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Designing an Ergonomic Elderly Trolley to Improve Hypermarket Competitiveness: an Indonesian Perspective

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Abstract

Owing to physical constraints, elderly individuals frequently have trouble shopping at hypermarkets. To address this issue, this study builds a trolley to assist the elderly in shopping comfortably. Furthermore, this design provides a hypermarket with distinct and competitive advantages in terms of increasing customer traffic. This study employs both qualitative and quantitative approaches. Soft System Methodology was utilized to conceptualize the problem qualitatively, while quality function deployment and morphological diagrams were employed to process quantitative data. The result of this study was an elderly trolley design. The trolley is designed based on anthropometric data of the elderly. The shape of the trolley is not much different from a regular trolley but is equipped with a powered component so that it can be driven, a raised seat, and a foldable basket. Payment service support for the designed trolley has also been developed. With the design of the trolley and payment services for the elderly, it is expected that the elderly will be more comfortable shopping and increase the competitiveness of hypermarkets.

Keywords: competitive advantage, elderly, product design, shopping trolley, soft system methodology, quality function deployment

1. Introduction

The COVID-19 pandemic has immobilized firms worldwide owing to government restrictions on social separation to minimize the rate of COVID-19 transmission from 2020 to mid-2022. When COVID-19 levels steadily declined, businesses began to normalize. However, not all enterprises have recovered fully. Many firms are still losing money compared to their pre-pandemic levels. Hypermarkets are businesses that have escaped the plague relatively untouched, but their earnings have drastically reduced. Consequently, hypermarkets must be distinctive to attract more people. Hypermarkets must find new ways to attract customers and increase their incomes.

However, for some city dwellers, shopping in hypermarkets has become a form of recreation. People usually go to hypermarkets with their families, including their elderly relatives. However, because most elderly people have physical restrictions, walking around in hypermarkets, which often have enormous expenses, might be exhausting or challenging. With this limitation, there is a demand for assistive gadgets to assist the elderly in shopping and walking around hypermarkets. This design approach is worth considering because the elderly constitute a substantial percentage of society, frequently shop with their families, and prefer to visit hypermarkets. Furthermore, it can give hypermarkets a competitive advantage, particularly because many have yet to regain their pre-pandemic revenue levels. As a result, it is projected that more elderly people prefer to visit the hypermarket because they benefit from the comfort of shopping through special facilities, thus increasing the hypermarket's income.

The goal of this research was to create an ergonomic trolley that would assist both the elderly and the hypermarket. This study was conducted in Indonesia for numerous reasons. First, the family system is still prevalent in Indonesia, and many families prefer to travel with elderly people. Second, Indonesia

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has many elderly people. The elderly population in Indonesia is predicted to reach 10.82% in 2021, according to the Indonesian Central Bureau of Statistics (Girsang *et al.*, 2022). Finally, as shown in Figure 1, the trolleys used for shopping in hypermarkets in Indonesia are largely the same. There were some size variances, but the designs were nearly the same. The trolley was made of iron, used four wheels, and was equipped with a basket, a child seat made of plastic, and a handle to push the trolley. This trolley was quite heavy for the elderly to use, it was also difficult to load and unload goods because the basket was large and deep. For these reasons, the elderly trolley was designed based on the needs of the Indonesian elderly and anthropometric data of the Indonesian elderly.

Over the past five years, many shopping trolleys have already been designed for the elderly (Kobayashi *et al.*, 2018; Ryumin *et al.*, 2020; Kavitha *et al.*, 2021; Yin, 2021) and many more. Most trolleys have been designed using automation or robotics (Al-Hakmani and Sajan, 2019; Raiyani, 2019; Bello-Salau *et al.*, 2021; Kavitha *et al.*, 2021). In Indonesia, automation and robotic technology are not yet suitable for hypermarket trolleys. This is because the price is relatively expensive, its use is considered complicated by some elderly people, and people are not fully aware of maintaining public property and require more intensive maintenance. Therefore, a manually operated shopping trolley would be more appropriate. Some designers do not specifically design trolleys and use anthropometric data of the elderly but designed systems in hypermarkets, such as payment systems (Bello-Salau et al., 2021; Kavitha et al., 2021; Soori, Abraham and Osman, 2021) and goods search systems such as Yin, Ranchhod and Qiu, 2013; Priya *et al.*, 2021.

From a review of previous designs, it is rare to find designs that help the elderly shop in hypermarkets, especially those that use anthropometric data of the elderly in their design. In addition, there are no previous publications related to the design of shopping trolleys for the elderly in Indonesia. Thus, this research can be claimed to have novelty. This study utilized both qualitative and quantitative methods. The Soft System Methodology (SSM) was used to develop the concept of improving the elderly trolley, and Quality Function Deployment (QFD) was used to design the elderly trolley. Until now, few articles have used both tools together.

Figure 1. Common supermarket and hypermarket trolley

2. Literature Review

Ergonomics studies anatomical, physiological, and psychological aspects of human work. This is related to human efficiency, health, safety, and comfort (International Ergonomics Association, 2010). Ergonomically designed items are sought to maximize user productivity and convenience. Anthropometric data were used to establish trolley dimensions to ergonomically construct the trolley. The anthropometric data used were based on the population of product users. The trolley design in this study was determined by the consumers of the product, specifically the elderly. Following the Government Regulation of the Republic of Indonesia, the retirement age starting in 2019 is 57 years old

(Government of the Republic of Indonesia, 2015). So, in this study were determined elderly as people aged 57 years and over.

