Designing technical specifications for goyor woven fabric as material for civil servant official uniforms using quality function deployment and conjoint analysis

D Refinda¹, E Liquiddanu¹, I W Suletra¹, W Sutopo¹ and M Budijanto¹

¹Department of Industrial Engineering, Sebelas Maret University, Surakarta, Indonesia
deltarefinda@student.uns.ac.id, liquiddanu@gmail.com, suletra@staff.uns.ac.id, wahyudisutopo@staff.uns.ac.id, murman.budijanto@gmail.com

Abstract. Sragen regency has a traditional woven fabric called goyor woven, whose presence is disappearing. One way to revive its existence is to encourage its use as the material for official uniforms of Sragen civil servants. For this purpose, there is a need to research the most preferable design of the goyor woven fabrics by the civil servants. The aim of this research is to determine the technical specifications of the goyor woven fabric by combining the characteristics of the goyor fabric and the preferences of Sragen civil servants. The method used is integrated QFD with conjoint analysis. QFD is used to translate consumer voices into technical specifications while conjoint analysis is used to find the best combination of the proposed goyor woven fabric design with the technical specifications. The initial result of the research indicates that the technical specifications of the goyor fabric design that is formed are red and blue fabrics with floral and geometric patterns. Based on conjoint analysis the option that best suits the preferences of Sragen civil servants is the combination of blue goyor fabric with geometric pattern.

Keywords: Goyor woven fabric, Conjoint Analysis, Quality Function Deployment (QFD), Technical Specifications

1. Introduction
One of the typical Central Java woven fabrics that penetrate the international market is goyor woven fabric. Goyor in Javanese means soft or falling, because if it is used the cloth falls and is not stiff. Goyor fabric is made using traditional looms and made from rayon yarn. Goyor woven fabric has a characteristic that is cool when used in hot weather but feels warm when used in cold weather.

In Central Java, there are two regions which are the center of goyor woven fabric production, it is Tawangsari-Sukoharjo and in Kalijambe-Sragen. For the Tawangsari region, the production of goyor woven fabric is done to supply the export market, while in Kalijambe the production of goyor woven fabric has begun to disappear and leaves only a few workers who make goyor woven fabrics if there are orders from local businessmen, and even then the weaving process only.

Based on the field observations and data from central statistics agency, the decline in the production of goyor woven fabric in Kalijambe was inseparable from the declining level of the goyor woven fabric sales. The sale of goyor woven fabrics for the export market has been dominated by the Tawangsari area, while the goyor woven fabric itself has not been able to attract the attention of the local market. Based on this, one of the ways to revive the center of the goyor Sragen woven fabric is
by targeting the local market [6]. To open the way of marketing goyor fabric in the local market is to make its use as the main material for civil servants uniforms in Sragen. With the local government enforcing its employees to wear a series of goyor woven fabrics, the demand for fabric production will increase and its existence is protected.

This research aims to determine the technical specifications of the design of goyor woven fabric as the official uniform material of the Sragen civil servants. Moreover, it is important to know the preferences of the needs and desires of civil servants in Sragen. After that, the translation of the consumer’s voice into the technical voice is used as a reference in making the design, pattern, color and model of the goyor woven fabric that is used, so that the fabric design can be designed in such a way without reducing the high values contained in it and able to follow the current trends. The method used to identify customer needs is by Quality Function Deployment (QFD).

QFD would provide an overview of what the customer needs to be immediately produced by the company. QFD makes it possible to prioritize customer needs, find innovative responses to these needs and improve the production process [3][9].

Whereas to determine the proposed goyor fabric design, conjoint analysis is used. This analysis is used to determine consumer desires for the most preferred combination of fabric designs [2]. From this conjoint analysis, there would be stimuli or proposals for fabric design with several combinations. The combination formed is obtained from the QFD results. This analysis is needed because indicators such as colors and patterns cannot stand alone. These indicators are relative, depending on consumer preferences and how each indicator is combined [3].

2. Methods

The step of this research is strart by measure consumer preferences by using a questionnaire. The step aims to get VOC (Voice of Customer) that would be used in making QFD [5]. Respondents in this study were civil servants in Sragen Regency. The sampling technique used was sampling quota with a target of 150 respondents.

There are 3 stages to collect respondents’ preferences: open questionnaire stage, closed discussion with experts, and closed questionnaire stage. The open questionnaire contains the characteristics of the goyor fabric and how consumers think about goyor fabric-based clothing. From this open questionnaire, VOCs are produced. In preparing open questionnaire questions based on apparel design framework [7]. The closed discussion stage was carried out with goyor woven fabric practitioners as well as exporters from Sukoharjo. The results of closed discussions are in the form of VOE (Voice of Engineer) where the activity aims to get technical specifications which are then made product proposals that are in accordance with VOC and VOE. While the closed questionnaire contains questions that have been directed to find out the response what if the fabric is goyor used as aofficial uniform for civil servants. In preparing closed questionnaire questions based on apparel design framework [7] and VOE results.

