can identify and address design flaws, technical challenges, and usability issues before investing significant resources in full-scale production. This helps mitigate risks and reduces the likelihood of costly errors.
4. **Iterative Development:** Prototyping supports an iterative design approach, where multiple versions of a product are created and improved upon based on feedback. This iterative process leads to a more refined and user-friendly end product.
5. **Cost Savings:** It is generally more cost-effective to identify and rectify problems during the prototyping phase than after the product has been manufactured or deployed. Prototypes help prevent costly design changes late in the development cycle.
6. **Investor and Stakeholder Confidence:** High-fidelity prototypes can be used to secure funding and gain the confidence of investors, as they provide a realistic preview of the final product's capabilities and potential.

In summary, prototypes are invaluable tools in product development, allowing teams to explore ideas, engage with users, and refine concepts to create products that are more likely to succeed

In the market. They support an iterative and user-centered design process, ultimately leading to better, more user-friendly, and cost-effective products.

8.3 Creating Prototypes

8.3.1 Tools and Materials for Creating Prototypes

Creating prototypes is a vital part of the product development process, allowing you to turn your ideas into tangible models for testing and refinement. The choice of tools and materials depends on the type of prototype you're building and your project's requirements. Here are some commonly used tools and materials:

1. Sketching and Paper Prototypes:

- **Sketchbooks and Paper:** Basic sketching materials like pencils, pens, markers, and paper are essential for low-fidelity paper prototyping.

2. Digital Prototyping:

- **Design Software:** Use graphic design or prototyping software like Adobe XD, Sketch, Figma, or InVision to create interactive digital prototypes with realistic user interfaces.
- **Coding:** For high-fidelity interactive prototypes, web and app developers may use HTML, CSS, and JavaScript to create functional prototypes.

3. 3D Modeling and Printing:

- **3D Modeling Software:** Tools like Autodesk Fusion 360 or Blender are used for creating 3D models of physical products.
- **3D Printers:** For physical prototypes, 3D printers can transform digital designs into tangible objects.

4. Materials for Physical Prototypes:

- **Clay and Sculpting Materials:** Useful for creating sculptures or models of product designs.
- **Cardboard and Foamboard:** Excellent for building low-cost, low-fidelity physical prototypes.
- **Wood, Plastic, or Metal:** For more durable and high-fidelity physical prototypes, these materials are commonly used.

5. Prototyping Kits:

Some projects may benefit from specialized prototyping kits that include a combination of materials, tools, and components, such as Arduino kits for electronics prototypes.

6. 3D Scanners:

These devices can be used to scan existing objects and convert them into digital models for modification or replication.

8.3.2 Building Low-Fidelity Prototypes

Low-fidelity prototypes are essential for quickly visualizing and testing early-stage concepts. Here's how to build them effectively:

1. Sketching and Paper Prototypes:

- Start with rough sketches and drawings of your product or interface on paper. Keep it simple and focus on layout and basic functionality.
- Use sticky notes or index cards for interactive elements, and simulate user interactions by manually moving or swapping them.
- Conduct usability tests with team members or potential users to gather feedback and make improvements.

2. Digital Prototyping (Low-Fidelity):

- Create wireframes or mockups using design software. These are simplified representations of the final product with minimal details.
- Use placeholder text and generic icons to convey content and functionality.
- Test the digital prototype with stakeholders or users to gather feedback on the overall layout and user flow.

3. Physical Prototypes (Low-Fidelity):

- Utilize readily available materials like cardboard, foamboard, or clay to build physical mockups of your product.
- Focus on the basic form, size, and functionality while keeping aesthetics secondary.
- Test the physical prototype for ergonomics, usability, and fit within the intended environment.

The 8 Most common prototyping methods are: Sketches and Diagrams, Paper Interfaces, Storyboards, Lego Prototypes, Role Playing, Physical Models, Wizard of Oz (faked) Prototyping and User Driven Prototypes.



Teacher's Guide

"What is a Prototype?"

<https://www.twinkl.com/teaching-wiki/prototype>

A fine resource with simple language and clear pictures to explain the concept of prototypes.

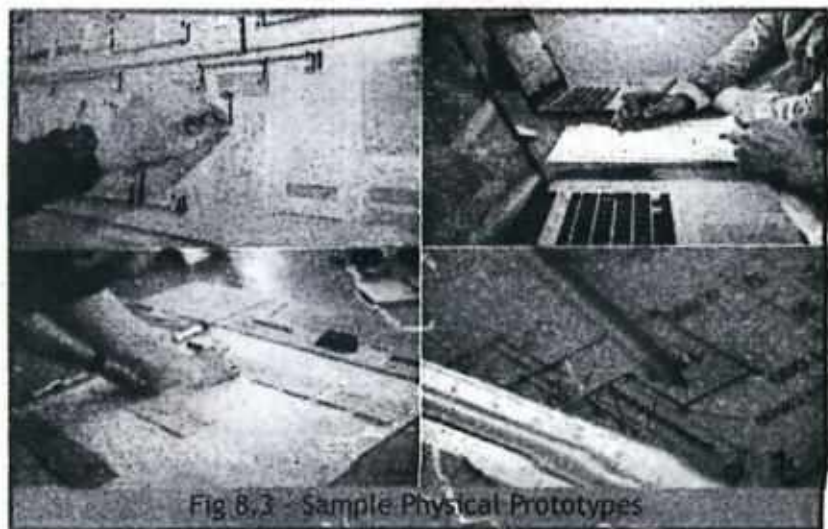


Fig 8.3 - Sample Physical Prototypes

8.3.3 Iterative Design and Refinement

Prototyping is an iterative process that involves creating, testing, and refining your designs multiple times. Here's how to approach iterative design and refinement:

