

# The Trashcan Design Using Quality Function Deployment (QFD) Method For The Campus Garbage Separation

Endah Utami

*Industrial Engineering Department  
Ahmad Dahlan University  
Yogyakarta, Indonesia  
endah.utami@ie.uad.ac.id*

Okka Adiyanto

*Industrial Engineering Department  
Ahmad Dahlan University  
Yogyakarta, Indonesia  
okka.adiyanto@ie.uad.ac.id*

Zahrul Mufrodi

*Chemical Engineering Department  
Ahmad Dahlan University  
Yogyakarta, Indonesia  
zahrul.mufrodi@che.uad.ac.id*

**Abstract**—Waste management is currently a popular topic in the campus environment. Waste management in the campus environment is carried out in several methods one of them is the method of 3R (Reuse, Recycle, and Reduce). The purpose of waste management in the campus environment is to create a green campus program. One of the acts of the waste management program in the campus environment is by separating waste. The problems of creating a green campus program are related to unavailability of proper trashcan for garbage separation on campus. This waste separation requires an attractive trashcan so that the waste management program in the campus environment can be made possible. The objective of this research to design of attractive trash cans using the Quality Function Deployment (QFD) method. The data needs and Voice of Customers (attributes) that had been obtained were used to create a questionnaire which was the process of quantifying the needs. A total of 394 questionnaires had been distributed. The data were in the form of opinions of respondents about the level of consumer interest in Ahmad Dahlan University campus III. Based on this method, the result from this research is designing a trashcan which has an interesting shape, has a lid that is easy to open, holds a wide range of sizes according to the type of waste, has large-sized sac for plastic, has strong material, has a clear instruction for which kind of rubbish, and has an attractive color.

**Keywords**—waste management, Quality Function Deployment, product design, trashcan

## I. INTRODUCTION

Sustainable waste management is one of the important topics in recent days. One application of sustainable waste management is carried out in a university. The campus environment is very instrumental in integrated waste management starting from waste sorting and waste management. Waste management carried out within the university can create a green campus program. The Green Campus Program has a broad meaning such as the hope that the campus environment will be a comfortable, clean, calm, beautiful and healthy place. The campus environment is expected to be a place that is comfortable, clean, green, beautiful and healthy. To make it happen, some actions should be taken by all of the elements of the campus, including waste management, waste separation and water utilization in the campus area.

Education and the public environment has been recognized as the primary contributions of scientist to provides exciting connection between science and real the

world [1]. Starting the waste management and water utilization in the campus area as well as the separation of waste it is very helpful.

Provision of trashcan is one of waste management by the campus. The availability of sufficient trashcan is able to encourage the campus people to dispose of waste as desired, namely orderly behavior in disposing of garbage. In connection with this matter, it is necessary to know what kind of trashcan the users want and need so that users can be encouraged to behave in an orderly manner in disposing of garbage. Quality Function Deployment (QFD) was firstly introduced in the late 1970s by Mitsubishi and Toyota which have been widely used in Japan and recently in the United States and other leading industrial countries [2]. QFD is a quality design and improvement technique so is closer to the customers. QFD can serve as a flexible framework can be modified according to customer requirement [3].

Quality function deployment (QFD) was employed to design and produce new types. Customers have special requirements and the requirements were transformed into House of Quality (HOQ). These things require applied techniques to make a new design of the products. Making a new design of the products means transform the product, for example, changing the product shape, pattern, color, function or materials [4]. New product design that considers esthetics design is very important to attract a consumer. Therefore, a designer should provide the user to combine voice of customers and technical requirements [5]. Some research on design using the Quality function deployment method, namely the design of packaging tea beverage product [6]. In this research the design of packaging design focuses on food products. Subsequent research on the design of mobile assistive devices [7]. in this study QFD was used to design the wheelchair. Another QFD, namely in the manufacture of portable polybags[8]. From this research no one examined is the manufacture of products in the campus environment.

## II. METHODOLOGY

### A. Voice of Customer (VOC)

Arranging Voice of Customer is the first step in the manufacture of the House of Quality. Voice of Customer illustrates the desire of consumers to design the trashcan.

Consumers' perceptions are very important in determining what the offer to consumers as well as how to offer it [9].

The first step was to distribute a questionnaire to get their opinions about the design of the trashcan. The first questionnaires were used to survey the customers' need. From the questionnaire, an attribute named Voice of Customer (VoC) can be obtained and can be seen in table 1.

