Integrated Fuzzy Quality Function Deployment (I-FQFD) to Improve Service Quality

Andi Sudiarso, and Sonni H. Kailani

Abstract—Service Quality Function Deployment (QFD Service) is an adjusted method of QFD model for services that aims to design services and improve service quality. However, in its development, adjusting quality dimensions on the Service QFD has not been good enough to map consumer requirements. This is because each quality attribute, besides having the importance level also have different characteristics from each other, so it is necessary to utilise SERVQUAL, Kano model and fuzzy numbers. SERVQUAL model improves Service QFD by focusing quality-attributes-priority based on their performance, Kano model focuses quality-attributes-priority based on how far each attribute affects customer satisfaction, while the fuzzy numbers helps reducing vagueness in the assessment.

In this paper, a quality improvement of digital printing has been developed, as a study case, using an Integrated Fuzzy Quality Function Deployment (I-FQFD) with SERVQUAL and Kano Model. The design starts with the data collecting process to build House of Quality (HoQ), continues with the validation process using the traditional QFD Service, and ends with making some suggestions for improvements.

From the HoQ matrices, some factors which affect service quality have been identified in order to develop some suggestions for improvements. The proposed improvements include: development of standard operating procedures, employee training, implementation of quality management, integrated point of sales development, and development of changeable production schedule.

Keywords—Service QFD, House of Quality, fuzzy, SERVQUAL, Kano, service quality.

I. INTRODUCTION

COMMUNITY needs for printed materials cannot be separated from the high communication and information needs to meet digital printing service that offers individuals and corporate printing solutions at affordable prices. The increasing number of similar businesses adds fierce competition among digital printing services. One method that can be used to plan strategies to improve quality of services is QFD (Quality Function Deployment). In this study, QFD is applied together with fuzzy logic to reduce the subjectivity factor of respondents (Chan and Wu, 2004) and the integration of it with the SERVQUAL and Kano in goal planning strategy development quality digital printing services.

Quality Function Deployment (QFD) is defined as a structured method in product development planning process to define the specification needs and desires of consumers, as well as evaluating a product or service capability systematically to meet the needs and desires of consumers (Cohen, 1995). Because the most of products are intangible services and interpersonal then takes a different approach to product goods partly by changing the dimensions of quality products with dimensions of service quality (Dubé et al., 1999).

To facilitate the application of QFD in the service industry, QFD applications can also be equipped with SERVQUAL method which useful for measuring the performance of the quality of services (Zeithaml et al., 1985). Hinterhubber, et al. (1998) was first to integrate measurement Kano model of customer satisfaction and the development of the QFD House of Quality adjustment calculations by introducing the concept of Importance Rating. However, the subsequent development of the concept is considered to have a weakness for Kano category only taken into consideration in the decision-making priorities of Importance Rating. Pawitra and Tan (2001) proposed Importance Adjusted Rating which is an adjustment of Importance Rating by multiplying the weight of Kano. Zadeh (1965) is often found to disclose information obtained as input from the manufacture of House of Quality are biased and subjective, requiring methods to be able to reduce it by Fuzzy QFD (FQFD). There are various types of Fuzzy Set Theory can be applied in FQFD one of which is symmetrical Trapezoidal Fuzzy Numbers that have advantages over other Fuzzy Sets (Chan and Wu, 2004). From these studies, this research tries to incorporate all the benefits and advantages of previous research to be used in quality improvement plan of the company.

In the application of fuzzy logic in the process of making the House of Quality, when marking numbers (crisp number) translated into a scale model of fuzzy numbers using STFNs as illustrated in Table I. The scale of fuzzy numbers described in forms such as traditional graphs are shown Figure 1.1.

Integration of FQFD with SERVQUAL model makes the process of assessment in the planning matrix adjusted for Importance Rating Model SERVQUAL where associated as Service Gap, the difference (gap) between the consumer perception of the services received and services are expected to be achieved as a manufacturer of the product developers. Service Gap were obtained by the equation:

\[
\text{Service Gap} = \text{Perceived Service} - \text{Expected Service}
\]  

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TABLE I
TRANSLATIONAL SCALE TO SCALE NUMBER CRISP FUZZY NUMBERS

<table>
<thead>
<tr>
<th>Crisp Number Scale</th>
<th>Fuzzy Numbers Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>± (0, 0.02, 0.2)</td>
</tr>
<tr>
<td>3</td>
<td>(0.1, 0.32, 0.4)</td>
</tr>
<tr>
<td>5</td>
<td>(0.3, 0.52, 0.7)</td>
</tr>
<tr>
<td>7</td>
<td>(0.6, 0.72, 0.9)</td>
</tr>
<tr>
<td>9</td>
<td>(0.8, 1, 1)</td>
</tr>
</tbody>
</table>

Fig. 1. Graphs with Scale Assessment STFNs

While integration of FQFD with Kano Model Customer Requirement categorize into three main categories, namely Kano Attractive, One-dimensional Must-be and then subsequently translated into weight categories Kano. Pawitra and Tan (2001) proposed the determination of the weight of Kano as shown in Table II.