1. **Gather Feedback:** Collect feedback from users, team members, and stakeholders after each round of testing. This feedback should focus on usability, functionality, and overall user experience.
2. **Analyze Data:** Analyze the data and observations from usability tests to identify areas of improvement. Look for common pain points, issues, and patterns in user behavior.
3. **Iterate:** Based on the feedback and analysis, make necessary changes and improvements to the prototype. This may involve revising the design, altering the user interface, or addressing technical issues.
4. **Repeat Testing:** After making revisions, conduct further testing with the updated prototype. Continue this cycle of testing, analysis, and refinement until the prototype meets the desired goals and user needs.
5. **High-Fidelity Prototyping:** As the design matures and you gain confidence in the concept, transition to high-fidelity prototypes with more realistic details, including graphics, colors, and interactive elements.
6. **Final Validation:** Use high-fidelity prototypes for final validation with users and stakeholders. Ensure that the product aligns with expectations and is ready for further development stages, such as production or coding.
7. **Documentation:** Document the changes and decisions made during each iteration to maintain a record of the design evolution. This documentation can be valuable for reference and future development.

Iterative design and refinement through prototyping are key to creating products that are user-friendly, functional, and aligned with your project's goals. The process allows you to catch and address issues early, reducing the risk of costly changes later in the development cycle.



Teacher's Guide

"The ABCs of Making: C is for Cardboard"

<https://www.tinkercad.com/blog/the-abc-of-making-c-is-for-cardboard>

a good resource for creating cardboard prototypes with a step by step guide.

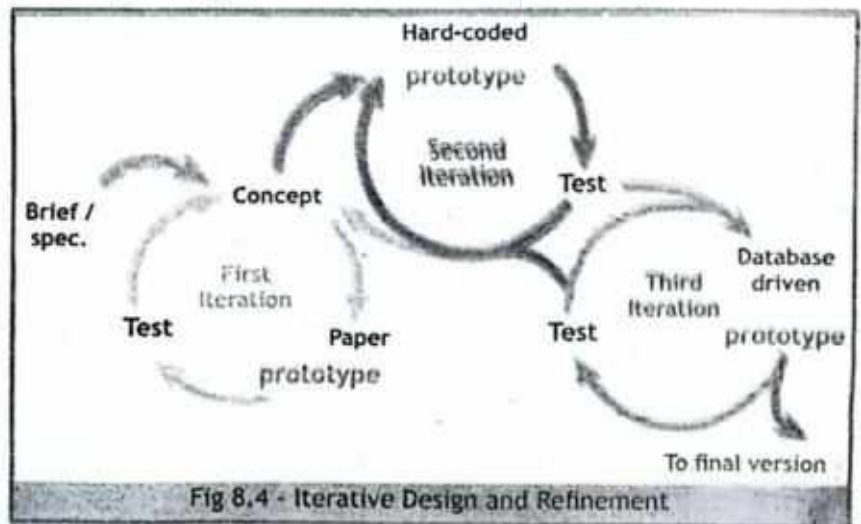


Fig 8.4 - Iterative Design and Refinement

8.4 Testing Prototypes

8.4.1 Importance of User Testing

User testing is a critical phase in the product development process, and its importance cannot be overstated. It serves several essential purposes:

1. **User-Centered Design:** User testing helps ensure that the final product aligns with the needs, preferences, and expectations of the target audience. This user-centric approach leads to a more satisfying and functional end product.
2. **Identifying Issues:** Testing prototypes allows you to identify and address usability problems, technical glitches, or design flaws early in the development cycle. This can save time and resources by preventing costly changes later on.
3. **Validation:** User testing validates the assumptions and design decisions made during the development process. It confirms whether the product concept effectively solves the identified problem or meets the intended goals.
4. **Feedback Collection:** Gathering feedback from real users provides valuable insights into their thoughts and experiences. This feedback can inform design improvements and refinements.
5. **Usability Improvement:** Usability testing specifically focuses on how users interact with the product. It helps improve the user interface, navigation, and overall user experience.
6. **Iterative Refinement:** The results of user testing drive an iterative design and development process, allowing you to make incremental improvements until the product meets or exceeds user expectations.

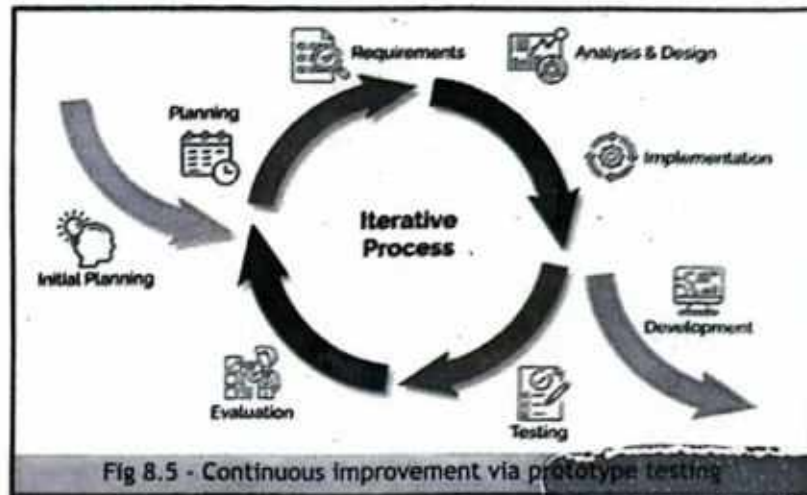
8.4.2 Analyzing and Interpreting Test Results