SSM is a systematic approach to modelling for problem-solving and change management (Hanafizadeh, Mehrabioun and Mostasharirad, 2021). SSM helps to solve problems in complex situations (Checkland and Poulter, 2010). SSM was initially used as a systematic modelling tool in the business sector but later became a learning and training development tool to transform messy situations into systematic ones (Holland and Garfield, 2016). SSM can formulate various stakeholder needs and their interactions so that they can be better described and understood (Wu *et al.*, 2021). There are seven stages in SSM to solve problems as follows (Checkland and Poulter, 2010). The problematic scenario and stakeholders were identified in the first stage. Following the second stage, the problem is portrayed using a "rich picture" to present the structures, processes, linkages, and issues pertinent to the problematic scenario. In the third stage, the root definition of the system was determined. The determination is made by identifying Customers, Actors, Transformation, Worldview, Owner, and Environmental constraints (CATWOE) (Checkland and Poulter, 2010). Thus, complex problems can be systematically observed. The CATWOE identified in this research is related to trolleys for elderly people. The fourth stage represents the conceptual model of the pre-defined system. The fifth stage involved comparing the conceptual model to reality. The sixth stage involves adjusting and changing as needed, and the seventh and final stages involve taking action.

Along with SSM, this study also uses QFD, which has been widely used as a product design tool. QFD helps designers deploy user requirements into technical responses and specifications. Later, the function of the QFD expanded and was used for planning, decision-making, and management of teamwork, time, and cost (Hong and Huo, 2010). In terms of the field designed, QFD also expanded, where at first QFD was widely used for tangible products such as (Erdil and Arani, 2019; Mistarihi, Okour and Mumani, 2020), and was then used for services such as (Dinçer, Yüksel and Martínez, 2019; Liu, Gao and Ma, 2019) and later for product-service systems such as (Sousa-Zomer and Cauchick Miguel, 2017; Haber, Fargnoli and Sakao, 2020).

As previously stated, older adults frequently face many challenges when shopping at hypermarkets. Some obstacles include weariness from walking through a large hypermarket, picking up objects placed in high locations, and handling trolleys (Pettigrew, Mizerski and Donovan, 2005; Kohijoki, 2011). Therefore, they required support. The hypermarket trolleys provide these services. As a result, trolleys were chosen as support facilities. Therefore, a new trolley design is required to address these challenges. Many researchers have conducted research on and redesigned shopping trolleys. Some researchers have developed smart trolleys that are mainly used to count groceries so that customers do not need to queue at the checkout, namely smart trolleys with the help of robots (Priya *et al.*, 2021), smart trolleys using RFID (Peradath *et al.*, 2017; Prabakaran *et al.*, 2017; Bhumika *et al.*, 2021; Kavitha *et al.*, 2021; Murugesan *et al.*, 2021), smart trolleys using chip and barcodes (Sainath *et al.*, 2014) and smart trolleys using smartphone and Arduino (Bedi *et al.*, 2017). In addition, researchers have developed a supermarket trolley with tools to guide customers in a hurry to immediately find the items they need (Ng *et al.*, 2015; Prabakaran *et al.*, 2017). Researchers have designed a motorized trolley (Murugesan *et al.*, 2021) and even a robotic trolley for the elderly (Kobayashi *et al.*, 2018). In addition, (Yin, 2021) designed a trolley that can accommodate the use of shopping bags, baskets, or personal trolleys for the elderly. The trolley was redesigned by considering anthropometric data has also been done (Handrian, Rahaju and Sianto, 2009).

Despite numerous studies, there are still few trolley designs exclusively for the elderly, particularly those that employ anthropometric data. Furthermore, most designs employ automation or smart trolley technology, which is not yet appropriate for Indonesian conditions. Consequently, in this study, a trolley was specifically built for the elderly in Indonesia. This trolley meets the needs of the elderly by assisting them in walking around hypermarkets, picking up products from high locations, and making it easier to store them in the cart. Furthermore, the cart is intended to be useful, inexpensive, and ergonomic for the

elderly population. In terms of methodology, it is also uncommon for research to mix SSM (qualitative methods) with QFD (quantitative methods).

3. Research Method

This study aimed to design a shopping trolley suitable for the elderly. In designing the trolley, we conducted research to make it suitable for the elderly. We combined qualitative and quantitative methods, namely SSM, QFD, and morphological charts. This study followed the steps shown in Figure 2.

