Private Shopping Trolley Design to Raise Customers' Convenience and Increase Supermarkets' Income

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Abstract - **Currently, the COVID-19 pandemic has faded, although there are still several issues emerging regarding the existence of new COVID variants. Therefore, people are still concerned about the virus. One of the problems that arises is the use of tools simultaneously. This article aims to design a personal supermarket shopping trolley. This trolley will be designed using qualitative methods with the help of soft system methodology (SSM) and quantitative methods with the help of quality function deployment (QFD). The qualitative method is implemented by conducting interviews with supermarket customers, while the quantitative method is implemented by administering questionnaires to customers. This article proves that qualitative and quantitative methods can be used synergistically and complement each other in implementing product design. The qualitative method seeks customer needs, while the quantitative method measures customer perceptions. The final result of this article is the design of a personal trolley. Thus, people are not worried about shopping at supermarkets.**

Keywords: **private shopping trolley, product design, Quality Function Deployment, Soft System Methodology**

I. INTRODUCTION

Although the COVID-19 pandemic has subsided, the news about the emergence of new COVID variants has increased the concerns of some people about contracting the virus. One of the consequences is that many people are afraid to share public equipment with others. Also, some people are afraid to shop at supermarkets that are usually crowded and have to use the public shopping trolleys provided in supermarkets together with other people. Viruses and bacteria can stick to the trolley, especially on the trolley handle, as research found many microbes on the trolley handle and spokes [1]. With alternating use, viruses and bacteria can be transmitted to other customers. Moreover, not all supermarkets carry out serious, consistent, and thorough cleaning and spraying of disinfectants on newly used trolleys. This condition, in addition to causing difficulties for customers, will also cause a decrease in supermarket income.

The purpose of this study is to design a personal shopping trolley to be carried and used by customers when shopping at the supermarket and taking shopping home. This concept, the personal trolley has the characteristics of being easy to operate in supermarkets, practical to carry, and eliminating the use of disposable shopping bags.

This design would be beneficial for customers because they can shop without worrying about using a public trolley. In line with this, this trolley design can also increase people's interest in shopping at the supermarket; it also increases the supermarket's income. The benefit of this design is the reduction of disposable bag usage, thereby helping to reduce the environmental burden.

Related to this study, many researchers have designed trolleys for shopping at supermarkets. Several researchers have developed smart trolleys that are mainly used to count shopping, so that customers do not need to queue at the cashier, namely smart trolleys with the help of robots [2], smart trolleys using RFID [3]–[6], smart trolleys using chips and barcodes [7], [8], and smart trolleys using smartphones and Arduino [7]. In addition, there have also been researchers who have developed supermarket trolleys with tools to guide customers in a hurry to immediately find the items they need [9], [10]. Trolley designs also accommodate the elderly [11], [12]. However, the studies above all designed shopping trolleys commonly used in supermarkets. These trolleys are all used by customers alternately, so there is a risk of becoming a medium for transmitting viruses or bacteria.

In addition, this study also uses qualitative and quantitative methods in synergy, which can be an idea for researchers. These two methods have different functions, namely exploring customer needs and measuring customer perceptions, but they support each other for product design.

II. METHODOLOGY

Product design has been done by people for a long time. The methodology that has been used by people for a long time and is considered an effective methodology is Quality Function Deployment. This methodology has been used by many researchers, for designing products such as [13], [14], services such as [15], [16], and product service systems such as [17], [18]. QFD is a methodology that uses quantitative methods, namely to determine the importance of customers (IC) for customer needs and customer satisfaction (CoSP) with existing products or services. To complement QFD, we use qualitative methods to explore customer needs based on the needs of various parties. Our research methodology can be seen in Figure 1.

In this study, we conducted a qualitative method, through in-depth interviews with 10 customers, 5 supermarket employees, and 2 supermarket managers, also used secondary data, and articles to collect underlying data. The main purpose of the in-depth interview was to obtain the conditions of shopping trolleys in supermarkets, and the constraints on existing shopping trolleys. Each interview took an average of 30 minutes. It was found that after the COVID-19 pandemic subsided, customers began to flock to supermarkets again and shop, but there were still concerns about using public trolleys provided by supermarkets. The data was subsequently processed using the soft system methodology [19]. Soft system methodology (SSM) is a system thinking way to see the wholes, involving relations and patterns to characterize the phenomenon [20].