Analyzing and interpreting test results is crucial for making informed design decisions and improvements. Here's how to approach this process:

1. **Data Collection:** Collect both quantitative data (e.g., task completion rates, time spent, survey responses) and qualitative data (e.g., user comments, observations) during testing.
2. **Data Analysis:** Organize and analyze the collected data to identify patterns, trends, and outliers. Look for common usability issues or areas where users struggled.
3. **Prioritization:** Prioritize the identified issues based on their severity and impact on the user experience. Focus on addressing critical issues first.
4. **Iterative Changes:** Use the test results to inform iterative changes to the prototype. This may involve adjusting the user interface, improving navigation, or fixing technical bugs.
5. **Validation:** Re-test the prototype after making changes to ensure that the issues have been resolved and that the user experience has improved.
6. **Documentation:** Document the results of each testing phase, the changes made, and the rationale behind those changes. This documentation serves as a valuable reference and can help track progress.

7. **Continuous Improvement:** Recognize that testing and refinement are ongoing processes. Continue to test and iterate until the prototype meets the desired level of usability, functionality, and user satisfaction.

By conducting user testing and effectively analyzing the results, you ensure that your prototype evolves into a final product that not only meets user needs but also provides an exceptional user experience. This user-centric approach increases the likelihood of success in the market and fosters customer satisfaction and loyalty.



8.5 Building and Launching the MVP

8.5.1 Developing the MVP

Minimum Viable Product (MVP) is a critical concept in product development, representing the most basic version of your product that includes essential features for addressing the core problem or need of your target audience. Here are key steps in developing the MVP:

1. **Feature Prioritization:** Identify the core features and functionalities that are absolutely necessary to address the primary problem or need. These features should provide value to early users.
2. **Simplicity:** Keep the MVP as simple and lean as possible. Avoid feature creep and focus on delivering a streamlined user experience.
3. **Rapid Development:** Utilize agile development methodologies to build the MVP quickly. This allows for flexibility in responding to changing requirements and user feedback.
4. **Testing:** Continuously test the MVP with real users to gather feedback and validate assumptions. Iterate and make improvements based on user insights.
5. **Scalability:** While the MVP is minimal, design it in a way that allows for scalability in the future. Ensure that the architecture and technology choices support future enhancements.
6. **User Onboarding:** Pay attention to user onboarding and guidance within the MVP. Make it easy for users to understand how to use the product effectively.



Successful Business Examples

Facebook:

- **Approach:** Facebook initially started as a social networking platform for college students but followed an iterative development approach. They continuously added features, expanded to different user demographics, and acquired companies like Instagram and WhatsApp.
- **Success:** Facebook is now one of the largest social media platforms globally, with over 2 billion monthly active users. Its iterative approach allowed it to adapt to changing user needs and preferences.

Amazon:

- **Approach:** Amazon began as an online bookstore and gradually expanded into a vast e-commerce platform. They embraced iterative development by experimenting with new features, such as user reviews and recommendations, and expanding into new product categories.
- **Success:** Amazon is now one of the world's largest online retailers, offering a wide range of products and services, including Amazon Web Services (AWS) and Amazon Prime. Its focus on continuous improvement and customer-centric design has been key to its success.

Netflix:

- **Approach:** Netflix started as a DVD rental service and transitioned into a streaming platform. They continuously analyzed user data to improve their recommendation algorithms and content offerings.
- **Success:** Netflix is now a global streaming giant with millions of subscribers worldwide. Its iterative approach to content production and personalized recommendations has revolutionized the entertainment industry.



Successes and failures: Lessons Learned

Twitter's Early Failures:

- **Challenge:** Twitter faced multiple technical issues and outages in its early years due to rapid user growth. Scalability and infrastructure challenges posed significant obstacles.
- **Lesson Learned:** Twitter's perseverance and commitment to continuous improvement allowed it to address these issues over time. It learned the importance of investing in infrastructure and scalability to support its growing user base.

Snapchat's User-Driven Features:

- **Challenge:** Snapchat initially faced criticism for its seemingly simple and ephemeral messaging concept. It needed to continuously innovate to stay relevant and compete with larger social media platforms.
- **Lesson Learned:** Snapchat's iterative development approach included introducing new features like Stories, Filters, and Discover, which catered to user preferences. The company learned the importance of listening to its young user base and adapting to their evolving needs.

Airbnb's Trust and Safety Concerns:

- **Challenge:** Airbnb faced trust and safety challenges as hosts and guests encountered issues such as property damage and security concerns.
- **Lesson Learned:** Airbnb invested in robust trust and safety measures and continually improved its platform based on user feedback. It demonstrates the importance of maintaining a strong focus on user safety and trust, even in the sharing economy.

Uber's Global Expansion:

- **Challenge:** Uber faced regulatory challenges and resistance in various markets during its rapid global expansion.