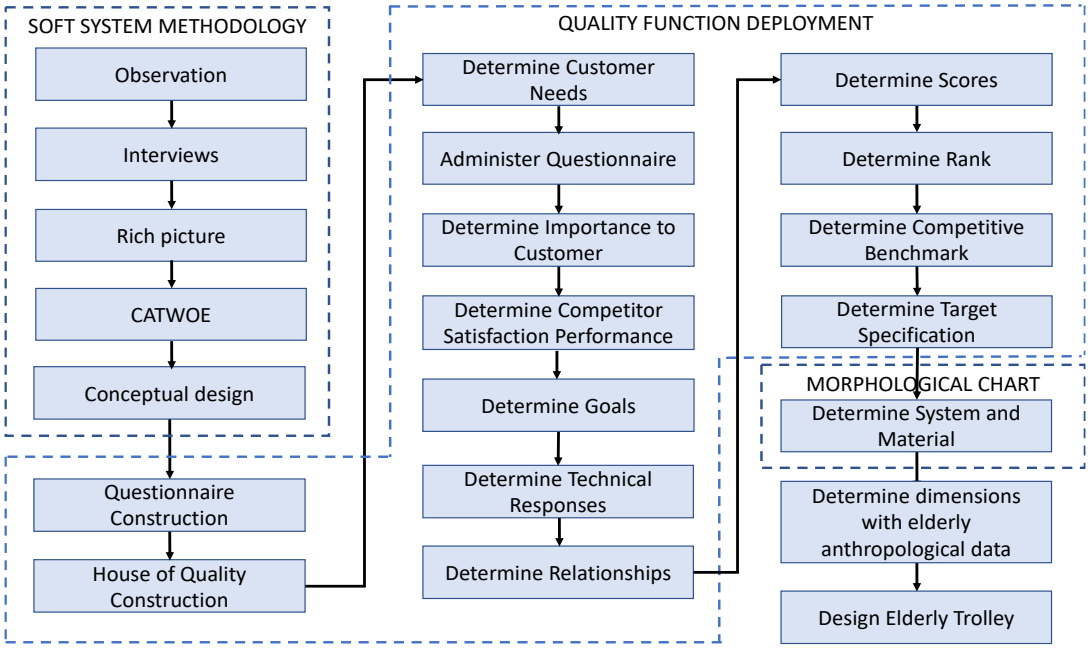


Figure 2. Design steps for elderly trolley by integrating SSM and QFD

The research started with a qualitative method formulated using SSM. The first step of SSM, identifying problematic situations, was performed by observation. In this case, observations were made in hypermarkets for the elderly regarding the use of shopping trolleys. The second step of SSM is carried out by interviewing elderly respondents, elderly families, and hypermarket owners or employees to determine the use of trolleys by the elderly and the problem of reduced hypermarket visitors since COVID-19. The results of the observations and interviews are depicted in a rich picture to see the links and relationships more clearly, as shown in Figure 3.

This research involves elderly people as interview and questionnaire respondents. However, what was asked was their views on hypermarket trolleys, including an assessment of the existing trolleys and the need for trolleys. Consent to become a respondent was obtained from each respondent verbally before the interview was conducted and before asking to fill out the questionnaire.

The next step is to determine the root definition of the system. For this purpose, CATWOE (Customer, Actors, Transformation, Worldview, Owner, Environmental Constraints) was analyzed. In this study, the customers: are elderly trolley users in hypermarkets; the actors: are elderly trolley users, elderly families, hypermarket owners, and hypermarket employees; transformation: increasing the comfort of the elderly in shopping, and increasing the number of hypermarket visitors; worldview: the perspective and understanding of each actor based on observations and interviews is as in the rich picture in Figure 3; owner: the owner of the activity is the elderly and the owner of the hypermarket; environmental constraints: existing trolleys are not ergonomic and suitable for the elderly; the COVID-19 pandemic has created new habits for people, namely, reducing shopping by visiting supermarkets and hypermarkets.

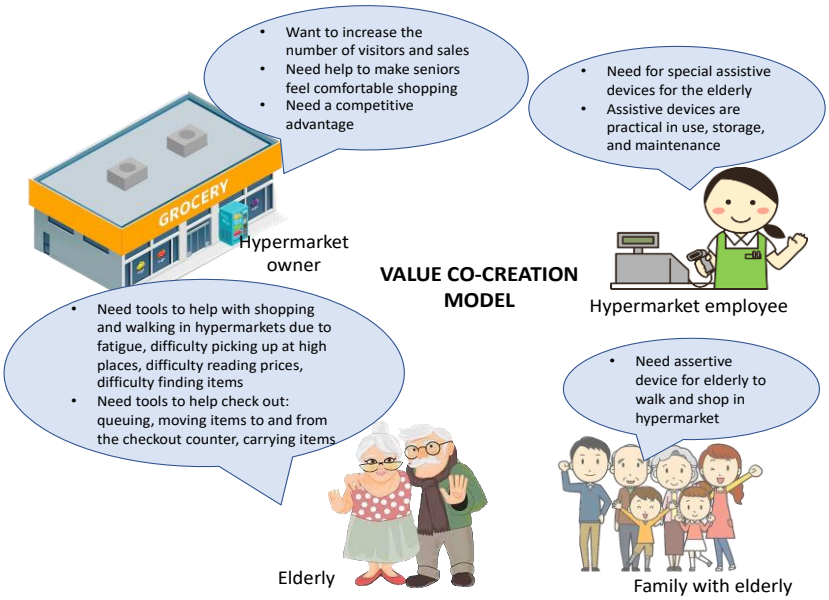


Figure 3. The rich picture of elderly trolley design perspectives among stakeholders

Step 4 is drafting the concept by considering the needs and opinions of all stakeholders, so it can be called value co-creation. This concept is based on the needs and opinions of various actors. In this study, the concept was that of an elderly trolley for use in hypermarkets. The trolley is designed so that the elderly feel comfortable shopping or walking around hypermarkets, which then becomes a competitive advantage for hypermarkets, making the work of hypermarket employees easier. The variables were obtained from observations and interviews with various parties.

The next stage of the SSM is to compare concepts with reality. Quantitative methods were used to obtain real data through questionnaires. The questionnaire consisted of items based on the analysis of observations and interview results. A questionnaire was used to explore the importance of each user's needs and satisfaction with the current shopping trolley. The shopping trolleys currently in use are competitors. The respondents of the questionnaire were 57-year-old people and above who had shopped at hypermarkets. Thirty-eight respondents were included in this study, we obtained 38 respondents. We also used this questionnaire to form the House of Quality (HOQ) method, which will result in new design specifications.

This research continued with the creation of the HOQ. The leftmost column in the HOQ, as shown in Figure 4, shows user needs obtained from observations and interviews. Next, importance to customers (IC) and Competitor Satisfaction Performance (CoSP) obtained from questionnaires filled out by respondents are listed on the right side of the HOQ, followed by goals. The objective is determined as the best value for each IC and CoSP for each customer requirement.

