



Design and Development of Multipurpose Shoeshine Chair

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Abstract

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The paper is proposed to design and develop a multipurpose shoeshine chair which can be used in shoe shining operation. The design incorporates all features of shoe shining which include seat, shoe rest, and shoe shine box. Customer need identifying, Quality function deployment, concept generation, concept selection, and economic analysis is used for design and development of the product. The solid model of the product is proposed. Finally, the economic analysis of the product suggests that the product can be competitive in the market.

1. Introduction

Product development is defined as the set of activities beginning with the perception of a market opportunity and ending in the production, sale and delivery of a product [1]. Product development affects the success and failure of the firms.

Shoeshiner is an occupation in which a person polishes shoe. Shoeshiner use two different products that are a chair for the customer to seat on and shoeshine box for storing shoeshine equipment and as a shoe rest. However, it is difficult to transport all the equipment's from home to work place. The purpose of this paper is to design and develop a multipurpose shoeshine chair which can be used as a chair and shoeshine box.



Figure 1 Shoeshiner at his work environment [2]

2. Literature review

In the literature review, Patents which are directly or indirectly related to the proposed work are reviewed and presented as follow.

Leroy Talley designed a portable shoeshine kit. The kit includes a case rollable on wheels, a collapsible seat and umbrella for a customer and a foldable stool and seat for the operator carried by the case, and the case also carrying foot rests, brushes and polishes, the case being used as a platform upon which the footrests and customer's seat and umbrella are erected [3].

J. Weber et al. designed shoeshine stand for barber chair. In this design, The foot rests are adjustable for com fort; the stand is adjustable to fit any chair, and the chair can be raised or lowered to its limits of vertical adjustments without raising or lowering the stand; and a special adjustment prop is provided to support the front portion of the stand when the chair is tilted when it is in an elevated position. The stand is quickly attachable to and detachable from the chair and retains its relative-position irrespective of vertical adjustments of the chair. This design incorporates a bar which has an integral partitioned box to hold shoeshine materials [4]. Multipurpose shoeshine chair comprises the following components: Seat Foldable Back Storage Leg rest and Scissor mechanism.

Henry Bascom designed shoeshine stand that is collapsible and portable when not in use but may be easily extended and solidly positioned for use by the operator. Additionally, it provides a foot-rest adjustable for patrons of varying leg lengths to insure comfort and relaxation While being Served [5].

Orville A. Blalack et al. designed shoeshine stand for household use. This invention includes a compact box and a post or stand for the shoe rest adapted to be extended to any desired working level and collapsed to house the same in the box. And it provides means for steadying the box while shining a shoe [6].

This paper aims at designing simple, compacted, and inexpensive multipurpose shoeshine chair which can be adapted successfully for shoe shining operation.

3. Multi-purpose of Shoeshine Chair and Its Parts

New features of shoeshine chair combine a seat and shoeshine box into a single platform. This product includes scissor lift that makes the chair to be raised into the desired working level and collapsed into a compact form while not in use for ease of transportation. Slidable shoe rest which is derived from suitcase handle is used. the back is folded against the seat by a means of a hinge. It also incorporates a case for storing shoeshine materials. This product is simple and it has small setup time as compared to the previous designs.

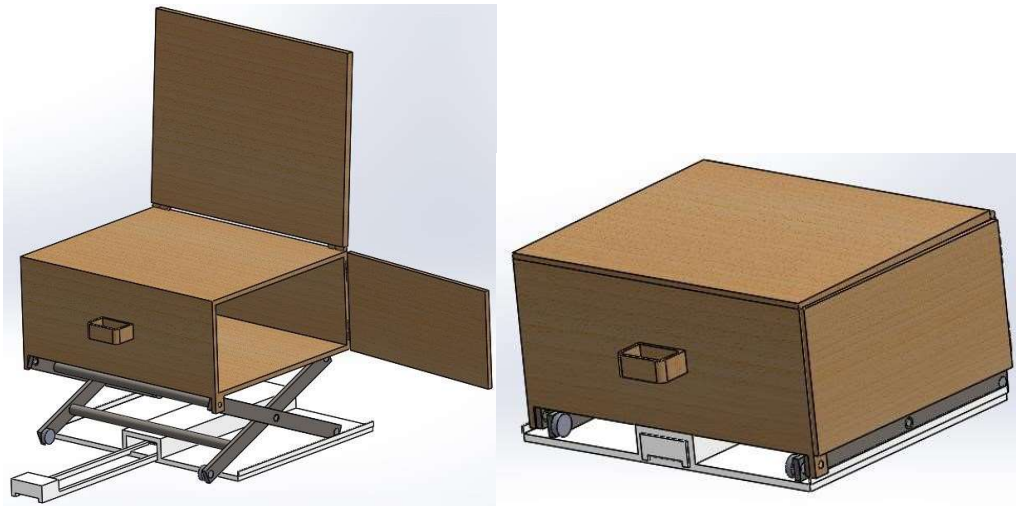


Figure 2 Multipurpose shoeshine chair (a) working position, (b) initial position.

