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Research Article

Design Of Edc Machine Case And Stand Using House Of Quality And Anthropometry Measurement

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Abstract: Non-cash transactions using an electronic data capture (EDC) machine is a normal thing that happens in a store (merchant), the primary users are between the cashier and the customer. EDC which is widely used in Indonesia is only able to accept non-cash payments from one bank or payment channel, resulting in shops having to provide various types of EDC machines from various banks. PT TX plans to make EDC with the latest features that can accommodate non-cash payments from various banks and payment channels, so an ergonomic EDC case design is required. The research objective was to design an EDC case according to the needs of potential users. . The method used is the House of Quality (HoQ) because this method can process the customer requirements into a correlated technical response to help the EDC case design process. Also, the anthropometric approach is used to realize an ergonomic product design, namely using the dimensions of the eye height. Data processing using HoQ shows that the design attributes of the shape and size dimensions of the product are the attributes with the highest-ranking, and become the main technical sponge that must be focused on in designing the EDC machine case and stand. From anthropometric data processing obtained information regarding the amount of the angle of inclination for customer display is 25 degrees. The resulting product design has considered customer requirements and ergonomic principles in product design, thus it is expected to meet user satisfaction.

Keywords: anthropometry, EDC machine, HoQ, product design

1. Introduction

Along with the development of industry 4.0, the lifestyle of the Indonesian people is getting more advanced, one of which is related to payment methods. Non-cash payments have become accustomed to being used by most Indonesians, especially in big cities, until their development has increased significantly. One of the non-cash payments can be accessed by Electronic Data Capture (EDC). EDC is generally used by cashiers and buyers (customers) who make transactions in a store. EDC in Indonesia only accommodates payments from one bank or one payment channel, so it is found that more than one EDC is available at the cashier, this makes the activities of cashiers and merchant owners less effective.

PT TX is a start-up company that is developing an integrated multiplatform system in the field of payment solutions. The payment solution provided is an online payment that can accommodate various banks and various types of payment channels and can be accessed using a fingerprint as a payment account. Fingerprints are natural human identities that have been predicted to be widely used as account identities to access various devices, one of which is EDC. PT TX designed an EDC machine consisting of sophisticated high-specification devices to accommodate future requirements for accessing bank payments and online payments.

The sophisticated devices contained in the EDC planned by PT TX are Android tablet phones, external dual cameras, mini Liquid Crystal Display (LCD), and capacitive fingerprint scanners. These sophisticated devices will then be packaged by an EDC machine case and stand. EDC machine Case is a wrapper that acts as an intermediary for the physical media between devices with the EDC, while an EDC machine stand is a tool to prop up the machine placed on the counter. The required product design needs to answer requests from potential users and is ergonomically designed to be comfortable to use.

Product design that suits the needs of potential users, of course, considers input from potential users, therefore the Quality Function Deployment (QFD) method is appropriate to use as a design reference. Ergonomic EDC machine case and stand resulted from the anthropometric approach. The ergonomic EDC machine case and stand will simplify the process of non-cash payment transactions, so that transaction times can be shorter and ineffective problems can be avoided. This study aims to design an EDC machine case and stand that can meet user needs and user satisfaction.

2. Literature review

Product design and development is a series of activities starting with the analysis of market perceptions and opportunities, then ending with the production stage. Product design and development is a sequence of steps or activities of a company that prepares, designs, and commercializes a product. Products designed and developed are not only limited to physical products, but also non-physical products such as services [1][2].

The design and product development stages are commonly referred to as the phase. The product design and development phases, consisting of phases 0 to 5 [1], are as follows:

a. Phase 0 of Product Planning is characterized by the pre-approval of the project and the actual product development launch process.

b. Phase 1 of Concept Development begins to identify customer needs or target markets, make various alternative concepts and then choose the best one to be continued in the next development process. The concept is a description of the form, function, and appearance of a product and is usually accompanied by a set of specifications, analysis of competitor products, and economic considerations of the project.

c. Phase 2 of System Design includes the definition of product architecture and the description of the product into subsystems and components. The output in this phase usually includes the layout of the product form, functional specifications of each product subsystem, and an introductory process flow diagram for the final assembly process.

d. Phase 3 Detailed Design includes the complete specification of the shape, material, and tolerances of all the unique components of the product and identification of all standard components purchased from the supplier. A process plan is stated and equipment is designed for each component made in the production system.

e. Phase 4 Testing and Repair involves the construction and evaluation of various initial production versions of the product. In this phase, an initial prototype (alpha prototype) and a later prototype (beta prototype) were created. Early prototypes were made using components and shapes that resembled the original, but with a simpler manufacturing process. Initial prototypes are made to see whether the product can work as planned and can meet customer needs. Meanwhile, the next prototype was made with the components needed, but not through the actual assembly process. This prototype is intended to answer questions about performance and reliability to identify technical changes for the final product.

f. Phase 5 Initial Production, in this phase the product is made using the actual production system. The purpose of this initial production is to train the developer in solving problems that may arise in the actual production process.