The top of the HOQ was filled with technical responses. Technical responses can meet customer requirements. The middle part of the HOQ is filled with the relationship between customer requirements and technical responses. This section describes the relationship between the two variables. For strong, medium, and weak relationships, values of 9, 3, and 1, respectively, were assigned. The bottom of the HOQ is filled with a priority score, which is calculated by summing the multiplication of the relationship with the goal in each row. Rankings were determined based on the priority score. Ranking is determined by sorting priority scores from the largest to the smallest values. Next, we determine the competitive benchmark. In this study, the competitive benchmark is filled with current trolley specifications, which are assumed to be competitors for each technical response. Next, we determine the target specifications for each technical response. The target specifications were determined according to the customer requirements for the hypermarket trolley to be designed.

Customer Needs	Trolley wheel design	Ergonomic trolley	Easy trolley control	Trolley helps walking	Trolley as a tool to pick up goods in high places	Trolley size	Transfer of goods to the cashier's desk service	Payment processing service	The process guarantees hyg	IC	CoSP	Goal
Convenience of carrying/pushing the trolley	9	9	9	3						3.71	2.92	3.71
Reduce walking fatigue	9	9	3							3.47	3.13	3.47
Makes it easy to pick up items on high shelves					9					3.42	2.61	3.42
Makes it easy to take items from the trolley to be moved to the cashier's desk during payment						9	9			3.61	2.84	3.61
Current general trolley capacity						9				3.24	3.11	3.24
Service makes payment easy							9	9		3.37	2.97	3.37
Service makes payment convenient								9		3.34	3.00	3.34
Hygienic guarantee service									9	3.47	2.89	3.47
Score	64.66	64.66	43.82	11.13	30.79	61.58	62.76	60.39	31.26			
Priority	1.5	1.5	6	9	8	4	3	5	7			
Competitive benchmark	Four wheels, rubber, can rotate 360 degrees	Standard dimensions, not according to elderly anthropometric measurements	Control with front wheel via handrail	No help	No help	L=82, FW=41, RW=49.5, FH=40, RH=58	No help	Service by cashier and wrapper	Spraying sanitize 3 times a day			
Target specification	Seven wheels, 2 front wheels for control, 1 motorized rear wheel, 4 cart wheels	Using anthropometric data for the Indonesian elderly	Control with steering wheel	Motorized trolley / Trolley can be ridden	Trolley seat can be elevated	Dimension according elderly anthropometric data, adjustable size	Assistance service for moving goods to the cashier desk / Detachable trolley basket	Payment system and assistance service at the cashier	Spraying the trolley after every customer use			

Figure 4. House of Quality

Next, we determine competitive benchmarks. In this study, the competitive benchmark is filled with specifications of existing common trolleys, which are assumed to be competitors for each technical response. Next, we determine the target specifications for each technical response. Target specifications were determined based on customer needs and conditions, designer design, and anthropometric data.

The next step is to change. Here, we selected the materials and features of the trolley using a morphological chart. In the morphological chart, alternative materials and features that could be used for trolley parts are identified. Next, the designers choose the most appropriate one. After that, the dimensions of the trolley are determined according to the anthropometric data of the appropriate elderly (Sarvia, et al., 2021).

The last step of SSM takes action. This step was carried out by designing an elderly trolley and related services. Related services are also designed to assist the elderly in using the newly designed trolley to maximize their convenience.

4. Result and Discussion

The initial stage of gathering data for this study was to observe this problem. We discovered from direct observation that many older people find it difficult to stroll in hypermarkets because of physical restrictions. This observation is in line with (Kohijoki, 2011; Pettigrew et al., 2005). Furthermore, elderly people who are compelled to shop alone in hypermarkets find pushing trolleys around the store restricted. On the other hand, hypermarkets have suffered a decrease in footfall and sales because of the habits acquired during the COVID-19 pandemic. As a result, it is vital to redesign hypermarket trolleys that are ideal for the elderly to be comfortable while also serving as a special draw for them to come and shop at hypermarkets.

The interviews were conducted in the next step. Interviews were conducted with hypermarket owners, staff, families who attended hypermarkets with the elderly, and the elderly who were the focus of the research. According to the findings of the interview with the owner, the owner believes that shopping trolleys are not appropriate for the elderly, and the vastness of the hypermarket has the potential to exhaust the elderly when strolling around it. The hypermarket owner believes that a trolley design that is comfortable for the elderly, practical, and easy to maintain should be developed. According to interviews with hypermarket personnel, there are undoubtedly challenges for the elderly when using trolleys if they arrive alone. Supermarket employees want the trolley design to be functional in terms of storage and maintenance. Because of the vast size of the hypermarket, most families reported that it is difficult for the elderly to shop and stroll around it.

The results of 34 interviews with older people revealed the reasons and obstacles that elderly people faced when shopping at hypermarkets. According to the interview findings, the majority of the elderly prefer to shop in hypermarkets for a variety of reasons, as shown in Table 1. For a variety of reasons given by the elderly to shop in hypermarkets, the elderly can be considered a prospective market niche. Therefore, assistive device design for the elderly is required. Interviews with the elderly also seek to identify the obstacles that the elderly face when shopping in hypermarkets, as seen in Table 2. In the HOQ, these issues are analyzed and summarized according to user needs.