- Lesson Learned: Uber learned the importance of adapting its business model and strategies to address local regulations and cultural differences. It emphasized the need for flexibility and collaboration in overcoming market-specific challenges.

These case studies illustrate the power of iterative development and continuous improvement in the success of various products and services. They also highlight the importance of resilience, adaptability, and user-centricity in overcoming challenges and achieving long-term growth.



Pakistan's Successful Business Startups

Tajir:

- Tajir is a business-to-business platform for small businesses.

GrocerApp:

- GrocerApp is a low-cost online grocery store that allows customers to order products from a variety of categories and have them delivered right to their door.

Dawaai:

- Dawaai is a digital health platform that includes an online pharmacy network and generic pharmaceuticals.

Finja:

- Finja is a financial services platform that provides professionals and SMEs with payment, loan, and collection services.

Salesflo:

- Salesflo is a business-to-business platform that allows retailers to place orders directly with manufacturers, wholesalers, and authorized distributors.

Daraz.pk:

- Daraz is an online retailer that sells branded clothing, footwear, apparel, jewelry, and accessories for men and women.

Bykea:

- Bykea is a social impact app that saves clients time and money by providing INSTANT transport and courier services.

Cheetay:

- Cheetay is Pakistan's fastest-growing NOW-Commerce platform, with five verticals to choose from.

SadaPay:

- In Pakistan, SadaPay is a "neobank."

TAG:

- TAG is Pakistan's first digital bank.

Zameen.com:

- Zameen is Pakistan-specific software that assists people in navigating the real estate market.

CarFirst:

- CarFirst is a marketplace in Pakistan for selling secondhand vehicles quickly. WE BUY CARS AT CarFirst.com.

Pakistani Entrepreneur Example

Neuro-Mat provides a classical example of an e-health startup. A comfortable mat, as shown in Fig-8.6, is equipped with sensors such that basic parameters of an elderly or a patient can be monitored while resting.



Fig 8.6 - E-health Startup product Neuro Mat

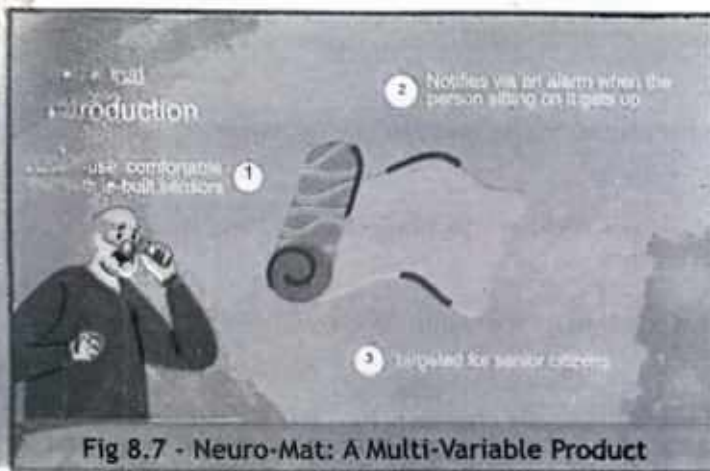


Fig 8.7 - Neuro-Mat: A Multi-Variable Product

The product 'Neuro-Mat' is a multi-sensory mat, which not only provides comfort but also collects data using sensors for monitoring the elderly and patients movements. The uses of the mats are multiple in terms of comfort and observation of a patient's health. The mat is furnished with an alarm which buzzes and intimates the attendants and health staff when the patient leaves the mat, as shown in Fig-8.7.

The inspiration was taken by the startup from the less number of health care staff in certain places. So, they came up with the idea to minimize the tedious task of continuous monitoring of patient, while staying physically with the patient. Absence of a support staff can minimize the elderly's mobility and injury to a patient, as shown in Fig-8.8.

With the use of Neuro-Mat, health care staffs are now in a better position to accommodate and support multiple patients, simultaneously.

