Student Design Project

Project Brief:
Design and Development of Innovative Shoe Rack with Seating. The aim of the project is to design and prototype innovative shoe rack with seating by improved usability, space utilization, ergonomics and cost. And collect user feedback on the prototype.

MSME Unit:
Balaji Industries is a leading player in furniture industry. Balaji Industries has best in class machinery and wood working workshop.

Salient Features:
- Simple and rich design keeping the market requirement and customer response.
- Flip-down storage for shoes with adjustable racks making product user friendly.
- Sliding door cabinet with ample storage space.
- Swivel seat with storage space eliminates the additional seating requirement.
- Built in leg rest and hanger for umbrella making product feature rich
- Advantage over Chinese product in the market for the MSME unit.

Commercial Viability:
Project Completed- Positive response on prototype based market feedback collection will help in development and production activity. Target product yet to be finalized.
Design of Innovative Shoe Rack with Seating

M. Sc. [Engg.] Dissertation in
Product Design

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1 – Introduction

1.1 Shoe Rack:

A shoe rack is a storage unit designed for holding and organising shoes. Shoe racks are also known as shoe cabinets, shoe shelves and shoe cupboards. Generally shoe rack is an independent unit built with wood or metal.

1.2 History:

Until the mid 1800s, shoes were handmade in small shoe-making shops by cobblers. Since shoes were either made to order or in limited quantities, cobblers had no need for significant storage space or adequate housing for shoes. As innovations in the shoe industry advanced, the invention of the sewing machine in 1846 and automated shoe-making machinery, so too did the need for a storage utility for the newly mass-produced product. [1]

Shoe boxes began as a way to store shoes sold at retail, meanwhile expensive designer shoes helped give birth to the shoe box used for storing and preserving shoes at home. Over the years, these shoe boxes gave birth to shoe racks. Shoe racks are storage utility that help manipulate space and increase organization. They can be used under beds, in closets or in any available space in open rooms. While the primary function of a shoe rack is to store and care for shoes and over long periods of time, there are many other fundamental uses for shoe boxes as well.

The world is no more the same to what it used to be, when our forefathers lived their life. It was a period when anybody hardly spent some time in thinking about the decor of their home. Now shoe rack is also an important part of house interiors.
2.1.11: Indian Anthropometric dimensions\textsuperscript{[12]}:
2.2 Summary of Literature Survey:

- A wood with properties like close-grained, strong and durable, which takes polish are preferable for furniture manufacturing.
- Plywood, Particle board and MDF boards are widely used for various furniture's and interiors.
- Many engineered woods are available like laminated timber, laminated veneer lumber and other which is resistance to water.
- A major advantage of WPC over wood is the ability of the material to be moulded to meet almost any desired spatial conditions. It can also be bent and fixed to form strong arching curves.
- Wood working machines like universal wood working Planner, universal wood working machine, will reduce labour costs and increase the quality.
- Mortise and tenon joint and Rabbet joints are commonly used wood joints in carpentry. Dovetail joint is preferable for corner joining.
- Various types of semi finished furniture's, Hardware's and accessories are available and used according to the requirements.

Table 2.2 Human factors

Design of Innovative Shoe Rack with Seating
3.4.3 Gemba study findings:

- Users with own house go for expensive shoe cabinets or shoe benches, whereas steel shoe racks are preferred by users stay in rental house.
- Shoe cabinet users need chair for wearing shoes. In small houses users take nearby chair and in big corridors separate chair is kept for this purpose.
- It is observed that shoes are kept on the floor after removing it from the rack. Users bend over and wears shoes/tie lace.
- Bending posture is uncomfortable for fat people, so they keep the leg on rest and tie shoe lace.
- Users cannot reach shoes while they are seated on the couch in case of shoe rack with seating.
PDS of the shoe rack with seating to be designed was prepared from the QFD and is explained in the Table 3.1.

<table>
<thead>
<tr>
<th>SL. No</th>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Part name</td>
<td>Shoe rack with seating</td>
</tr>
<tr>
<td>2</td>
<td>Area of usage</td>
<td>Inside the house (House entry way, corridor, Hall)</td>
</tr>
<tr>
<td>3</td>
<td>Target customer</td>
<td>Upper middle class</td>
</tr>
<tr>
<td>4</td>
<td>Material</td>
<td>Solid wood/Particle board/MDF</td>
</tr>
<tr>
<td>5</td>
<td>Size HxWxD</td>
<td>900mmX900mmX350mm</td>
</tr>
<tr>
<td>6</td>
<td>Storage Capacity</td>
<td>8 pairs</td>
</tr>
<tr>
<td>7</td>
<td>Installation</td>
<td>RTA (Ready To Assemble)</td>
</tr>
<tr>
<td>8</td>
<td>Ergonomics</td>
<td>Easy handling, Easy reach, Comfortable</td>
</tr>
<tr>
<td>9</td>
<td>Features</td>
<td>Flip down door, Drawer, Umbrella storage, Seat, Accommodates both men's and women's shoes, Easy access, Space for socks &amp; shoe polish, extra storage space and Leg rest</td>
</tr>
</tbody>
</table>

Table 3.1 PDS
criteria were entirely based upon aesthetics and design features. Concept 2 has been selected as the final concept according to the total score obtained (Refer table 5.1).

Table 5.1 Ranking method
5.8.1 Selected concept:

Concept 2 had been selected for development

Figure 5.14 Selected concept
Figure 6.3 Final concept views

6.3 Concept Detailing with Material Specification finish:

The materials that are to be used for the manufacturing of the shoe rack was decided based on the ease of manufacture, cost and usability.

Figure 6.4 surface finish
6.5 Prototype Model:

Final assembly of the prototype model is shown in the figure 6.7

Figure 6.7 Prototype model
7. Validation

7.1 Introduction:
Validation of the final concept was done to ensure the potential of the design. Prototype model was developed to validate the proportions and surfaces of the design. Manufacturability of the concept also was validated through the prototype model. The final prototype model was produced in front of users. Their opinion and suggestions for improvement were documented.

7.2 Final concept validation:
Ergonomics, Aesthetics and Usability these three major parameters are considered for validation of the final concept. Feedbacks from users are mentioned below:

Furniture show room owner
- Very good concept, innovative design
- Glass shelf could be added on the top of the cabinet.
- Quite useful design with many features
- Weight could be reduced using thin wood sections
- Front opening in the seat can be changed to backwards
- Aesthetically appealing
- Wheel movement could be made smoother.
8. Conclusion

8.1 Summary:
The whole work of the project was summarized as follows:

- Secondary research method like literature review was conducted on shoe racks by referring magazines, journals, manuals, publications, websites etc.
- Data collection was done by product study, user study and market study through ethnography, interviews, images, videos etc.
- QFD was prepared using the data collected during the research and the needs identified.
- Then the target PDS was arrived at based on the QFD.
- Concepts were generated using the ideation tools like brainstorming, Mind mapping etc.
- From those concepts 5 concepts were selected and they were digitized using software’s like Photoshop, Pro E etc.
- A final concept was then selected from these five concepts using weighted ranking method.
- Detailed drawing of the concept was prepared.
- Prototype model was made using pre laminated particle board, sun board etc.

8.2 Conclusion:

An innovative shoe rack with seating is designed with the help of user study data's. A prototype model is made which is aesthetically well pleasing and is appreciated by many people. Works mentioned for the future will be completed soon.

This project has given the opportunity to learn the new product design and development process in an organization. This project has helped to enrich knowledge about complete product design process. It has been a wonderful experience to work as an individual designer in an organisation.