The next step was to form a rich picture. This figure describes the opinions and needs of each actor. A rich image is shown in Figure 3. The next step is to use the CATWOE identification to establish the root definition of this problem. Elderly people over the age of 57 who shop at hypermarkets are customers. The actors included hypermarket owners, employees, elderly families, and the elderly. The proposed alteration aims to make it more pleasant for the elderly to shop at a hypermarket, thereby increasing the number of visitors. Figure 3 depicts a rich image of the viewpoint of this problem. The elderly and hypermarket owners are proprietors of activities. The decrease in the number of visitors to hypermarkets since the COVID-19 pandemic, due to the fear of transmission of the COVID-19 virus, and then a shift in people's habits that are more comfortable purchasing online are environmental restrictions.

Furthermore, shopping trolleys in Indonesia have a uniform shape and size, and the existing conditions of hypermarket trolleys are unsuitable for the elderly.

The next step is the concept construction. Based on the needs of all stakeholders, the concept of an elderly trolley must be designed so that the elderly can walk and carry the trolley inside the hypermarket. For this reason, the design of a trolley can be driven, practical to wear, practical to store, and designed according to the anthropometric data of the elderly. In addition, it is necessary to design a payment system at the cashier that is appropriate for the trolley and facilitates the elderly.

The following phase in the SSM is used to compare conceptions with reality. In this study, we evaluated the HOQ building because the HOQ construction process comprised user importance (IC) and satisfaction (CoSP), which were compared and coupled with the concepts produced. This is a previously discussed concept. The HOQ is shown in Figure 4.

We listed eight variables as customer needs related to elderly shopping trolley design based on the interviews. These eight factors were incorporated into the HOQ's customer demands, as shown in the leftmost column of Figure 4. Based on these variables, a questionnaire was created to determine the IC and CoSP of the current trolley, which are listed in the third and second columns from the right. The goals are listed in the right-hand column. The purpose of the HOQ construction is to compare concepts with reality. Customer needs were deployed to the nine technical responses included at the top of the HOQ. Technical responses served as answers to the customer's needs. Next, the relationship between each customer's needs and each technical response was identified and written at the centre of the HOQ based on the strength of the relationship.

Table 1. Reason for elderly like shopping at hypermarkets

No	Reason for Liking Shopping at Hypermarket	%
1	Comprehensive shopping	67.65
2	Shopping while sightseeing and refreshing	20.59
3	No need to haggle over prices	20.59
4	Directly see and choose the product	8.82
5	Practical	5.88
6	No need to haggle over the price	2.94
7	Happy to buy imported fruits	2.94
8	Shopping while enjoying the culinary delight	2.94
9	Proximity to residence	2.94
10	Can maintain distance while shopping	2.94
11	Easy to find the items you need	2.94
12	Prices are still affordable	2.94
13	Better quality assurance for the products purchased	2.94

Table 2. Elderly's difficulties related to hypermarket trolley used

No	Difficulties Faced by Elderly	Frequency	%
1	Fatigue from queuing for payment at the cashier	22	64.71
2	Difficulty in picking up products on high shelves	13	38.24
3	Difficulty in moving products from the trolley to the cashier's desk	10	29.41
4	Difficulty in pushing a trolley in a hypermarket	6	17.65
5	Fatigue from walking in the hypermarket	6	17.65
6	Difficulty in seeing prices	1	2.94
7	Difficulty finding parking	1	2.94
8	Spending too much time	1	2.94
9	Difficulty in finding items	1	2.94
10	Trolley getting in the way of consumers	1	2.94

The priority of the technical responses is then determined by multiplying the relationship with the goal for each technical response (each column). The highest score indicates the highest priority. The top and second priorities of the technological answers were discovered to be the trolley wheel design and ergonomic trolley. However, with this design, we accounted for all the technical replies.

A competitive benchmark was included at the second bottom of the HOQ. The specifications of the existing trolley are included in the competitive benchmark. Finally, the target specification was written at the bottom of the HOQ. The target standards for trolley design and support services were developed based on client needs, technical responses, benchmarks, and designers' inventiveness. This specification is referred to in the Design section.

Next, we developed a morphological chart as shown in Table 3. This step is also related to the change step in the SSM. A morphological chart helps the designer to determine the features of the trolley, such as the material, system, and form. Using a morphological chart, we determined the features of the trolley designed as oval shapes.

Next, the dimensions of the trolley were determined. Table 4 lists the features and dimensions of the designed trolley. The dimensions listed in Table 4 were determined based on the Indonesian elderly anthropometric data (Sarvia *et al.*, 2021) based on gender and percentiles that match the condition of the trolley during use.

The design of the elderly hypermarket trolley, considering customer needs, is shown in Figures 5–9. This design represents the steps of the SSM. This trolley is designed to assist the elderly according to the needs expressed by research respondents in shopping at hypermarkets. According to feedback from respondents, one of the problems faced by the elderly is fatigue from walking in hypermarkets and difficulty pushing a trolley around the hypermarket. Therefore, we designed a trolley with an engine that could be ridden and driven by the elderly.

The trolley design was divided into two components: the basket and motorized parts, as shown in Figures 5 and 6, respectively. The basket component can be paired with and released from the power component. The two hooks and locks connect the two components. When shopping, the two parts are joined, as shown in Figure 7, and can be released upon payment and storage. Powered parts include a driving machine, steering wheel, acceleration pedal, and seat; thus, when in use, the elderly can sit in the provided seat and drive the trolley around the hypermarket.