4. Mission statement

Before we start the development process, it is essential to provide guidance to the development team. The team specifies a market segment and assumption which should be considered during the development process. This information's are summarized in mission statement as shown in table 1.

Table 1 Mission statement for multipurpose shoeshine chair

Mission Statement	
Product description	<ul style="list-style-type: none"> • A multipurpose chair for Shoeshiner
Benefit proposition	<ul style="list-style-type: none"> • It can be used to seat in and as shoeshine box to hold different materials like shoe cream, brush and so on.
Primary market	<ul style="list-style-type: none"> • Shoeshiner
Secondary market	<ul style="list-style-type: none"> • households, coffee sellers (in the street)
Assumptions and constraints	<ul style="list-style-type: none"> • fully manufactured in Ethiopia
Stakeholders	<ul style="list-style-type: none"> • Purchaser and user, manufacturer, distributor

5. Identification of customer need

Identification of the customer need follows the steps provided in Ulrich and Eppinger [1]. The customer needs are directly gathered from the customer as written statement form and interpreted by the development team in order to capture the exact sense of the customer about the product.

Table 2 Customer data template filled in with sample customer statements and interpreted needs

Question/prompt	Customer statement	Interpreted need
Typical uses	I need a chair which can be easily handled from place to place	compact
Likes	it is less expensive	Low cost
	It has less weight	Less weight
Dislikes	It is boring to move the chair and bring back every day	Easy to move
	With the current chair it is difficult to change work position when necessary	Flexibility
	Feature to support the legs or shoe of the customer to be served	Shoe supporting mechanism
Suggested improvements	Feature to keep necessary equipment and materials	multipurpose
	It should be comfortable to customer	Ergonomic design

Organize the needs into a hierarchy

Primary needs:

Easy to move

Compacted

Less weight

Low cost

Secondary needs:

Multipurpose

Flexibility

Shoe support mechanism

Ergonomic design

6. Quality function deployment

Quality function deployment is a structured approach that define customer requirements and translate them into design specifications for producing products to meet those requirements. QFD matrix for multipurpose shoeshine chair is constructed as shown in figure below.

Customer \ Technical	Priority	Size (cm)	Price (birr)	Mass (kg)	Comfortable (sub)	Flexibility (sub)	Foldable (sub)	Competitor 1	Competitor 2	Our
								Bamboo chair	Metal chair	We
Easy to move	9			9		9	9	2	1	5
Compacted	8	1					9	2	1	5
Low cost	6	9	9	9		1	1	5	1	4
Less weight	8			9				5	1	5
Multipurpose	7					9		1	1	5
Flexibility	8							2	1	5
Shoe support mechanism	6		1	1		9		1	1	5
Ergonomic design	4				9	1		4	3	5
Competitor 1		100 *40	5000	200	Yes	No	No			
Competitor 2		120 *40	150	5	No	No	No			
Target		50* 30	1000	5	yes	yes	yes			

Figure 3 Quality function deployment for multi-purpose shoeshine chair

7. Concept generation

After product specifications has been captured, the next step in product design and development is concept generation. Concept generation can be done inexpensively and quickly as compared to other development processes [1]. For multipurpose shoeshine chair five different concepts has been generated by examining many directly or indirectly related products to satisfy the customer requirements. The concepts generated are presented as follow:

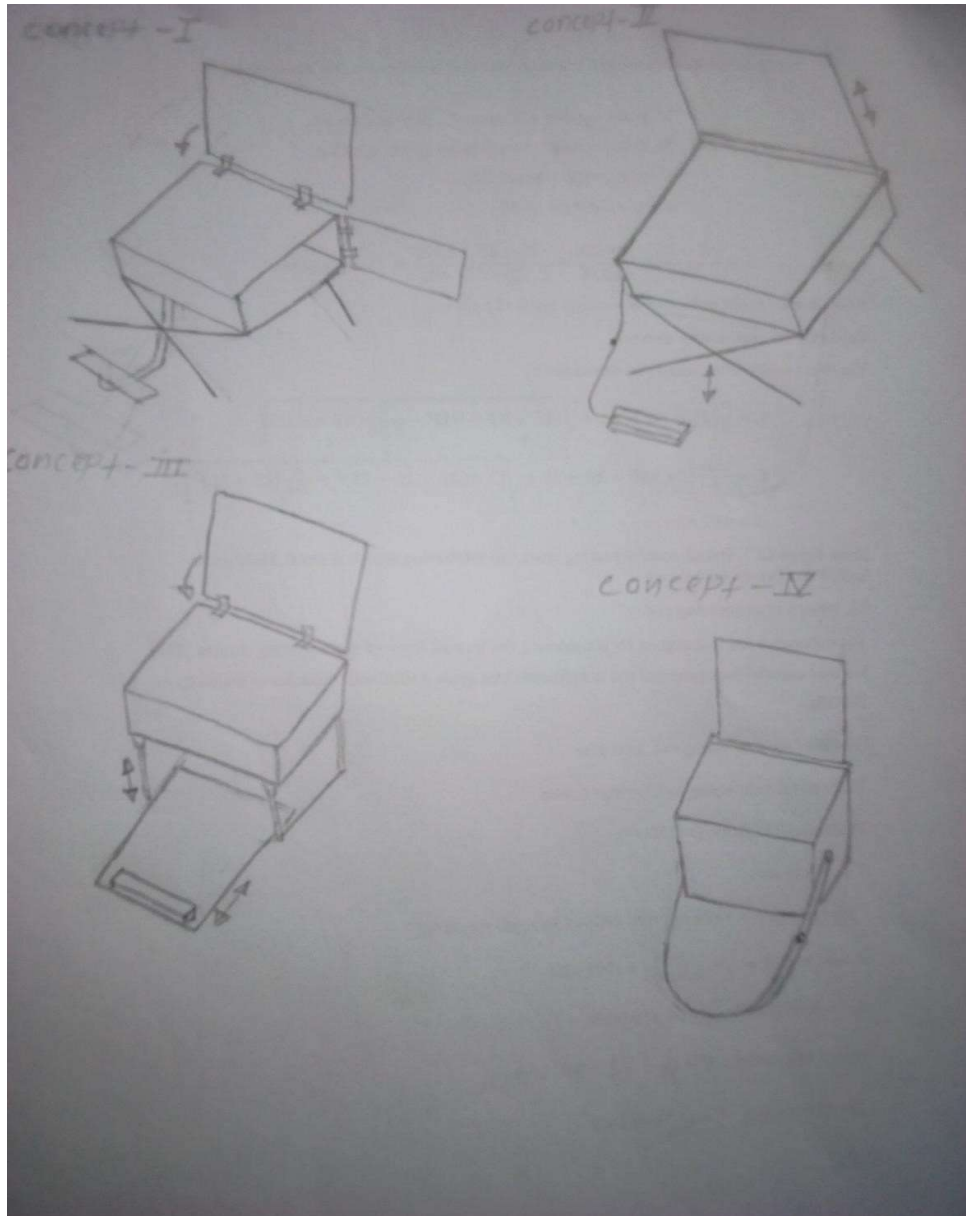


Figure 4 Generated concepts for multi-purpose shoeshine chair

Concept 1: This concept uses hinge for the back seat, and it has foldable legs. It has also storage for Shoeshiner to store materials used in shoe shining. And the shoe rest which is attached to the bottom of the box can also be rotated to make the handling easy.

Concept 2: this concept has similar legs with concept one. However, it uses sliding mechanism for the back and the shoe rest can be folded and attached to the side of the box.

Concept 3: Concept four uses similar mechanism with concept one for the back. However, it uses sliding mechanism for the leg of the seat and the shoe rest.

Concept 4: Here, the concept of the shoe rest is derived from the tea pot handle and it can be folded and attached to the bottom surface of the box.

Concept 5: Concept five is generated by combining concept three and one. It uses scissor mechanism to make the system compacted. The concept for shoe rest is derived from suitcase handle.

8. Concept selection

After different alternative concepts has been generated, selecting the promising concept carefully based on the customer requirement is essential for product success in the market. From the scoring matrix concept 5 has scored maximum and it has been selected for further development process.

