1. INTRODUCTION

In garment sample development, the designer’s fashion sketch is most important because it provides a basis for the finished product. The garment shape is constructed primarily by a patternmaker according to the designer’s fashion sketch. A patternmaker constructs a three-dimensional garment from a two-dimensional sketch. This process is called as a patternmaking or pattern cutting [1, 2]. A patternmaker translates the proportions of the designer’s working sketch into a series of pattern components which, in a finished garment [1]. One of the basic concepts of patternmaking is how to render something essentially flat into something three-dimensional [2].

Good patternmaking must be precise so that the piece fit together accurately otherwise the garment will look poorly made and will fit badly [2].

During the patternmaking process, there are many interactions between a designer and a patternmaker to create a beautiful and comfortable garment. In this study, designer’s work was defined as creating the origin of styles and patternmaker’s work was defined as developing of sample [1]. Recently, garments are manufactured all over the world and a designer and a pattern maker are not directly communicating [3]. Information and communication technology such as cloud CAD system and e-mail is used. Therefore, understanding the nature of these interactions is necessary for both fashion business management and manufacturing [4, 5]. In particular, the gathering and processing of information between designers and patternmakers is important to enable efficient fashion creation and manufacturing [6].

Patternmaking processes have been investigated by some researchers. A common framework for bra patternmaking was described in one study, along with variations in individual work methods [7]. The patternmaking process for pants was also investigated, taking into account the specifications of published patternmaking methods [5]. However, implicit specifications depending on a common understanding between the designer and the patternmaker remained unclear. During designers develop garments, designers follow a sequenced chain of creative processes that builds upon each preceding link [2]. As the design process progresses, more detailed specifications are developed based on the patternmaker’s discretion (modeling [1]) and the designer’s opinion [7, 9]. Therefore, even if the same initial sketch is provided, different patternmakers will construct different clothing patterns [10-12].

We have been investigating the effects of patternmakers’ work processes on clothing design. In our previous study [8], we investigated the effects of a patternmaker’s proficiency on the process and the resultant pattern taking into account their information processing such as attention, recognition, reasoning, decision-making associated with values and preferences, and representation. A proficient patternmaker was able to identify potential problems and
then consider possible solutions to those problems. Moreover, a proficient patternmaker was able to create a representation that was more in line with the expectations of the designer.

We also investigated the effect of a patternmaker’s proficiency on garment creation. We asked two patternmakers to make two patterns from the same design and compared the patternmaking processes and the resulting manufactured garments [12]. The designer deemed the patterns acceptable if the designer was sufficiently satisfied with a toile or a sample, because nobody can provide a perfect result. The patternmakers’ experience and skills had an effect on the final garments. Based on the results, implicit agreement between the designer and the patternmaker was observed. This agreement had been developed by past interactions between them, and these interactions had an effect on garment creation. Although a designer tries to describe their intentions in a design brief, this information is not enough, especially in the creation stage. More detailed specifications are developed through interactions with the patternmaker. However, the contents of those interactions and their effect on the patternmaker’s proficiency are unclear.

Therefore, in the present study, the effects of a patternmaker’s experience working with a designer on clothing design was investigated. We employed two expert patternmakers who had different levels of experience working with a designer. By comparing the interactions during the patternmakers’ work processes between their first and second session working with the designer, we investigated how patternmakers are able to improve their understanding of a designer’s intention and the efficiency of clothing design.

2. EXPERIMENTAL METHOD

To investigate the influence of a patternmaker’s experience working with a designer on their patternmaking, one designer and two patternmakers, P1 and P2, were employed. The designer has more than 15 years of experience and manages a self-brand in France. The patternmakers have different levels of experience working with this designer as shown in Table 1. P1 has 13 years of experience working in France and has worked with the designer many times. P2 has worked in Japan and the United States for more than 20 years, but has had no experience working with this designer.

The designer designed two sets of garments for a luxury maison in France, named EG1 and EG2 as shown in Table 2. EG1 consists of a jacket and a skirt, and was used in a previous study [12]. EG2 consists of a jacket, a blouse, and a skirt. She was also asked to select the textiles for the garments. Figures 1 and 2 show sketches and flat drawings for EG1 and EG2. Figure 3 shows the textiles that were selected. The sketches, flat drawings, and swatches of the fabrics that the designer selected were presented to the patternmakers. In addition, French size 38 (bust 87 cm, waist 68 cm, hip 93 cm) was specified. First, the patternmakers were asked to make patterns for EG1. This was the first time P2 had worked with this designer. After the patterns for EG1 had been made and the samples had been approved by the designer, we asked the patternmakers to make patterns for EG2. We investigated the patternmaking method and the interactions between the patternmakers and the designer by listening to and observing them while they worked. The differences between the patternmaking processes and their interactions with the designer while making patterns for EG1 and EG2 were examined.