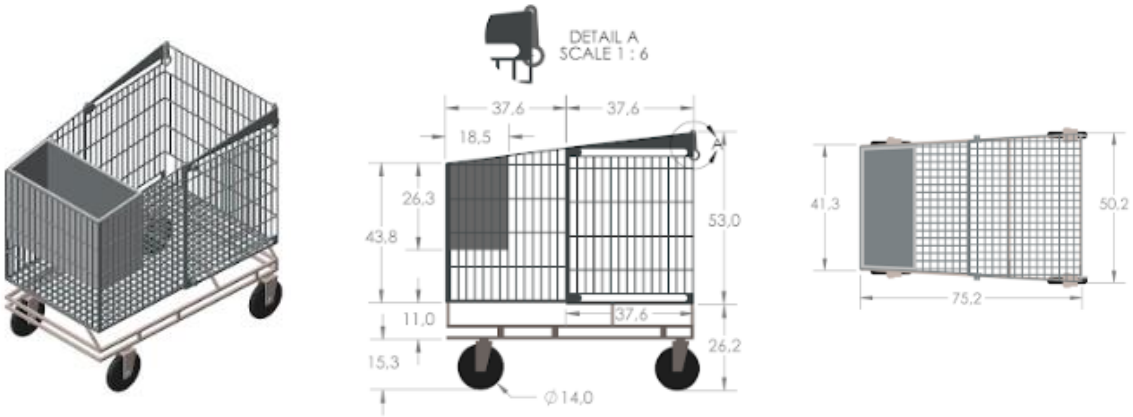
Table 3. Elderly trolley morphological chart

	Feature	1st alternative	2nd alternative	3rd alternative	4th alternative
1	Trolley basket	plastic	steel	wood	aluminium
2	Little basket	plastic	steel	wood	aluminium
3	Seat	plastic	spons with leather	spons with imitation leather	wood
4	Trolley	iron	steel	aluminium alloy	plastic
5	Starter and gear	iron	aluminium	steel	
6	Front wheel	steel	steel with rubber	plastic	rubber
7	Rear wheel	steel	steel with rubber	plastic	rubber
8	Foot rest	iron	aluminium	steel	plastic
9	Steering wheel	plastic	steel	aluminium alloy	
10	Steering wheel cover	leather	textile	imitation leather	
11	Elevating system	hydrolic	electric	mechanic	

Table 4. Elderly trolley dimensions

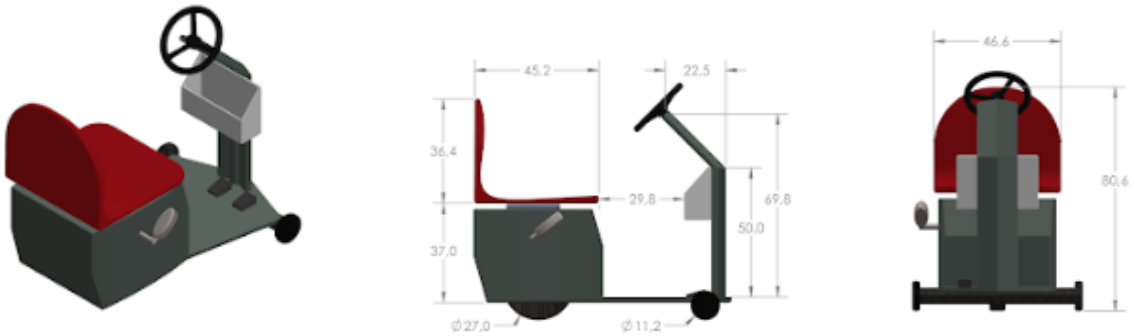
Part	Material	Dimension	Anthropometric Data (Elderly)	Gender	Percentile	Dimension (cm)
Trolley Basket	Chrom platted steel	Length	Frontal Gripping Distance of the Hand + 1/2 Width of the Shoulders	Woman	P5	75.2
		Front width	Width of the Shoulders/Bi-Deltoid Width	Woman	P50	41.37
		Rear width	Width of the Elbows	Man	P50	50.2
		Front height	Midshoulder Height	Woman	P5	43.8
		Rear height	Midshoulder Height	Woman	P50	53
Little Basket	Synthetic	Length	Maximum Extension of the Hand	Woman	P50	18.5
		Width	Width of the Shoulders/Bi-Deltoid Width	Woman	P50	41.3
		Height	1/2 Frontal Gripping Distance of the Hand	Woman	P50	26.3
Seat	5 cm thick sponge leather imitation steel	Length	Buttocks-to-Popliteal Length	Man	P50	45.2
		Width	Width of the Hips	Man	P95	45.6
		Height	Popliteal Height	Woman	P5	37
		Back rest length	3/4 Midshoulder Height	Man	P5	36.45
Trolley	Stainless steel	Trolley length	Basket length + seat length + 3/4 Buttocks-to-Popliteal Length	Woman	P50	176.9
		Steering wheel height	Popliteal Height + 3/4 Midshoulder Height	Woman	P5	69.85
		Wheel height	Based on general dimension			15.2
		Hole Height	Based on general dimension			15
Starter and gear	Steel plate	Length	As the parts dimension			10
		Width	As the parts dimension			25
		Height	Popliteal Height + Thickness of the Thigh in a Seated Position	Woman	P95	64.3
Front wheel	Rubber without air	Diameter	Dorsal arch height + shoe allowance			11.2
Rear Wheel	Rubber without air	Diameter	Based on general wheel dimension			27
Footrest	steel plated covered with rubber	Length	Length of the Foot	Man	P95	29.8 (+3 allowance)
		Width	Width of the Hips	Man	P95	45.66 (+2 allowance)
Steering wheel	steel covered with leather imitation	Diameter	Based on general wheel dimension			25
		Handle Diameter	Based on general wheel dimension			2.5

The elderly trolley is likewise designed to make it easier for the elderly to store stuff in the basket while sitting, but the basket has a large volume and may contain numerous objects. The trolley basket was designed to be collapsible, as shown in Figure 8 so that it could have two different volumes. Folding of the basket is accomplished by pulling the front of the trolley basket against the given rail until it is half the length of the trolley, then securing it with the attached hooks. The elderly can fill the trolley basket first, and once it is full, the hooks are opened and the basket's front is pushed, increasing the basket capacity, and can be filled with more items.