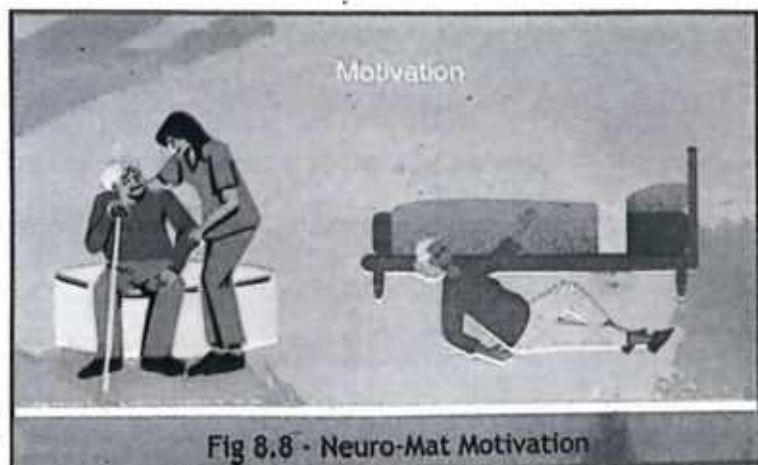
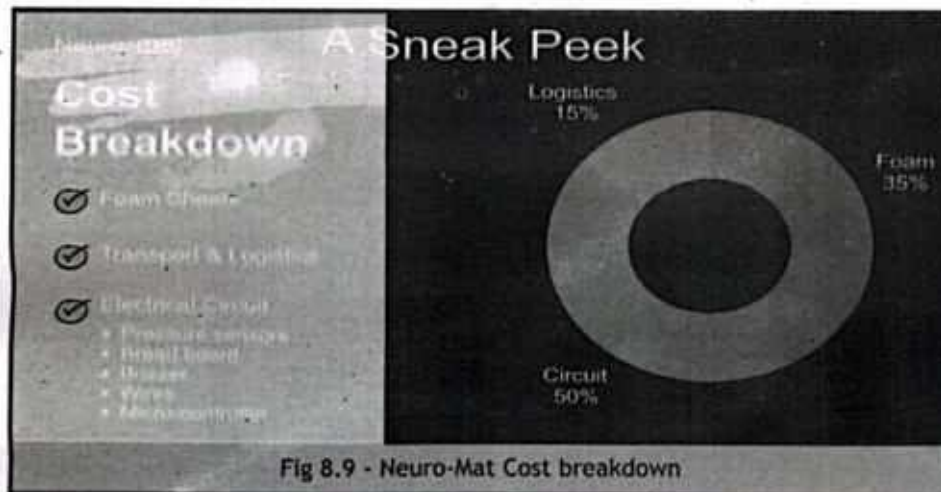
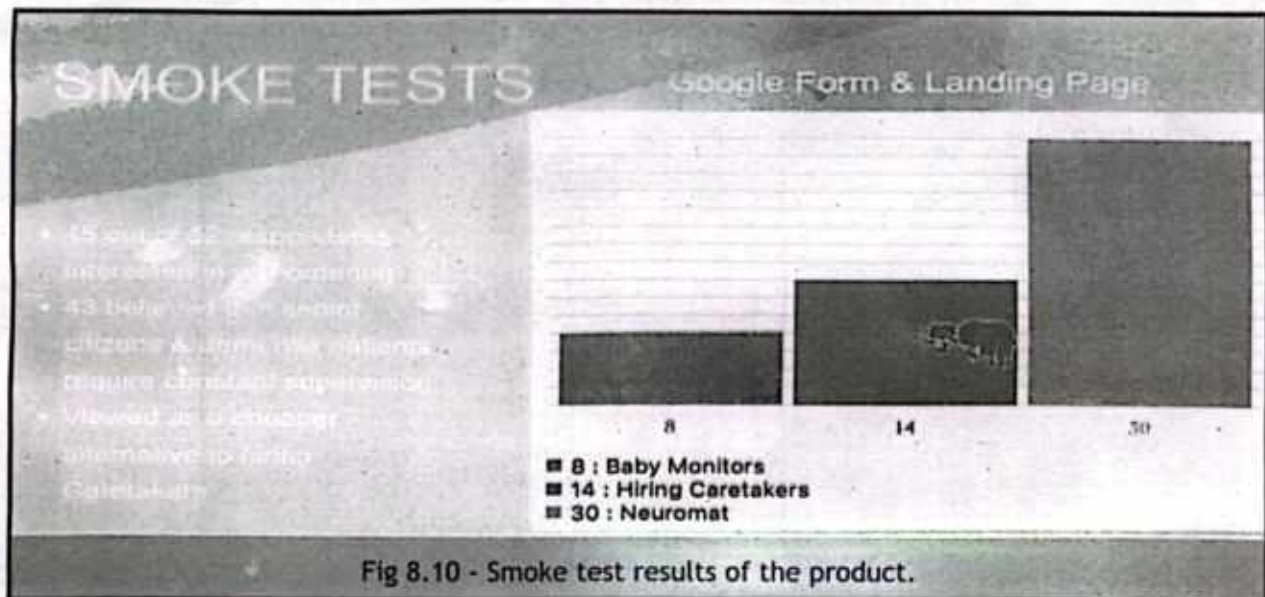


Fig 8.8 - Neuro-Mat Motivation



While incorporating the idea, the feasibility states that the cost of sensors and incorporating them in the mat will be around half while material and logistics will be the other half of the cost, as shown in Fig-8.9.



Later, when the product was tested against baby monitors and hired caretakers, the Neuro-Mat achieved positive results, around double than the nearest competitor, i.e. hired caretakers. The constant monitoring of the Neuro-Mat was a booster and due to one-time purchase cost, it was treated as a cheap solution. This ultimately resulted in more than 85% users who used it during the Smoke test, showed interest in pre-order; which can be termed as a huge success, as shown in Fig-8.10.

Fig- 8.11 sheds light on the various feedback from people after experiencing Neuro-Mat.

Additionally, as shown in Fig- 8.12, people preferred to buy and keep at home for continuous use or as a backup; rather than get it on rent. Furthermore, the interest was shown more if the product can be delivered at their doorstep, in the mode 'cash-on-delivery'.

What People have to say about Neuro mat

"A beautiful initiative for a category that is dear to us, and the least we can offer them is a response to their kindness."

"Definitely a cheaper alternative to caretakers. Looking forward towards seeing it in the market."

"It is great initiative, especially having dealt with a dementia's patients, I know how important it is to be constantly notified about every activity they do"

"It would be a great initiative. These days it's difficult for family members to look after the patient as they need work."