Quality Function Deployment (QFD) is a methodology for translating customer needs and wants into a product design. Technically, QFD has defined as structured ways to make or develop products in a company's cycle. QFD has some engineering and quality requirements. QFD can also assist the product development process. The initial steps for starting QFD product design are as follows [3]:

a. Obtain information on the needs of customers or potential customers.
b. Determine product variations and themes.
c. Determine the priority scale value of the House of Quality (HoQ) matrix.
d. Create an HoQ matrix.
e. Make a design

The HoQ matrix is a product planning matrix whose task is to process the value of the technical response based on customer demand so that a ranking of the technical response is obtained. The ranking of technical responses is useful as a major consideration in designing a product. The composition of the HoQ matrix is shown in Figure 1.

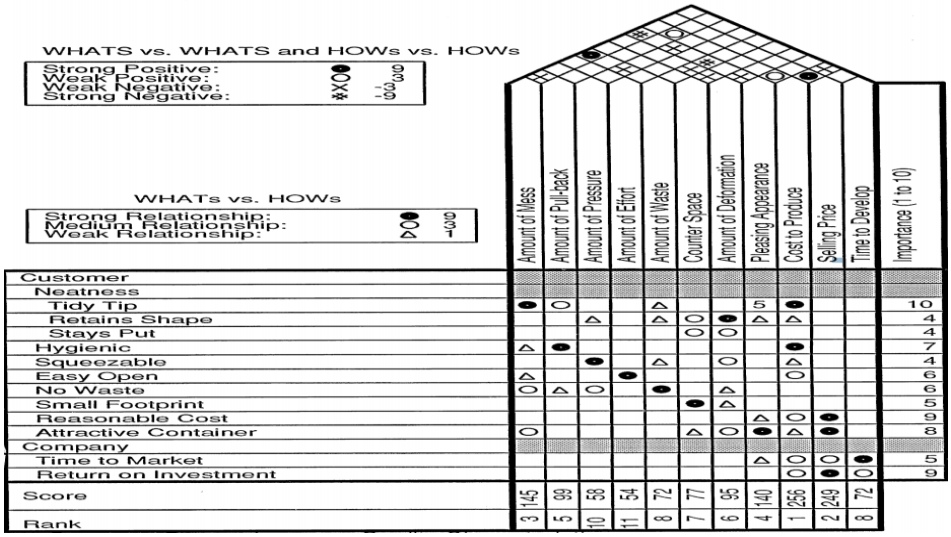

Figure 1. The Full House of Quality [3]

The ergonomic element is necessary for product design. Ergonomics is defined as the study of human aspects of the work environment in terms of anatomy, physiology, psychology, engineering, management, and product design. Ergonomics is continuous with optimization, efficiency, health, safety, and human comfort in the workplace.

For ergonomic product design, it is necessary to involve understanding anthropometry [4]. Anthropometry is knowledge about the human body, especially the dimensions of the body. The dimensions considered in anthropometry measurement, include stature height-standing, eye height-standing, shoulder height-standing, sitting height, elbow rest height-sitting, etc. Anthropometry Dimensions of the Human Body [5, 7] describe in Figure 2.

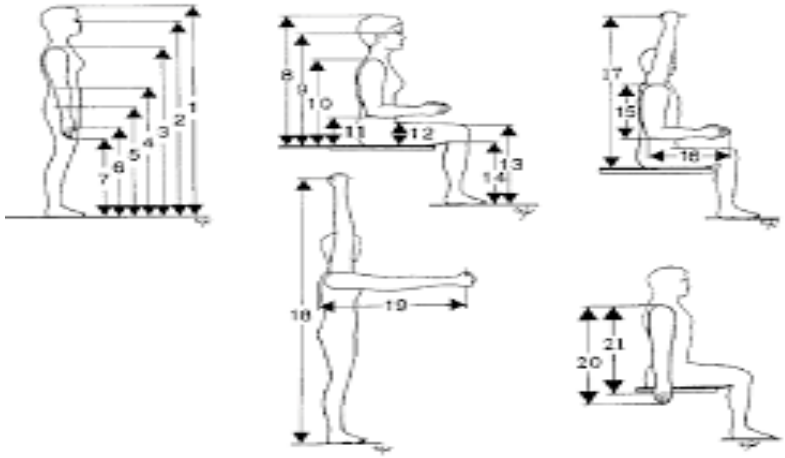

Figure 2. Anthropometry Dimensions of the Human Body [5]