After knowing the preferences of the respondents, the next step is to make a combination of the proposed designs of goyor woven fabrics. Design combinations are made using conjoint analysis. Conjoint analysis help quantify the utility for consumers who would buy based on specific product attributes. Through it, the optimal utility of attributes can be identified and used to design products with attributes that are most preferred by consumers [4], [10].

The main advantages of conjoint analysis with other methods is the method is able to form stimuli of multi-level product attributes and set product attributes according to their level. In general, the basic model is conjoint analysis with the following linear regression approach [8]:

\[
U(x) = \sum_{i=1}^{m} \sum_{j=1}^{k_i} \alpha_{ij} x_{ij}
\]

\(U(x)\) = total utility
\(\alpha_{ij}\) = the value of the use attributes of the first level j
\(x_{ij}\) = attribute dummy variable to level j
\(m\) = number of attributes
\(k_i\) = number of attribute levels
The value of the importance of an attribute, \( I_i \) is defined as follows:
\[
I_i = \{ \text{Max} (a_{ij}) - \text{Min} (a_{ij}) \} \text{ for each } i
\]  

(2)

The relative importance of an attribute to other attributes:
\[
W_i = \frac{I_i}{\sum_{i=1}^{m} I_i} \quad \text{where} \sum_{i=1}^{m} w_i = 1
\]

The level of relative importance of each attribute uses the following formula [1] :
\[
\text{TKR}_i = \frac{U_{Ti} - U_{Ri}}{\sum_{j=1}^{K} (U_{Ti} - U_{Ri})}
\]

\( \text{TKR}_i \) = the level of importance of the \( i \)-attribute  
\( U_{Ti} \) = the highest usefulness of the \( i \) attribute level  
\( U_{Ri} \) = the lowest value of the \( i \)-attribute level  
\( K \) = number of attributes

3. Result and discussion

Data collection and processing in this study was done by collecting consumer preferences using an open questionnaire. The results of the open questionnaire were validated by goyor woven practitioners through closed discussions, then the results were used as a reference in making a closed questionnaire. The result of an open and closed questionnaire is the VOC, while the results of closed discussions with practitioners are VOE. After knowing the VOC and VOE, HOQ (House of Quality) can be made which would produce technical specifications from the goyor woven fabric design. From the technical specifications that have been obtained, a proposal design is made using conjoint analysis.

3.1. Open questionnaire

The initial stage to find out the preferences of civil servants members is by making an open questionnaire. This questionnaire contains the characteristics of goyor fabric and how consumers think about goyor fabric-based clothing. The questionnaire is made with an open type where the respondent can write down the answers along with the reasons as detailed as possible. The questionnaire is divided into 3 main sections: a brief definition, respondent data, and general questions. In the first section contains a brief definition of goyor woven fabric, the second part contains the identity of respondents describing geographical variables and demographic variables, while in the third part contains general questions containing 6 questions to translate functional variables, 2 questions to translate aesthetic variables, 4 question items to translate expressive variables. Thus the number of question items given to respondents is 12.
Table 1. Open questionnaire grid

| Dimensions   | Indicator                        | Description of questions                              | Instrument       |
|--------------|----------------------------------|-------------------------------------------------------|------------------|
| Geographical | Consumer area                    | Where did the respondent come from                    | Questionnaire II (4) |
| Demographic  | Age range of consumers           | What is the age of the respondent                     | Questionnaire II (2) |
| Demographic  | Consumer sex                     | What is the gender of the respondent                  | Questionnaire II (3) |
| Demographic  | The ability of consumers to buy   | What is the large range of respondents' income        | Questionnaire II (8) |
| Functional   | Fabric                            | Knowledge of goyor woven fabric                       | Questionnaire III (1) |
| Functional   | Display                           | How is the impression to goyor woven fabric          | Questionnaire III (4) |
| Functional   | Display                           | What is liked and disliked from goyor woven fabrics   | Questionnaire III (7-8) |
| Aesthetics   | Color                             | What fabric color is preferred                        | Questionnaire III (5) |
| Aesthetics   | Pattern                           | What fabric patterns are liked                        | Questionnaire III (6) |
| Expressive   | Habit                             | How often wear clothes made from woven fabrics in official service | Questionnaire III (11) |
| Expressive   | Job/Position                      | Do you agree if you pay more for products from goyor woven fabric | Questionnaire III (12) |

After the questionnaire questions have been prepared, the open questionnaire is ready to be distributed to the respondent. Because this questionnaire is open, it is not necessary to test the variability or reliability tests in compiling the questions, because the function of the open questionnaire is to find out the respondents' opinions and free answers on what the researchers asked the questionnaire. Questionnaires were distributed to the regional offices of Sragen Regency with a target of 150 samples. After all the answers to the open questionnaires have been collected, the next step is to validate the answers with the fabric goyor practitioners in Tawangsari Village, Sukoharjo Regency.