Fig 8.11 - People's Feedback

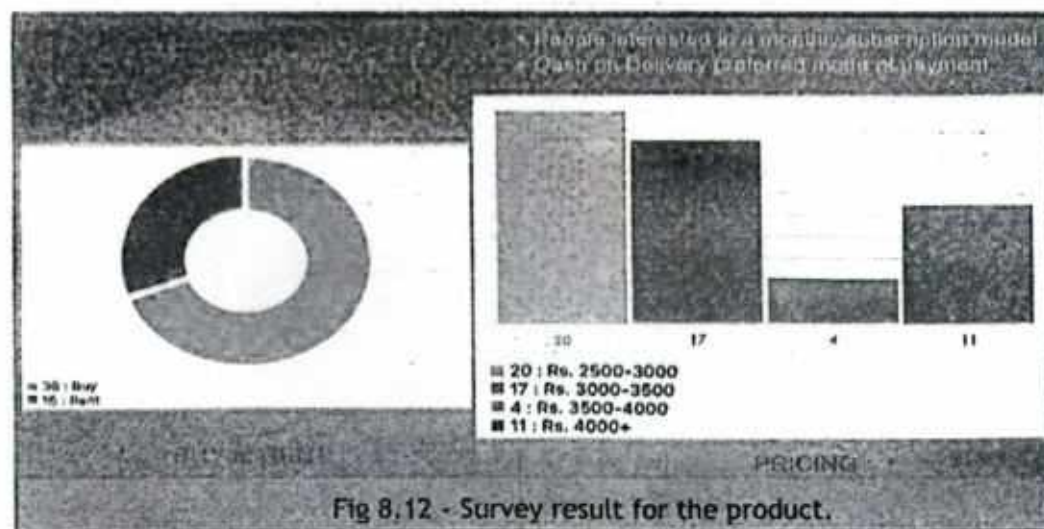


Fig 8.12 - Survey result for the product.

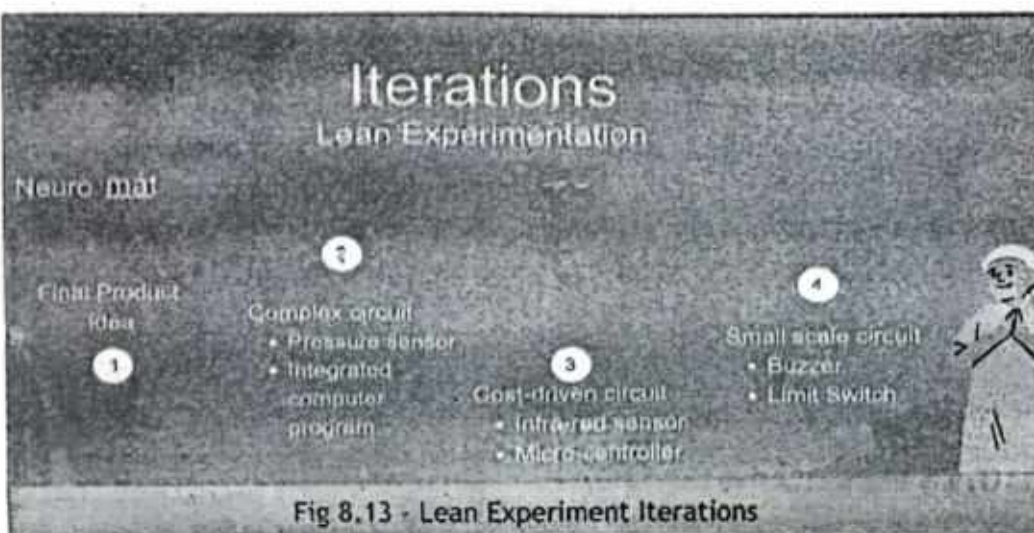
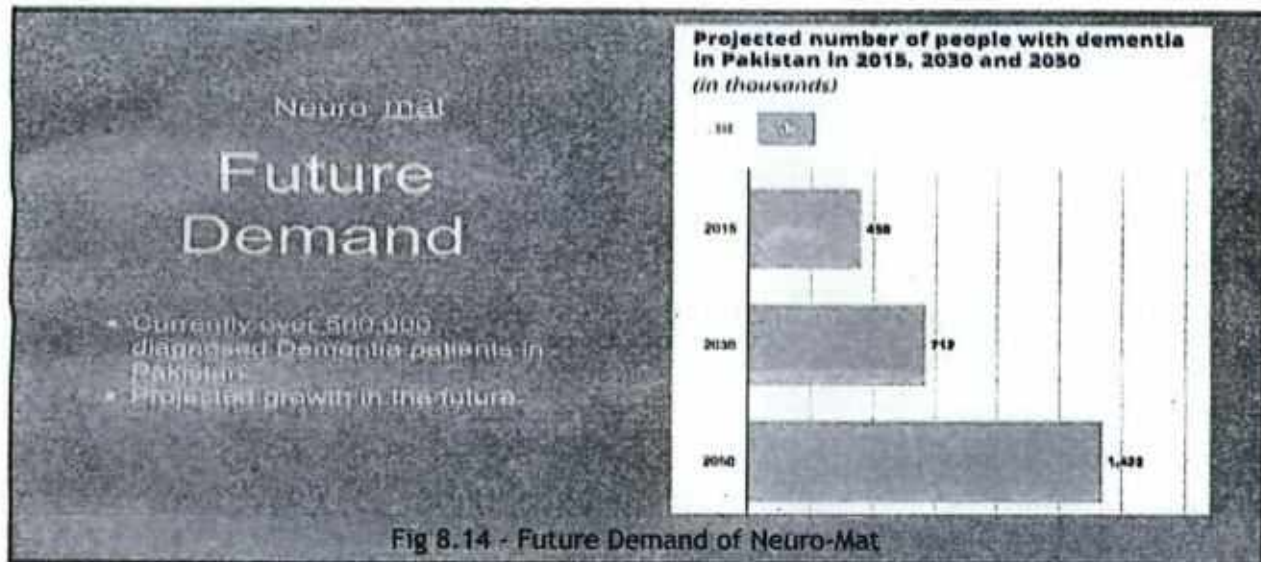