3. Research methods

The product design stages in this study refer to the product design stages according to Ulrich [1] but are limited only from stage 0 to stage 3. The product design stages that have carried out are as follows:

a. EDC machine case and stand product planning. At this stage, the researchers coordinated with the marketing and business teams of PT TX, to determine the aspects of the company's interests that need to be involved in product design.

b. Create a house of quality (HoQ) to identify customer requirements and determine selected technical responses.

c. Determining EDC machine case and stand specifications based on selected technical responses. At this stage, the determination of specifications also involves anthropometric measurement.

d. Make a Detailed Design of a Three-Dimensional EDC machine case and stand design.

4. Discussion

The design begins by setting attributes customer requirements obtained from a previous study conducted by PT TX. The attributes customer requirements are Minimalist Design, Accessibility, convenience, user experience, Completion Payment feature (card reader), and Technology. Then proceed with creating the House of Quality. Start with the identification of the technical response to each customer requirement attribute, described in Table 1. The resulting House of Quality described in Figure 3.

Table 1. Technical Response Identification

Customer Requirements	Technical Response	Customer Requirements	Technical Response
Minimalist Design	Size dimensions	User Experiences	Colour Selection
	Shape design		Size dimensions
	Removable Stand		Mini LED Indicator
	Touchscreen Device	Card Reader	Magnetic Card Reader
Accessibility	Customer Pin Pad		DIP Card Reader
	Customer Display		NFC (near field communication)
	Shape Design	Completion Technology	Touchscreen Device
	Colour Selection		Camera
Convenience	Size dimensions		Fingerprint Scanner
	Shape design		Slot Data USB
	Colour Selection		Charging Stand

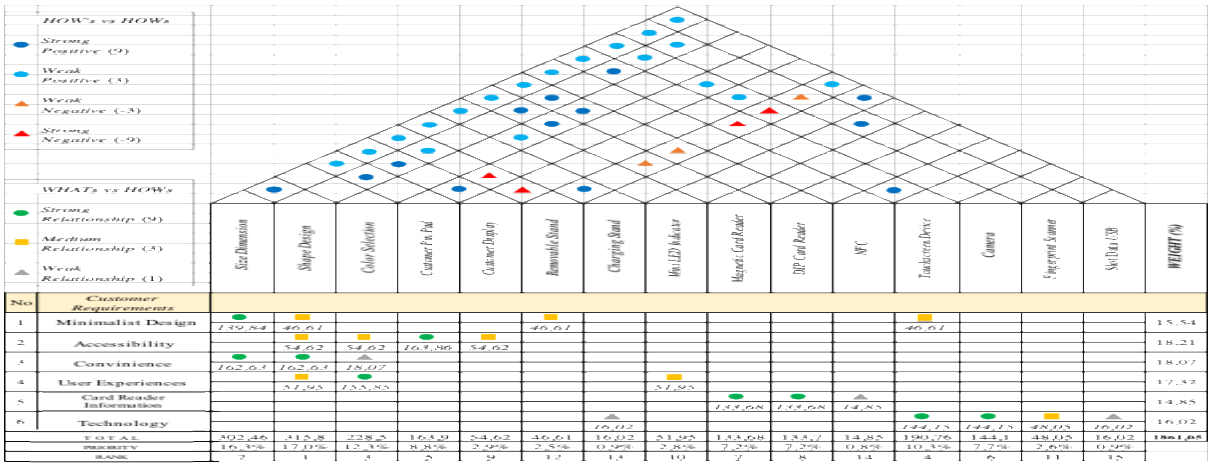

Figure 3. The House of Quality

From the HoQ, the output is a series of technical responses. Shape design and size dimensions are at the top rank, indicate that these two things are the priority of researchers in facilitating consumer requirements for the product specifications designed. The ranking of technical responses present in Table 2.

Table 2. Ranking of Technical Responses

Ranking	Technical Response	Decision
1	Shape design	be prioritized
2	Size dimensions	be prioritized
3	Colour Selection	be considered
4	Touchscreen Device	be considered
5	Customer Pin Pad	be considered
6	Camera	be considered
7	Magnetic Card Reader	be considered
8	DIP Card Reader	be considered
9	Customer Display	be considered
10	Mini LED Indicator	be considered
11	Fingerprint Scanner	be considered

12	Removable Stand	be considered
13	Charging Stand	be considered
14	NFC	be considered
15	Slot Data USB	be considered

This product development stage is continued by determining the EDC Machine case and stand specifications based on the Selected Technical Response. The specification consists of several product dimensions. Anthropometric data is involved in determining the dimensions of the product. Such as determining the dimensions of a pin pad, touch screen devices, square screens for customer displays, and others. The anthropometric data used was obtained from Indonesian anthropometric data [6].