3.2. Closed Questionnaire

Practical validation results will be used as a reference in making a closed questionnaire. Because this questionnaire is closed, respondents are not asked to express their opinions but only answer questions that have been directed to the proposed product in accordance with their preferences. The closed questionnaire has the same principle as the open questionnaire, the difference is that there is a product assessment section. The product assessment contains questions about respondents' preference for uniform clothes made from goyor woven fabric.

Table 2. Closed questionnaire grid

| Product Assessment                                                                 |
|-------------------------------------------------------------------------------------|
| 1. Respond of the respondent if the clothes are designed simply                     |
| 2. Respond of the respondent with fabric that looks falling so that makes it flexible/ fit to body |
| 3. Respond of the respondent if the clothes do not interfere with the user’s movement |
| 4. How agree the respondent if the clothes use comfortable materials               |
| 5. Respond of the respondent if the fabric color is dark                           |
| 6. Respond of the respondent if the fabric pattern is geometric                    |
| 7. Do respondents prefer to sew fabric into clothes instead of buying ready-made clothes |
| 8. How agree the respondent if the clothes are comfortable to use even outdoors   |
| 9. How agree the respondent with clothes with easy maintenance                    |
| 10. How agree the respondents to clothes that are durable even though they are often washed |
3.3. HOQ
The next process is making a HOQ to find out the technical specifications of goyor woven fabric designs that are in accordance with consumer preferences. To compile the HOQ, the first step is to determine the VOC (Voice of Customer) obtained from the processing of open and closed questionnaire data as well as VOE (Voice of Engineer) obtained from a closed discussion process with practitioners.

| Table 3.VOC | Table 4.VOE |
|------------|------------|
| **Voice of Customer** | **Voice of Engineer** |
| 1 Fabric color designs that tend to be dark like maroon and dark blue | 1 Rayon yarn used can be replaced with imported yarn from China to suppress COGS |
| 2 Pattern fabric design are geometric and flora | 2 Fabric design is made only 1 pattern (not using tumpal), so the weaving process is faster and more efficient because it doesn't change pattern |
| 3 Comfortable material to use | 3 Pattern design follows the export market (geometric) |
| 4 Comfortable clothes to use even at outdoors | 4 Fabrics don't need to be ironed |
| 5 Simple design | 5 Patterns are made big so that the work is easier and faster |
| 6 Does not interfere with user movements | 6 The yarn uses a standard size, which is 42/2 |
| 7 Prefer to sew cloth into clothes instead of buying ready-made ones | 7 The size of one fabric was made 70x300 cm (size 1 long sleeve shirt), not following the size of the export market which tends to be larger |
| 8 Easy cloth maintenance | |
| 9 Clothes are durable even though they are often washed | |
| 10 Affordable price | |

After the VOC and VOE are known, the next step is to combine them into a HOQ. The HOQ scheme consists of customer requirements and technical requirements. For the Customer Requirements section filled by the VOC that has been identified, while the Technical Requirement is filled in by the product material compose, the work process, and the proposed procedure of VOE. In this research, HOQ is limited by not including benchmarking with competing products because the focus of the research is to obtain technical specifications.

Figure 1. HOQ technical specifications for goyor fabric design
From the HOQ above, it can be concluded that the most important thing for consumers is uniform with materials that are comfortable to use even if they are outdoors, the prioritized customers requirement is prices that are not too expensive, while the prioritized technical descriptors is to make patterns and colors new that follow the local market.

### Table 5. HOQ assessment results

| Customer requirements                      | Importance to customer | Prioritized customers requirements |
|--------------------------------------------|------------------------|-----------------------------------|
| 1 Comfortable clothes to use even at outdoors | 3.44                   | 18                                |
| 2 Fabric maintenance is easy and durable    | 3.43                   | 36                                |
| 3 Comfortable material                      | 3.43                   | 18                                |
| 4 Does not interfere with user movements   | 3.24                   | 12                                |
| 5 Color designs tend to be dark             | 3.05                   | 18                                |
| 6 Geometric and flora patterns              | 3.09                   | 12                                |
| 7 Simple design                             | 3.09                   | 18                                |
| 8 Prices are not too expensive              | 2.58                   | 42                                |
| 9 Fit to body size                          | 2.95                   | 12                                |
| 10 Sew fabric into clothes                  | 2.86                   | 15                                |