In this study, the patternmaking processes used for EG2 were compared with those used for EG1. The patternmakers made each pattern based on the conditions

**Table 1: Pattern makers’ background**

<table>
<thead>
<tr>
<th>Pattern maker</th>
<th>Country</th>
<th>Career</th>
<th>Brand</th>
<th>Experience working with the designer</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>French</td>
<td>More than 13 years’ work experience</td>
<td>High-end, ready-to-wear clothing in France</td>
<td>Many times</td>
</tr>
<tr>
<td>P2</td>
<td>Japanese</td>
<td>More than 20 years’ work experience</td>
<td>High-end, ready-to-wear clothing in Japan and the United States</td>
<td>None</td>
</tr>
</tbody>
</table>

**Table 2: Design condition**

<table>
<thead>
<tr>
<th>Design</th>
<th>Target brand</th>
<th>Item</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>EG1</td>
<td>a luxury maison in France</td>
<td>Jacket, skirt</td>
<td>bust 87 cm, waist 68 cm, hip 93 cm</td>
</tr>
<tr>
<td>EG2</td>
<td></td>
<td>Jacket, skirt, blouse</td>
<td></td>
</tr>
</tbody>
</table>

(a) EG1  (b) EG2

**Figure 1: Designer’s fashion sketches [12]**
Effects of Working Experience of Patternmaker with a Designer on the Efficiency and Performance of Clothing Design

3. WORK PROCESS OF PATTERNMAKERS

The work processes of both patternmakers were similar to those observed in EG1 of the previous study [12]. For EG2, the patternmakers studied the sketch and flat drawings and then produced a pattern. After confirming the pattern by making a toile, they modified and completed the pattern. In each process, the work of each patternmaker was compared with that used to produce a pattern from EG1 in the previous study.

3.1 Information recognition

Based on the results of our previous study [11], we assumed that the patternmakers built a representation of the design beforehand. Then, we questioned them regarding the points they confirmed and the decisions they made before starting to make the pattern. Their replies were as follows.

1) Confirmed points and decisions of P1

P1 confirmed the textiles and the size specifications for each clothing design. P1 recommended bonding interlining in order to maintain the silhouette and shape of the jacket and skirt given the thin fabrics that had been selected. Measurements were set according to the sizes specified and the proportions shown in the flat drawings. Dimensions such as skirt length and jacket shoulder width of EG2 were set to the sizes specified in EG1. Although the sleeve of the jacket was shown as a one-piece sleeve on the drawing, P1 decided to make a two-piece sleeve because this made it easier to create the desired silhouette. P1 asked the designer how the sleeve cuffs opened and was told that a concealed fastener should be used. P1 set this in accordance with the designer’s answer. P1 also asked about the number of buttons, and was told by the designer to use their discretion.

2) Confirmed points and decisions of P2

P2 interpreted the design as a tailored jacket with straight lines and a stylish image. P2 also checked the textile properties such as sewability and thickness to decide on whether to use interlining and the width of the seam allowance. P2 recommended bonding interlining on the jacket fabric. In addition, P2 emphasized the necessity of an interlining test because she was worried about the separation of the interlining. P2 set the measurements for EG2 based on the sizes and design of EG1. P2 wanted to ask the designer whether the sleeve was intended to be a one-piece sleeve or a two-piece sleeve, but the designer was unavailable, so for convenience we instructed P2 to use her discretion. She decided to make a two-piece sleeve for the same reason as that cited by P1.

The comparison of confirmed points and decisions of P1 and P2 is listed in the Table 3.

![Figure 2: Flat drawings](image1)

![Figure 3: Selected textiles](image2)

Table 3: Comparison of confirmed points and decisions of P1 and P2

<table>
<thead>
<tr>
<th>Pattern maker</th>
<th>Common point</th>
<th>Different point</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>Usage of fusible interlining</td>
<td>Suggestion of Interlining test</td>
</tr>
<tr>
<td></td>
<td>Same measurements of EG1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Changes of one piece sleeve into two-piece sleeve</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Confirmation of sleeve hem of sketch</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Button number of the jacket.</td>
<td></td>
</tr>
</tbody>
</table>
3.2 Patternmaking

1) P1

In the patternmaking process, P1 used a basic pattern that has been used previously and drafted it by hand. P1 set the sizes by taking into account the flat drawings and the proportions on them, as shown in Figure 4. Fabric properties were not considered because P1 thought that this was the responsibility of the sewing division of the atelier in France.

2) P2

P2 used patterns that had been made in the past. For EG1, P2 noticed that the designer gave higher priority to the feeling and silhouette of the sketch than the flat drawings. Thus, she also gave higher priority to the sketch. The model height was not specified by the designer, thus P2 set the back length of the jacket based on a model height of 158 cm, which is the average height of Japanese women in their twenties. However, for EG2, P2 set this measurement at 167 cm because she heard the designer mention that the average height of French women is 167 cm while the designer was checking the toile for EG1. P2 commented that it took less time to understand the designer’s intentions for EG2 than for EG1. The details of the patternmaking process for each item are as follows.