TABLE I. ATTRIBUTE VOICE OF CUSTOMER (VOC)

No	Customer Requirement
1	The Trashcan interesting shape
2	The trashcan does not cause strong odors
3	Trashcan has a lid that is easy to open
4	The trashcan accommodate a wide range of size/volume according to the types of waste
5	Trashcan has large-sized for plastic
6	The trashcan has strong material
7	The trashcan made in accordance with the type of waste
8	Instructions are clear in any kind of rubbish
9	The trashcan has an attractive color

**B. Matrix Planning**

The data needs and Voice of Customers (attributes) that had been obtained were used to create a questionnaire which was the process of quantifying the needs. A total of 394 respondents have been distributed. The respondents consisted of 307 students, 48 lecturers, and 39 employees. The data were in the form of opinions of respondents about the level of consumer interest in the Ahmad Dahlan University. Once the results are known, it would require validation test using SPSS. The results from the statistic analytic can be seen in TABLE 2. Based on the validation test using SPSS, the data had been obtained such as in table 7. Based on the total sample of 355 with r product moment 0, 09., all items submitted valid indicator.

TABLE II. STATISTIC ANALYTIC

	Scale Mean if Item Deleted	Scale Variance if item deleted	Corrected Item Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item deleted
P1	27.83	8.678	.414	.307	.708
P2	27.12	9.811	.414	.399	.711
P3	27.22	9.396	.446	.379	.703
P4	27.42	9.119	.461	.295	.699
P5	27.97	9.440	.332	.198	.720
P6	27.56	9.015	.430	.255	.703
P7	27.34	8.978	.472	.313	.696
P8	27.29	9.212	.465	.315	.699
P9	27.80	8.795	.325	.282	.731

**C. Customer Importance Rating**

The customer importance rating is the respondents' perceptions of the importance of these attributes for designing

trashcan. The respondents were given an evaluation choice. The questionnaire has a scale from 1 to 5, with 5 is the most important and 1 the least important. The results from the questionnaire can be seen in table 3.

TABLE III. CUSTOMER IMPORTANCE RATING

No	Customer Requirement	Importance rating
1	The Trashcan interesting shape	3,035
2	The trashcan does not cause strong odors	3,838
3	Trashcan has a lid that is easy to open	3.712
4	The trashcan accommodate a wide range of size/volume according to the types of waste	3.441
5	Trashcan has large-sized for plastic	2.92
6	The trashcan has strong material	3,325
7	The trashcan made in accordance with the type of waste	3.536
8	Instructions are clear in any kind of rubbish	3,663
9	The trashcan has an attractive color	3.012

**D. Technical Requirements Determining**

Technical requirements determining is a prioritization of manufacturing processes and specifications for key process parameters that are deployed to the fourth and final phase. Technical requirements were based on Voice of Customer, technical requirements given by the team of developers. The results of the technical requirements were from the group brainstorming. The technical specifications must be quantifiable or measurable so that they can be used for design. Technical requirements can see in table 4.

TABLE IV. TECHNICAL REQUIREMENTS

NO	Attribute requirements
1.	Trashcan has an innovative design
2.	The trashcan has opening and closing tools
3.	Have a large capacity
4.	Plastic bins are larger than other junk
5.	Trashcan for paper has a transparent surface
6.	Trashcan made of plastic material
7.	Trashcan lid is made airtight
8.	A different color for each trash
9.	Printed images and text for each type of waste
10.	Has pictures and headline are not easily lost

**E. House of Quality (HoQ)**

House of Quality (HoQ) shows the relationship between the voice of customer and technical requirements. A house of

quality was employed to facilitate a detailed quantitative analysis of how well the various strategic thrusts and initiatives. HoQ is presented in a matrix form that shows Customer Requirements [10]. Relationship matrix indicates how much Design requirements affect each customer requirements. The rating scale can be presented in symbol (● = strong, ○ =medium, and Δ= weak) [7]. The HoQ can be seen in Figure 1.

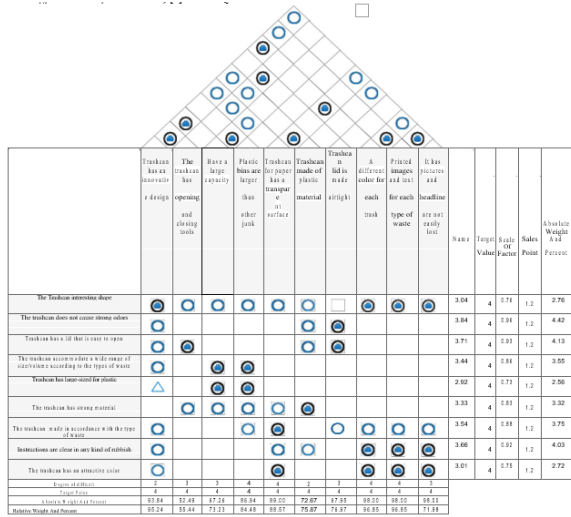


Fig. 1. House of Quality

III. RESULTS AND DISCUSSION

Based on the analysis, a draft of the proposed trashcan had been made. The proposed design of the trashcan can be seen in Figure 2 to Figure 4. The first bin is for organic waste, the second bin is for plastics or bottles, and the third bin is for paper waste.