Seven steps of SSM: (1) determining and understanding the problematic situation; (2) expressing the problem situation; (3) locating the root definition of the relevant system; (4) describing the conceptual model of the system in the root definition; (5) comparing the model to the real world; (6) making changes based on what is desired in a systematic and culturally feasible manner; and (7) determining actions to improve the situation, as illustrated in Figure 2 [21]. This article only covers the first through fourth phases.

After SSM is implemented, the next SSM result is used as customer needs for HOQ formation, which is listed on the leftmost part of HOQ. From HOQ, new design specifications are obtained, and a personal trolley is designed.

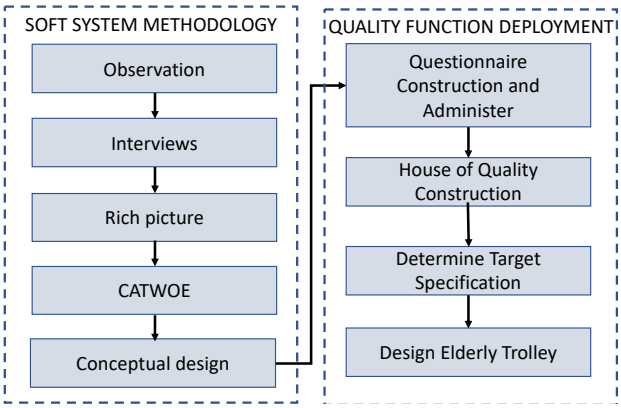

Fig. 1. Research methodology

III. RESULTS

As explained previously, SSM is used to formulate problems, build conceptual models, and apply them to the real world. Following the steps from [21], the first to fourth steps are as follows.

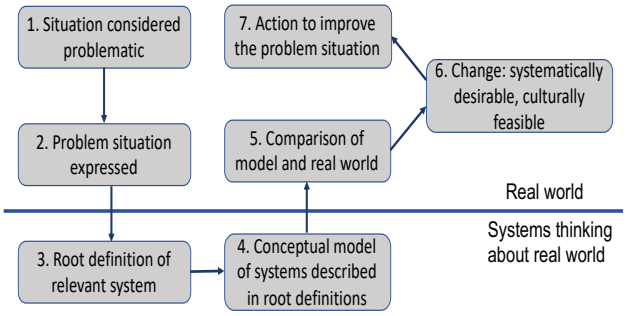

Fig. 2. Soft System Methodology Steps [21]

First step: The COVID-19 pandemic has raised public concerns about sharing equipment with others. On the other hand, customers like to shop at supermarkets because they can refresh themselves. Supermarkets also need people to visit and shop at supermarkets to maintain income. With this condition, an interview was conducted with supermarket customers, and it was found that one of the obstacles felt by customers was being afraid to use the public trolley provided in the supermarket. So, the idea arose to create a personal trolley.

Second step: The problem situation is depicted in Figure 3. This image is called a rich picture [24] which is made for the value co-creation model. However, in this study, this image was created to describe the conditions of each party related to the supermarket shopping trolley. In-depth interviews were conducted with various related parties to form this image. Here, there is a contradiction between the desire to use a personal trolley, and the consideration of additional costs to purchase the trolley.

Third step: Finding the root definition by identifying Customers (C), Actors (A), Transformation (T), World View (W), Owners (O), and Environmental Constraints (E) abbreviated as CATWOE [19]. In this study, the CATWOE analysis is as follows: C: Customers are people who visit and shop at supermarkets. A: Customers, supermarket employees, supermarket managers. T: Transformation so that people are more comfortable shopping, and supermarkets can increase their income W: The views and understanding of each party can be seen in Figure 3. O: The owners of the activity are the supermarket and its customers. E: Changes occur due to the COVID-19 pandemic and community concerns. From the rich picture, it can be seen that the three actors involved have an interest in getting many people to come to the supermarket. The fear that occurs is because currently, the trolleys used in supermarkets are public trolleys that are used together in turns by customers. Therefore, private trolleys can be one solution to this problem.