### Table 6. HOQ assessment results

| Technical requirements                      | Prioritized technical requirements |
|--------------------------------------------|-----------------------------------|
| 1 Yarn types                               | 24                                |
| 2 Naptol coloring                          | 12                                |
| 3 The loom                                 | 30                                |
| 4 Pattern composition                      | 18                                |
| 5 Design                                   | 42                                |
| 6 Fabric maintenance                        | 21                                |
| 7 Yarn size                                | 24                                |
| 8 Size per fabric                          | 18                                |

The difference between importance to customer and prioritized customer requirements is where the score is come from. Scoring for Importance to customer is from the average of respondent’s answer in close questionnaire. Scoring for Prioritized customer requirements and prioritized requirements is from corelation matrix on HOQ: 9 is +9 and 3 is +3.

3.4. Conjoint analysis

Conjoint analysis is used to determine consumer desires for a combination of the most preferred fabric designs and to identify the relative importance of each attribute. There are 2 attributes that would be analyzed using conjoint: Fabric color, whether red or blue and fabric pattern, whether flora or geometric.

The combination of attributes was obtained based on the results of the QFD where the majority of respondents liked the design of red and blue fabrics and fabric patterns in the form of flora and geometric. Of these two attributes, a combination that may be formed is 4 stimuli (design combinations). Of the four existing fabric designs, a questionnaire was made to find out the proposed design of the goyor woven fabric that was most preferred by respondents. For this reason, each respondent is given a question to assess the combination of existing fabric designs. Because there are 4 stimuli, the respondent must filling out the questionnaire by giving a value from 1 (least preferred) to 4 (most preferred) in each fabric design. Respondents for this questionnaire amounted to 10 people and were civil servants of the Sragen Ministry of Industry and Trade.
### Table 7. Utility estimate data processing stimuli

| Attribute | Utility Estimate |
|-----------|------------------|
|           | Resp.1 | Resp.2 | Resp.3 | Resp.4 | Resp.5 | Resp.6 | Resp.7 | Resp.8 | Resp.9 | Resp.10 | Subfile summary |
| Patterns  |         |        |        |        |        |        |        |        |        |         |                |
| Flora     | -.500  | 1.000  | .000   | -1.000 | -.500  | .000   | -.500  | .000   | .000   | 1.000   | -.050          |
| Geometrics| .500   | -1.000 | .000   | 1.000  | .500   | .000   | .500   | .000   | .000   | -1.000  | .050           |
| Colors    |        |        |        |        |        |        |        |        |        |         |                |
| Merah     | -.1000 | .000   | -.500  | -.500  | -1.000 | -1.000 | -1.000 | -.500  | .000   | -.650   |                |
| Biru      | 1.000  | .000   | .500   | .500   | 1.000  | 1.000  | 1.000  | .500   | .000   | .650    |                |
| (Constant)|        |        |        |        |        |        |        |        |        |         | 2.500          |

From the data processing above, it is known that if the utility estimate is negative, the respondent does not like the design combination. But if the utility estimate is positive, it means that the respondent likes the stimuli. It can be seen that Subfile Summary is a general assessment, where the majority of respondents like the design of goyor fabric with geometric pattern and blue color (proposed design of fabric stimuli 4).

### Table 8. Final Technical Specification

| Technical Specification |       |
|-------------------------|-------|
| 1                       | Local rayon yarn types |
| 2                       | Local naptol coloring |
| 3                       | Used traditional loom not machines |
| 4                       | Just 1 pattern composition |
| 5                       | Design follows local preferences |
| 6                       | No need to be ironed |
| 7                       | Using 42/2 yarn size |
| 8                       | Size per fabric is 70x300 cm |

### Figure 2. Propose Design of Fabric

#### 4. Conclusion

The conclusion of this research is that respondents liked and agreed that the official uniform material made from goyor fabric. In addition to the fabric that is comfortable to wear, cloth is also the result of local production of Sragen. The respondent's impression of the majority of goyor woven fabric is good, beautiful, and attractive. Respondents like red clothes (dark red, maroon, brick red, red heart) and blue (dark blue, donker, navy). The pattern of the clothes that most respondents like is geometric motifs. The most preferred by respondents from goyor woven fabric is the very comfortable material. It feels cool when used in hot and warm weather when used in cold weather. The most disliked by respondents from clothes made from goyar woven fabric is the material that is too falling or "goyor" so that it is difficult to arrange. For the combination of goyor fabric design, the most preferred by respondents is the blue color and geometric pattern.

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