While the angle of inclination of customer display, the researchers took direct measurements. To measure it, the dimensions considered are anthropometric in the form of eye height-standing, desk height, and the distance between consumers and EDC at the cashier table. The calculation result shows that the customer display tilt angle is 25º. Figure 4 shows the mechanism for determining the angle of inclination of customer display, and Table 3 shows the EDC Machine case and stand specifications.

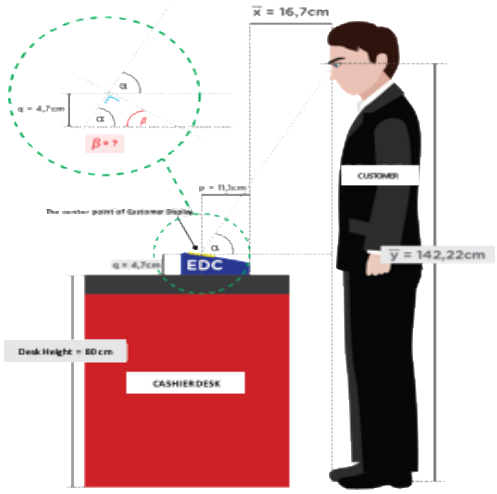

Figure 4. Determine the angle of inclination

Table 3 EDC Machine case and stand specifications.

Technical Response	Specification and Dimension	Technical Response	Specification and Dimension
Touchscreen Device	7inch screen 177x85x7.65mm Include NFC	Customer Display	Square screen Angle of inclination 25º
Customer Pin Pad	Button size 9x9mm Horizontal margin between button 2mm	Fingerprint Scanner	Capacitive sensor 24x14mm Thickness 6 mm
Camera	Additional camera 6x6mm Thickness 6 mm	Removable Stand	Thermal printer included (paper width 57 mm, paper roll diameter 40mm) Charging station include Space 50x30x20mm
Magnetic Card Reader	Thickness 1,5 mm Wide 14mm Swipe distance 100mm		
Slot Data USB	For USB Type C 12x3 mm	DIP Card Reader	Thickness 1,5 mm Wide 56mm Depth 35mm

Detailed design of a three-dimensional (3D) EDC machine case and stand design shows in some pictures below in Figure 4.