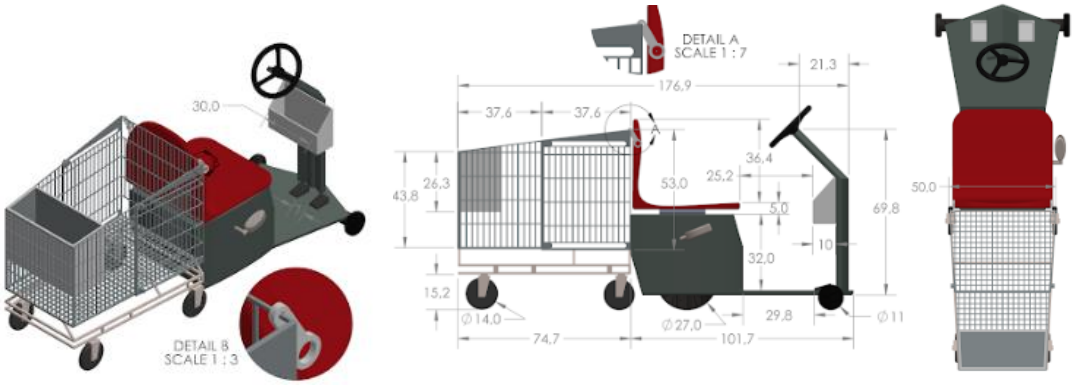
(a) Basket part 3 dimension (b) Side view of basket part (c) Top view of basket part

Figure 5. Basket part



(a) Powered part 3 dimension (b) Side view of powered part (c) Front view of powered part

Figure 6. Powered part

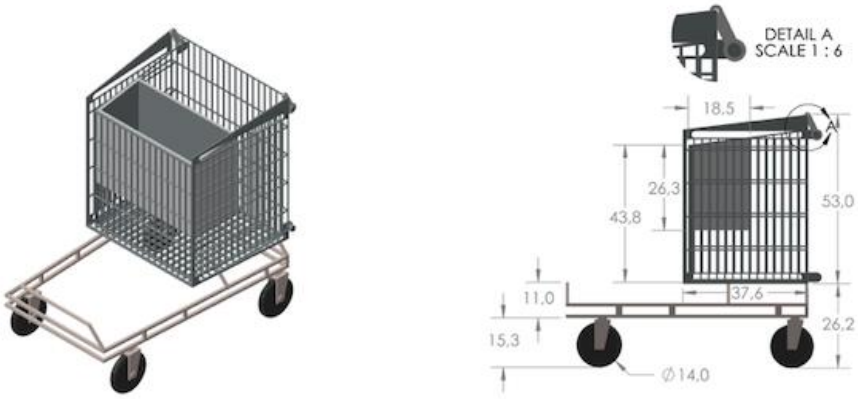


(a) Both part 3 dimensions (b) Side view of both parts (c) Top view of both parts

Figure 7. Basket and powered parts combined

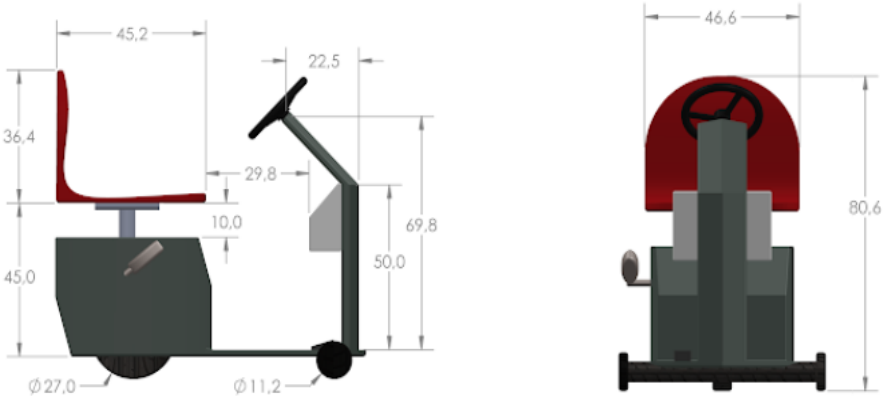
Moreover, to ease the elderly reaching goods in high racks, we equipped the elderly trolley with an adjustable seat using a hydraulic system, as shown in Figure 9. With this adjustable seat, the elderly could reach high racks at a certain height. Indeed, the designed height is only 10 cm, considering the safety of the elderly. Therefore, for more than that, the elderly can ask for help from the staff to get items.

We devised a payment method based on the challenges mentioned by the elderly, notably exhaustion from queuing for payment at the cashier and difficulty carrying items from the trolley to the cashier's desk. There are two payment options. To begin, the elderly can pay in a traditional style and cashier. As indicated in Figure 10, the elderly can separate the basket from the motorized section, push it to the cashier area, and make payments, as usual. Second, the elderly can pay for a separate cashier area. As shown in Figure 11, a unique cashier space is created with the cashier desk facing the opposite direction to the ordinary desk. When entering a cashier area, the elderly remain on the cart. The cashier assisted in removing the basket section and items, placing them on the cashier's desk, and calculating the amount to be paid. The Elderly pay the full purchase cost. The cashier or volunteer wraps the items and places them back in the trolley basket, and then the cashier reattaches the basket half so that the elderly can transport them to their vehicle via the trolley. Figure 11 depicts this procedure. Three of the five most common difficulties related to trolley design were solved using this newly designed trolley so that the elderly could shop and walk comfortably in the hypermarket.