Table 3 Performance rating

Relative Performance	Rating
Much worse than reference	1
Worse than reference	2
Same as reference	3
Better than reference	4
Much better than reference	5

Table 4 Concept scoring matrix for multipurpose shoeshine chair

		Concept I		Concept II		Concept III		Concept IV		Concept V	
Selection criteria	Weight (%)	R	WS	R	WS	R	WS	R	WS	R	WS
Easy to move	20	4	0.8	4	0.8	4	0.8	4	0.8	4	0.8
Compacted	10	4	0.4	4	0.4	4	0.4	4	0.4	4	0.4
Low cost	10	4	0.4	3	0.3	3	0.3	3	0.3	4	0.4
Less weight	20	4	0.8	4	0.8	4	0.8	4	0.8	4	0.8
Multi-purpose	25	4	1	4	1	4	1	4	1	4	1
flexibility	10	4	0.4	4	0.4	4	0.4	4	0.4	4	0.4
Ergonomic design	5	3	0.15	3	0.15	3	0.15	5	0.25	5	0.25
Total score		3.95		3.85		3.85		3.95		4.05	
Rank		2		3		3		2		1	

9. Economic analysis

Economic analysis for multipurpose shoeshine chair is conducted to see whether the business is profitable or not. In this section, bill of material and break-even point for multipurpose shoeshine chair is determined.

9.1 Bill of material

The bill of material for multipurpose shoeshine chair lists all components of the chair and their corresponding estimated costs. The bill of material for multipurpose shoeshine chair is shown below.

Table 5 bill of material for multipurpose shoeshine chair

Item No	Part Name	QTY.	Cost per item (birr)	Total cost (birr)
1	Body or box	1	150	150
2	Back	1	70	70
3	Scissor mechanism	1	300	300
4	Leg rest	1	150	150
5	Pin	6	5	30
6	Hing	4	10	40
7	Closure	1	50	50
8	Base	1	100	100
				Total=820birr

9.2 Break-even point

In this section, the money required to start the business is estimated and we have given the cost of a single product from the bills of material, so that we can determine the point where we cover the money spent to start the business.

The fixed cost is estimated as 250,000 birr, and single cost of the product is 820 birr from bill of material. Revenue per unit product is 900 birr.

$$\text{Profit} = \text{Total revenue} - \text{Total cost}$$

The break-even point can be determined at profit equals to zero, thus:

$$\text{Total cost} = \text{Total revenue}$$

Let Y = number of products to be sold

$$X = \text{total cost} = (\text{variable} + \text{fixed}) = 250,000 \text{ birr} + 820 * Y$$

$$\text{Total revenue} = 900 \text{ birr} * Y$$

Therefore, the break-even point will be

$$250,000 \text{ birr} + 820 * Y = 900 \text{ birr} * Y$$

Therefore, to cover all expenses the company need to sell 3125 products. The graph of break-even analysis of multipurpose shoeshine chair is shown in figure below.

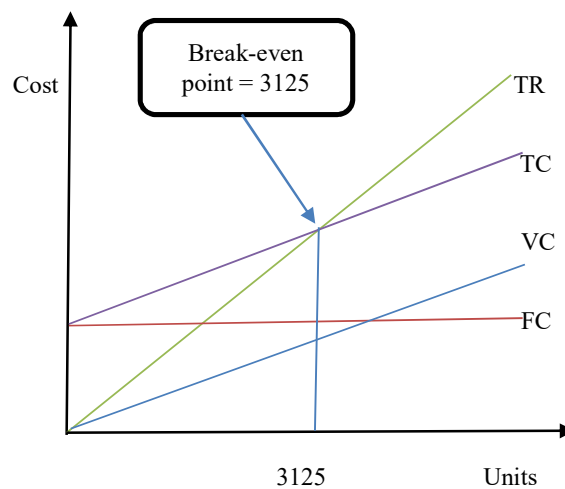


Figure 5 break even analysis for multipurpose shoeshine chair

10. Conclusion

The objective of this project is to design and develop multipurpose shoeshine chair which is suitable for Shoeshine operation. In this paper we go through product design and development processes to design suitable shoeshine chair. Finally, the solid model of product is proposed

and economic analysis (bill of material and break-even analysis) for the product has been conducted. Since the product integrated different features into a single platform, it reduces the cost of the product and it can be moved relatively easily from one place to another place. For further improvement, it can be designed by using other mechanism rather than using scissor lift for the chair to be compacted.

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