TABLE II
WEIGHT DETERMINATION OF KANO

<table>
<thead>
<tr>
<th>Kano category</th>
<th>Kano Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attractive (A)</td>
<td>4</td>
</tr>
<tr>
<td>One-dimensional (O)</td>
<td>2</td>
</tr>
<tr>
<td>Must-be (M)</td>
<td>1</td>
</tr>
</tbody>
</table>

The results of these calculations are then used at a later stage which would then be included in the matrix of the House of Quality.

Finally, the results of House of Quality as shown in Figure 2., which shows the relationship Customer Requirements and Technical Descriptors by considering service gap, and Kano category.

Fig. 1.2 FQFD Integrated with SERVQUAL and Kano Model (Govers, 1996: with modifications)

II. RESEARCH METHOD

Flowchart of the research process is as follows:

1. Start
2. Sample Selection
3. Early Data Collection
4. Revision:
   - Final Questionnaire
5. Data Analysis:
   - Design and Development of FQFD with SERVQUAL and Kano Model, validation using Traditional Service QFD and suggest service quality improvements
6. Conclusions
7. End

Fig. 2.1 Flowchart of the research
As for the process are:
1. Sample random sampling based on the willingness of respondents and conducted accidental.
2. Preparation and deployment of an initial questionnaire aims to solicit questions for the questionnaire variables end.
3. The preparation and dissemination of the final questionnaire to a sample of respondents in the study population that is consumer users of digital printing services in corporate research object and two comparison companies.
4. Questionnaires have been collected subsequently conducted a screening process, validity, and reliability test.
5. Analysis and interpretation conducted on House of Quality to identify customer needs, Gap analysis based on SERVQUAL Model (Importance Rating), then the classification models equipped with Kano for later obtained Importance Adjusted Rating, Rating Technical Absolute and Relative Technical Rating. Then in the end can look for business improvement. To validate the results of the development matrix House of Quality on FQFD Integrated testing is needed to determine whether there is a correlation between the process and the Service FQFD Integrated Traditional QFD correlation significance testing through Kendall’s Tau (t) and Spearman's Rho (rho). The subject is comparable Rank of Customer Requirements and Priority of Technical Descriptors.
6. Final step is drawing conclusions based on the results of data processing and analysis, as well as provide suggestions that can be used as input for the parties and the need for further research.

III. RESULTS AND DISCUSSION
Result of the construction of the House of Quality matrices can be seen in Figure 3.1. The picture shows the priority of customer needs and priorities of the proposed improvements.
To validate the process models are needed comparison FQFD Integrated QFD the Traditional Service. From the results of calculation and computation FQFD Integrated Traditional Service QFD obtained priority (ranking) and Technical Customer Requirements Descriptors. Results of the comparison showed that there is a correlation among them.
To determine the technical measures used to prioritize the Pareto diagram. Technical needs then sorted from the most important gi percentage to lowest percentage, diagram Pareto Technical Descriptors for sequences expressed in Figure 3.2.
Based on the diagram, proposed improvement priorities are as follows:
1. Development and implementation of Standard Operating Procedures (SOP) or work process flow chart.
2. Training of employees.
3. Implementation of quality management and continuous improvement.
4. Point of Sales is integrated with Inventory and Production.
5. Encourage and emphasize Quality Responsibility to all employees.
6. Changeable production schedule.
7. Management process


Fig. 3.1 House of Quality FQFD Terintegrasi

Legend:
- Simbols Interconnection:
  - Saingan Kuat: VV
  - Kuat: V
  - Moderat: <
  - Lebih: <
- Simbols Relationship Matrix:
  - Saingan Kuat: X
  - Kuat positif: X
  - Moderat positif: V
  - Moderat negatif: <

- Technical Descriptors
- Priority of Technical Descriptors
- Competitive Benchmarking
- Bank of center requirement

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