Fig 8.13 - Lean Experiment Iterations

For the product to be a multi-variable product, which addresses the problems of different categories of audience and supports them in various forms, series of experiments were conducted for the final product idea. The circuit became complex as the pressures sensors were distributed throughout the mat; and so did the computer program which was collecting data and analyzing it. So, micro-controllers and infra-red sensors were incorporated by replacing the existing devices and retested for different parameters for similar and better results. Lastly, a small scale circuit was added for switch and buzzer for the convenience of support and health staff. All the said series of experiments is summarized in Fig-8.13.



In the end, it is essential to highlight that currently over half a million Dementia patients are diagnosed in Pakistan. Fig-8.14 shows the projected number of Dementia patients till 2050; who being the primary audience raise the demand of Neuro-Mat.

- Product is the fundamental outcome of complex process design to meet the need of ____.
a) Consumers
b) Industry
c) Producers
d) Entrepreneur
- Developing new products that allow a company to explore new market is called ____.
a) Market expansion
b) Revenue generation
c) Innovation
d) Customer satisfaction
- Prototypes share the common goal of providing valuable insights to improve the ____.
a) Initial products
b) Revenue
c) Final products
d) Expansion
- In order to test technical aspects and validate the feasibility, _____ is used.
a) Proof of concept prototype
b) Working prototype
c) Digital prototype
d) Paper prototype
- _____ is used for internal testing and refinement.
a) Alpha prototype
b) Beta prototype
c) Digital prototype
d) Functional prototype
- Beta testing helps in identifying any remaining issue before the _____.
a) Product's first release
b) Product's final release
c) Product's official release
d) Product's beta release
- _____ helps to mitigate risk and reduce the likelihood of costly errors.
a) Risk reduction
b) Iterative development
c) Cost Saving
d) Visualization
- 3D printers can transform digital designs into tangible objects in _____.
a) Physical prototype
b) Paper prototype
c) Prototype kits
d) Beta prototype
- Iterative and refinement through prototype are key to creating products that are aligned with _____.
a) Project goals
b) User needs
c) Records
d) Elements
- _____ prototype closely resembles with the user interface.
a) Digital prototype
b) Working prototype
c) Proof-of-Concept prototype
d) Intellectual prototype



Give short answers to the following Short Response Questions (SRQs).

1. List out the products and services from following items:
 - a) Consulting
 - b) Books
 - c) Smartphones
 - d) Coordination
 - e) Healthcare services
 - f) Car-wash
 - g) Detergent
 - h) Overseas traveling
 - i) Catering
 - j) Electrical appliances
2. Why is successful product development important?
3. In what way is alpha prototype different from beta prototype?



Give long answers to the following Extended Response Questions (ERQs).

1. Explain the forces that are driving the growth of entrepreneurship.
2. Describe the important role that small businesses play in our nation's economy.
3. Entrepreneurs may use a minimal viable product for a lean start-up process. Enlist and elaborate the key steps in developing a minimal viable product.
4. Imagine you're ready to create an amazing new "bird feeder". What materials might you consider using to craft a rapid prototype?
5. Let's suppose you're aiming to design an exciting skateboard ramp for your toy cars. What household items could you gather to construct a rough-and-ready model for a trial run?

Suggested Reading and Resources

Read and discuss learnings on prototyping from articles such as:

- IDEO prototyping the shopping cart: <https://youtu.be/M66ZU2PClcm>
- Make Your Ideas Tangible Through Prototypes: <https://www.ideo.com/blogs/page/make-your-ideas-tangible-through-prototypes>
- Prototyping service: <https://www.ideo.com/blog/3-tips-to-help-you-prototype-a-service>
- Acumen Academy blog: <https://blog.acumenacademy.org/prototyping-design-process-pressure-test-ideas>

Case studies of MVP of some companies such as:

- Dropbox: <https://youtu.be/7QmCUDHpNzE>
- Door Dash: <https://youtu.be/MRfgomazu9o>
- AirBnB: <https://www.quora.com/What-did-Airbnb-MVP-look-like/answer/Kevin-Kononenko>



Activity 1

Work with a team of your classmates to develop ideas about what your college or university could do to create a culture of entrepreneurship on your campus or in your community.



Activity 2

Let group of students build a simple model of a website for a product, then each group is to brainstorm the features that can be added for improvement. Like adding of video clip, a chat bot for welcoming and guiding visitors, data analysis based on comments of the visitors, etc.



Activity 3

Allow students to play a game of imagination, which uses storytelling to build an invention together. Students will individually highlight a solution to the part of a bigger problem and later merge them in terms of collaborative functionality of the suggested prototype. This way, students will reflect and emphasize on collaboration, critical thinking, creativity, communication. For example designing questions for a questionnaire to interview:

- Emerging entrepreneur
- Successful entrepreneur.