There are differences in the design of trashcan that are made with designs from previous studies. In some studies, the shape of the trash that is made in a box and no cover, trashcan is made from plastic and fiberglass [11]. The material used to make the trashcan from this research is plastic, while the wheels and the handle are made of steel and rubber. Most of the part of the trashcan is made of plastic. This is because plastic is affordable and easy to obtain. Design of the trashcan is found in. Figure 2, Figure 3 and Figure 4.



Fig. 2. Isometric design of trashcan



Fig. 3. Design of trashcan looks ahead



Fig. 4. Design of trashcan looks aside

IV. CONCLUSION

Based on the results of the research about the design of the trashcan with quality function deployment, it obtained a conclusion which is the trashcan should have an interesting shape, the trashcan should not cause strong odors, the trashcan should have a lid that is easy to open, the trashcan should accommodate a wide range of size/volume according to the types of waste, the trashcan should have large-sized bin for plastics, the trashcan should have strong materials, the trashcan should be made in accordance with the type of waste, the trashcan should provide clear instructions for which kind of rubbish, and the trashcan should have an attractive color. Recommendation for further research is to describe the technical response from the results of the questionnaire.

ACKNOWLEDGMENT

This research was supported by Center for Energy and Environmental Studies, Ahmad Dahlan University.

**REFERENCES**

- [1] M. K. Biddinika, M. Syamsiro, A. N. Hadiyanto, Z. Mufrodi, and F. Takahashi, "Technology for public outreach of fuel oil production from municipal plastic wastes," *Energy Procedia*, vol. 142, pp. 2797–2801, 2017.
- [2] P. Rajeswaran and R. Gandhinathan, "Application of Quality Function In Product Development," *Int. J. Oper. Syst. Hum. Resour. Manag.*, vol. 1, no. 1–2, pp. 215–22, 2011.
- [3] V. S. Patil, N. G. Phafat, and D. R. Dolas, "QUALITY FUNCTION DEPLOYMENT: CASE STUDY ON ROADMAP FOR IMPELLER DESIGN," *Ind. Eng. J.*, vol. 11, no. 4, pp. 19–23, 2018.
- [4] C. Homkhiew, T. Ratanawilai, and K. Pochana, "Application of a quality function deployment technique to design and develop furniture products," *Songklanakar J. Sci. Technol.*, vol. 34, no. 6, pp. 663–668, 2012.
- [5] C. Yang, J. Cheng, and X. Wang, "Hybrid quality function deployment method for innovative new product design based on the theory of inventive problem solving and Kansei evaluation," *Adv. Mech. Eng.*, vol. 11, no. 5, pp. 1–17, 2019.
- [6] H. Dan and D. Kemala, "PERANCANGAN DESAIN KEMASAN PRODUK MINUMAN TEH DENGAN METODE QUALITY FUNCTION DEPLOYMENT ( QFD )," *J. Tek. Ind.*, vol. 5, no. 1, 2016.
- [7] K. Tsai, C. Yeh, H. Lo, G. Chang, C. Li, and C. Cheng, "Application of Quality Function Deployment in Design of Mobile Assistive Devices," vol. 28, no. 2, pp. 87–93, 2008.
- [8] W. Widiasih, "Penyusunan Konsep Untuk Perancangan Produk Pot Portable Dengan Pendekatan Quality Function Deployment ( QFD )," no. May 2016.
- [9] P. Shrivastava, "House of Quality : An Effective Approach to Achieve Customer Satisfaction & Business Growth in Industries," vol. 5, no. 9, pp. 1365–1371, 2016.
- [10] J. R. Hauser and D. Clausing, *The House of Quality*. 2019.
- [11] H. Soewardi, A. D. Sari, and R. Aktoba, "Ergonomic participatory approach for designing the innovative trash bin," *Int. J. Appl. Eng. Res.*, vol. 12, no. 24, pp. 14510–14513, 2017.