Step four: In this step, a value co-creation model is developed to solve the problem. Here, a personal supermarket trolley design is proposed that can improve customer convenience and increase supermarket income.

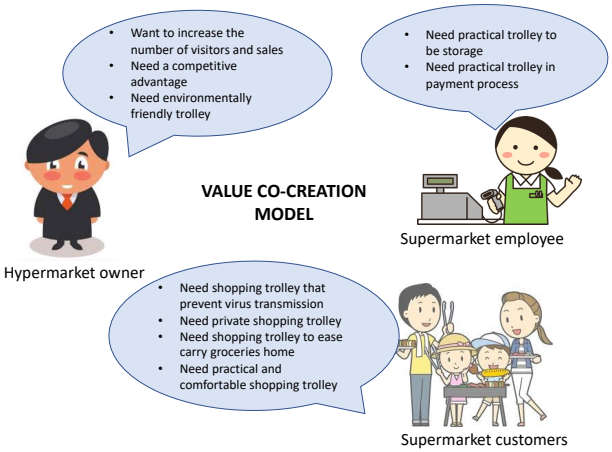

Fig. 3. Rich picture

After the 4 stages of SSM are completed, the next step is making HOQ. To make HOQ, a customer assessment of the level of importance (IC) and level of satisfaction (CoSP) of the current packaging is required. Therefore, we administer a questionnaire. The assessment through the questionnaire is carried out with a 4-level Likert scale, namely very unimportant (1), not important (2), important (3), very important (4) and very bad (1), bad (2), The questionnaire was filled in by 95 customers, and the results were summarized in the 3 rightmost columns, namely IC and CoSP. The rightmost column, namely Goals, is determined by rounding up the highest value between IC and CoSP.

Constructing HOQ begins by entering customer needs that have been determined from the rich picture (Figure 3) into the leftmost column of HOQ as can be seen in Figure 4. The top is filled with technical responses, namely answers to customer needs, the middle is filled with the relationship between each customer need and each technical response, with a value of 9 if the relationship is strong, 3 if the relationship is moderate, and 1 if the relationship is low. The bottom is filled with priority scores, which are the sum of the responses multiplied by the goals of each row, and then below that is the rank, which is the order of priority scores from largest to smallest. The next row contains the competitive benchmark, which is the current technical response condition of the shopping trolley, and the next row is the target specification, which is the technical response for the shopping trolley to be designed. Furthermore, the trolley design is carried out based on the target specification.

IV. DISCUSSION

As discussed in HOQ, the main thing that customers need is a shopping trolley that can be used to carry goods home. Therefore, the trolley design is designed to be used in supermarkets and to bring goods home directly. The second main requirement is a lightweight material, thus, the material is made of aluminium or stainless steel that is not solid and fabric from lightweight material. The third main requirement has many places and functions, so the trolley is designed with many partitions. Other needs are also accommodated in this design.

The design is a 2-tier trolley with a frame made of aluminium or stainless steel, as in Figure 5. This trolley can be folded for carrying in a car as in Figure 6. The trolley is equipped with a basket made of plastic and some are made of fabric and can be selected when used according to needs. Both types of baskets can also be folded, as in Figures 7 and 8. This shopping trolley provides flexibility for supermarket customers to choose its use, whether to use only 1 tier or 2 tiers and can also choose whether to use a plastic or fabric basket or a combination of the two.