Activity 4

In the busy schedule, the teacher (a plant lover) presents a problem that he is unable to water his indoor plants regularly. Each student group has to come up with an idea for the solution, create a simple working prototype and test the prototype.

Glossary

Algorithm	Algorithm is a step-by-step set of instructions that define how a specific problem should be solved.
Blockchain	A Blockchain is a digital ledger (database) of transactions that is shared and maintained by network users. The ledger is a list of continuously growing records, known as blocks. The blocks are chained together using cryptography.
Breakpoint	A breakpoint is the line in the code which needs close examination, so the debugger will definitely stop there.
Bug	Bug is an unanticipated error which is generally logical in nature.
Classification Model	Classification model analyzes and classifies a large and complex set of data points.
Cloud Computing	Cloud Computing is an IT infrastructure that provides data storage, databases, servers, networking and application software services over the Internet.
Communication Protocol	Communication Protocol is a set of rules that govern how data is transferred and understood between physical devices, sensors and the end users. Protocols provide exchange of information and methods of connection between devices and end users.
Computational Thinking	Computational Thinking is a thought process that helps us to understand the problem and solve it in a way that computers do.
Computer Program	A set of well-defined instructions which a computer can execute to solve a problem is called a computer program.
Correlation	Correlation describes an association between types of variables.
Cryptography	Cryptography is technology that protects information and communications by coding it in such a way that only those for whom it is intended can read and process it.
Cultural Impact	Cultural impact refers to how improved connection can affect and modify cultural behaviors, beliefs, values, and traditions, frequently as a result of the crosscultural exchange of ideas and information that computers facilitates.
Cybersecurity	Cybersecurity involves protecting internet-connected systems, networks, and data from malicious attacks.
Data Analysis	Data analysis is the primary step, where data is cleaned, explored, and summarized, providing insights and information for the construction of statistical models to make predictions or draw inferences about real-world phenomena.

Data Visualization	Data visualization is the graphical representation of information and data.
Decomposition	Decomposition is Breaking down the larger problems into smaller/ manageable ones and working on them one by one.
Development	Development describes the steps needed to convert or manipulate the inputs to produce the outputs.
Digital Literacy	Digital literacy is the ability to find, create, evaluate, communicate, and share digital contents.
Embedded Systems	Embedded Systems are small electronic devices which are combination of hardware and firmware.
Encryption	Encryption involves converting plaintext data into unreadable cipher text using encryption algorithms and keys.
Firmware	Firmware is software that is permanently installed in a device or electronic machine.
Flowchart	Flowchart provides a visual representation of flow and logic using defined symbols.
Human Impact	Human impact refers to the effects that more computing connectivity may have on social interactions, working habits, information access, and general well-being.
Hybrid Cloud	Hybrid Cloud is a combination of public <u>and</u> private cloud.
Infographics	Infographics transform intricate and voluminous data into visually appealing formats.
K-Map	Karnaugh Map (K-Map) is used to simplify Boolean functions and reduce logic circuit complexity.
Logic Gates	Logic gates are building blocks of digital circuits, with inputs and outputs represented as LOW (0) or HIGH (1).
Network Topology	Network topology refers to the arrangement of devices in a computer network.
Pattern Recognition	Pattern Recognition is to examine the problem for a pattern or similarities between previously solved problems.
Presentation	Presentation in context of data visualization refers to the act of showcasing the information in a meaningful way to the audience.
Prototypes	Prototypes serve as a sample for the final data or a scale down product/conclusion before the full-scale implementation of the concept.

Pseudocode	Pseudocode is an intermediate step between the algorithm and actual programming code.
Pattern Recognition	Examine the problem for a pattern or similarities between previously solved problems.
Population	Population is the complete data under consideration. Sample is a subset of the population.
Regression Model	Regression model is predictive model designed to analyze the relationship between independent and dependent variables.
Reinforcement Learning	Reinforcement learning involves training the algorithm to iterate over many attempts using deep learning.
Research Question	A research question is the goal or objective to achieve after collecting data, evaluating it, and finding the conclusion.
SDLC	Software Development Life Cycle (SDLC) is the process of creating new software products and involves various phases/steps.
Searching Algorithms	Searching algorithms are used to search desired element that is available in some group of elements.
Simulation	Simulation is an indirect method of data collection, in which the data for the research question is generated or created rather than collected through interview, surveys or questionnaires.
Sorting Algorithms	Sorting Algorithms are used to arrange data in a useful manner.
Statistical Model	Statistical model is a collection of probability distributions on a set of all possible outcomes of an experiment.
Supervised Learning	Supervised learning uses a labeled dataset for learning, with an answer key to determine accuracy as it trains on the data.
Survey	A survey is a systematic or structured tool designed for data collection from a group of individuals.
Trace Tables	The dry run of an algorithm can be done with a technique known as Trace Tables.
Turtle Graphics	Turtle graphics provides functions to design basic drawings and two dimensional geometrical shapes.
Unsupervised Learning	Unsupervised learning is given unlabeled data and attempts to extract features and determine patterns independently.
Use Case	Use case is a methodology used in system analysis to identify, clarify, and organize a system. A use case is a description of how the users will perform tasks or achieve the goal.

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