(a) Folded basket part 3 dimension (b) Side view of folded basket part

Figure 8. Basket parts in the folded position



(a) Powered part side view (b) Powered part front view

Figure 9. An elderly trolley with an elevated seat

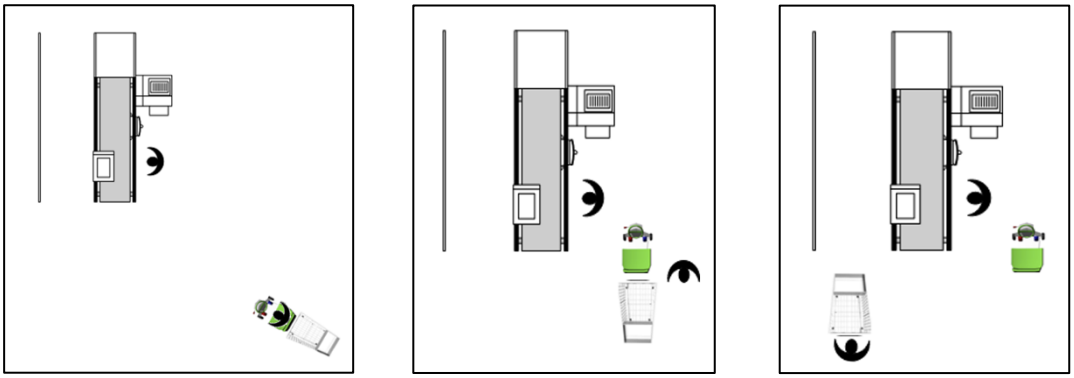


Figure 10. Payment service with users bringing their detachable carts

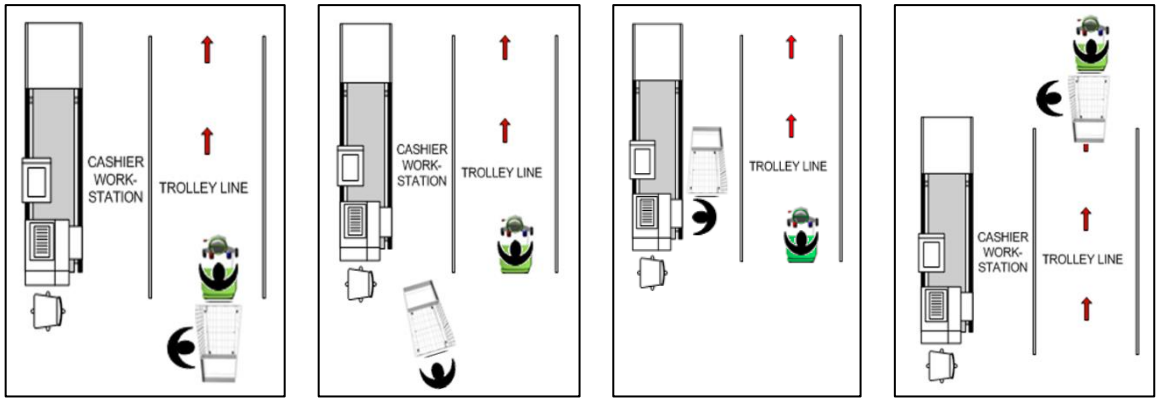


Figure 11. Payment service with users still riding the trolley

The new trolley design has advantages over the current one because it is more suitable for the elderly. However, obstacles to its use still exist. The first obstacle is the price of the trolley which is certainly more expensive than the current trolley. Thus, supermarkets/hypermarkets need to spend extra funds for its procurement. The second obstacle is the elderly's unfamiliarity with using or riding a trolley. This can cause difficulties or accidents during use. The third obstacle occurs at the time of payment. The unfamiliarity of the elderly and also the cashier who serves will cause the service to take longer, and there will be queues. Moreover, this design is still new, so a physical prototype needs to be created to test its use in supermarkets/hypermarkets.

5. Conclusion

This study designs an elderly shopping trolley for use in hypermarkets. To design the trolley, we used SSM, QFD, and morphological chart tools. The trolley has a basket section and a powered section that can be installed and removed from one another. The basket of the trolley can be folded to facilitate the storage of goods on the trolley. In addition, the trolley seat can be raised with a hydraulic system to increase the height of goods reaching the shelf. All trolley dimensions were designed according to anthropometric data of the elderly (Sarvia *et al.*, 2021). The newly designed trolley is equipped with a support payment system. In addition to making life easier for the elderly, this trolley design is a competitive advantage for hypermarkets that are currently struggling to restore their pre-pandemic sales.

This study combines qualitative and quantitative methods to find a better solution. This combination allows for a better exploration of the issues, as it uses qualitative methods that are suitable for exploring issues. Meanwhile, quantitative methods are used to test the concepts found in qualitative methods so that the results match the needs.

However, there are still weaknesses and limitations in the process and design of this trolley, which is a further research direction. First, this trolley can only help the elderly reach the shelf with an additional 10 cm. For a higher outreach, other assistive devices or service systems need to be designed. This design is made for the elderly, and the size is taken from anthropometric data of the elderly in Indonesia; for other segments, such as the disabled, there needs to be another design to be applied in other countries with significantly different anthropometric sizes, there also needs to be an adjustment. Other research can also be conducted to calculate the cost of creating a trolley and a feasibility study of using a trolley. Consideration of the ability of the elderly to ride a trolley also needs to be further researched to ensure that it is comfortable for the elderly and does not pose a danger. Finally, other studies can use different methods from the presented study and compare the results.

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