Fig. 5. Private shopping trolley

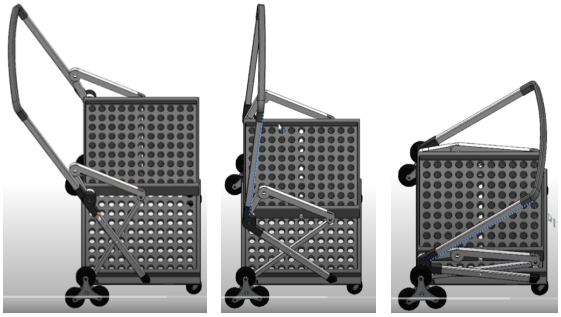

Fig. 6. Folded shopping trolley

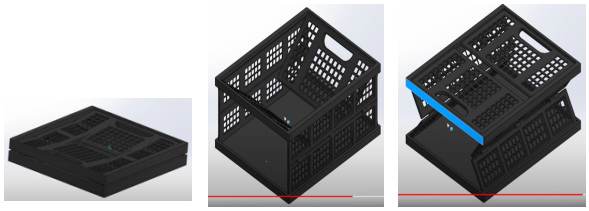

Fig. 7. Plastic basket

With the design of a private shopping trolley, customers feel safe in shopping at the supermarket and do not hesitate to shop. This benefits supermarket owners, because more visitors would increase supermarket revenue. Next, the presence of private shopping trolleys will reduce plastic bag waste, because

	Technical Response											
Customer Needs	Ergonomic dimensions	Easy to carry	Privately owned trolley	Can carry groceries home	Has multiple basket functions	Can go up and down stairs	Lightweight material	Simple construction	Separation of goods	**IC**	**CoSP**	**Goal**
Convenience of carrying/pushing the trolley	9	9	3	1			3			3.75	3.05	3.75
Helps prevent transmission of COVID-19			9							3.48	2.13	3.48
Make it easy to carry groceries home			1	9		1	3	1		3.58	2.93	3.58
Multifunctional					9	9			3	3.44	2.64	3.44
Lightweight trolley		3					9	9		3.43	2.77	3.43
Help reduce environmental burden				9	3					3.46	2.86	3.46
Grocery protector availability					3				9	3.36	2.65	3.36
Score	**33.75**	**44.04**	**46.15**	**67.11**	**51.42**	**34.54**	**52.86**	**34.45**	**40.56**			
Priority	**9**	**5**	**4**	**1**	**3**	**7**	**2**	**8**	**6**			
Competitive benchmark	Standard dimensions, not according to ergonomic anthropometric measurements	Cannot be taken home	Trolley is not private property	Cannot be taken home	Only 1 function	Can't go up and down stairs	Solid and heavy iron material	Simple construction but not foldable	No separation of groceries			
Target specification	Dimensions are determined based on the adult anthropometric size table	Collapsible trolley	Designed as a private trolley	Taken home with the basket	Two baskets are designed, and one of the baskets has a lid and a partition	The rear wheel is designed to go up and down stairs	Material made from aluminium or lightweight iron	Construction is kept simple, including folding construction	Designed to fit 2 baskets, and one of the basket designs has dividers			

Fig. 4. House of quality private shopping trolley

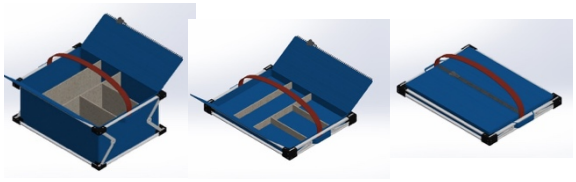

Fig. 8. Fabric basket

customers bring their bags used for shopping and take items home.

V. CONCLUSION

Personal trolleys have been designed according to the needs of supermarket customers with multifunction. This trolley can help customers at the supermarket and bring it home. This trolley can also be used in places other than supermarkets, such as modern markets, department stores, et cetera.

In this study, it can also be concluded that qualitative and quantitative methods can be used together and complement each other. Without qualitative methods, customer needs exploration becomes lacking, and without quantitative methods, measurement is difficult to do.

For further research, it is possible to design different models, different materials, and more ergonomic sizes, and examine the cost of making shopping trolleys.

ACKNOWLEDGMENT

The authors gratefully acknowledge Universitas Kristen Maranatha for providing financial support and facilities for this study

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Abstract **HTML**

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C. Wirawan ; E. Sarvia ; W. Yudiantyo ; Martin **All Authors**

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Published in: 2024 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)

Date of Conference: 15-18 December 2024

DOI: 10.1109/IEEM62345.2024.10857030

Date Added to IEEE *Xplore*: 04 February 2025

Publisher: IEEE

ISBN Information:

Conference Location: Bangkok, Thailand