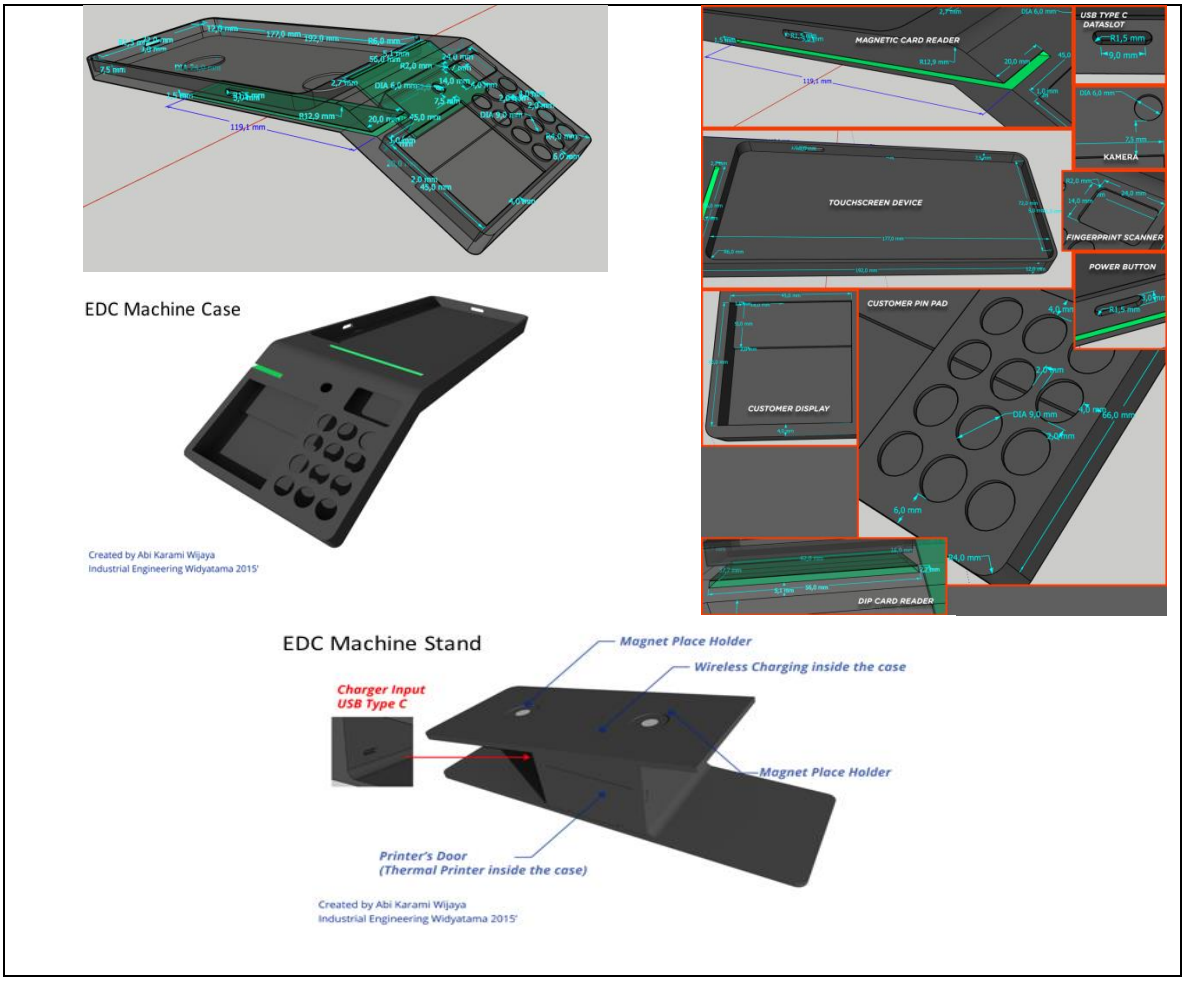

Figure 4. 3D Product Design

Figure 4 is a display of the EDC case visualized when the EDC component has installed. The camera, customer display, customer PIN pad, and fingerprint scanner are on the side of the EDC, facing the buyer. The DIP card reader has placed facing the cashier so that it is easy for the cashier to insert the card. The magnetic card reader is placed on the right side because the user experience from swiping the card is on the right side. A large touchscreen device is presented to the cashier to make transactions easier. NFC as a card reader included in the touchscreen device.

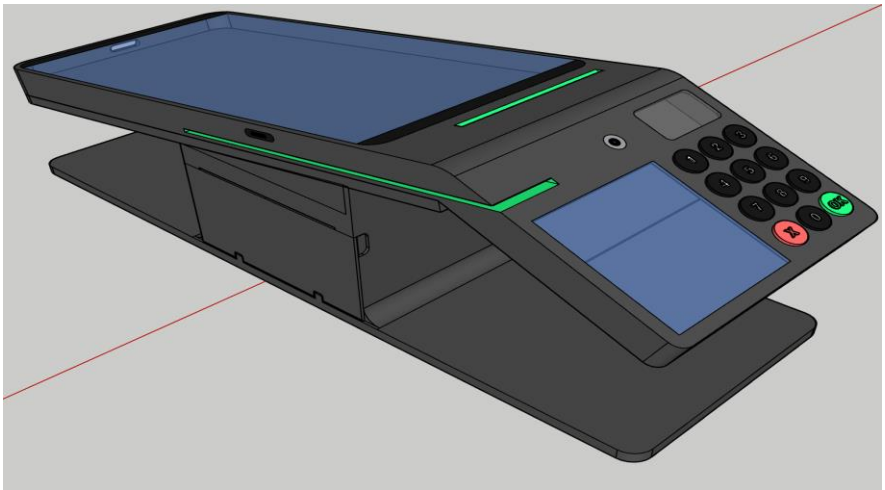

Figure 5. EDC Machine Case and Stand Final Design

Figure 5 is a display of the EDC machine case and stand visualized when the EDC has placed on the EDC machine stand. The EDC and the stand are magnetized so that the EDC will not easily separate from the stand. The EDC also receives power from the stand via wireless charging technology.

5. Conclusion

The results of this research are product designs obtained using the HoQ method and anthropometry. Hopefully, these results can support PT XY in realizing innovative payment solutions. Namely, an online payment system with an EDC machine that accommodates various banks and various types of payment channels, and can be accessed using a fingerprint as a payment account. This product design answers consumer requirements and considers the ergonomics side, to meet user satisfaction. Suggestions for further research are to analyze the results of this product design in terms of costs and finance.

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