- **Jacket**

  P2 recognized that the feeling conveyed by the sketch for the jacket was straight and stylish. For EG1, the designer emphasized the feeling of the sketch. Thus, P2 also emphasized the feeling of the sketch. The width of the narrow panels in the bodice was set to 3 cm, taking into account the fabric pattern and the sketch. The same shoulder pads used in EG1 were used in EG2 because they were approved by the designer. The sleeves and armholes used in EG1 were also used with some modifications to sizes. Figure 5 shows a comparison of the sleeves used in EG1 and EG2. These were similar, although the sleeve of EG2 was drawn to appear straighter.

- **Skirt**

  A basic pattern for a tight skirt was used. The length used for EG1 was also used for EG2 because it was approved by the designer. In addition, P2 considered the fabric properties. Because it was a thin and soft fabric, P2 thought it would be difficult to obtain a tight fit without bonding interlining. The waist size was set larger for EG2 than for EG1 after taking into account the low weave density and shrinkage of the EG2 fabric. Waist darts were inserted, even though they were not shown on the sketch and flat drawings. Although the fastener was positioned at the side in the sketch, it was changed to the center of the back after taking into account the sewing and seam allowance because P2 expected that the designer would approve the change if the desired silhouette was retained. The position of the slit end was set below the knee according to the sketch.

- **Blouse**

  A basic shirt pattern with a similar silhouette was used for the blouse. P2 raised the bottom edge of the armhole to change the shirt pattern into a blouse pattern. Based on the sketch, she also adjusted the size of the collar. P2 noticed differences between the flat drawings and the sketch. In the flat drawings, the outside curve of the collar was round and set away from the neck to look like a blouse. However, the sketch showed a linear collar line that looked more like a shirt. Because the designer gave priority to the sketch for EG1, P2 followed the sketch for EG2. The width of the tuck was set at 2.5 cm and the front facing width was set at 3 cm in accordance with the flat drawings. The tuck stitch also followed the flat drawings. Even though a dart was not shown on the bust in the sketch, it was inserted to achieve a more pleasing silhouette because P2 knew from previous experience with EG1 that the designer did not mind the presence of darts. The armhole line was drawn based on her previous experience. Because this was the first time...
P2 had made a pattern for a blouse by this designer, it took more time to set the size and silhouette for the blouse than for the jacket.

3.3 Toile checking and modification

1) P1

The designer decided that the jacket did not need any modification. For the skirt, the designer instructed P1 to increase the width and reduce the length. For the blouse, the designer asked P1 to add one more pleat. Figures 6, 8 and 9 show the final patterns and the manufactured garments.

2) P2 – the first check

The designer checked P2’s toile twice. The first time, this was done by photos sent via e-mail. P2 asked the designer questions and obtained responses by e-mail. The questions and responses are as follows.

(a) Jacket

P2 informed the designer about details such as the fly front and a stitch because P2 had used her discretion in relation to these issues. In addition, P2 also informed the designer that she had made a two-piece sleeve with a slit opening. The designer replied that the cuffs required a concealed fastener. In addition, she asked P2 to lower the return point of the lapel, and P2 made this modification. Regarding the sleeves, P2 thought that the sleeve silhouette would be too narrow if a concealed fastener was attached. Thus, P2 increased the width of the cuffs to make a silhouette closer to that shown in the sketch, even though the designer had provided no instruction on cuff width.

(b) Skirt

P2 informed the designer that she had inserted waist darts because it was a tight skirt. P2 also informed the designer that the width of the narrow panel of the skirt was the same as that of the jacket and that the fastener was set at the center of the back. Regarding the fastener position, the designer asked P2 to check for seam slippage because it was a thin tweed fabric. After testing, P2 confirmed that there was slippage of the fabric. Thus,
P2 suggested bonding interlining, which the designer approved. P2 modified the patterns as instructed.

(c) Blouse

P2 informed the designer about the placement of the top button, the front fly, the edge stitch on the yoke, and the three-winding of 1 cm at the hem. The designer instructed P2 to reduce the width of the sleeves, to add one pleat, to narrow the cuff width a little, to lower the position of the pocket a little, and to shorten the length of the blouse a little. P2 modified the pattern as instructed. Compared with the jacket and the skirt, there were many alterations requested.

3) P2 – the second check

The second time, the designer checked the actual toile while a model was wearing it. The designer instructed P2 to increase the size of the jacket armhole while retaining the same shape. The designer also instructed P2 to increase the width of the jacket sleeve and to reinstate the previous cuff silhouette. P2 modified the pattern as instructed. The final patterns and the garments are shown in Figures 7, 10 and 11.

The comparison of toile checking and modification of P1 and P2 is listed in the Table 4.

![Figure 8: Manufactured jacket and skirt (P1)](image)

![Figure 9: Manufactured blouse (P1)](image)

![Figure 10: Manufactured jacket and skirt (P2)](image)

![Figure 11: Manufactured blouse (P2)](image)

**Table 4**: Comparison of toile checking and modification of P1 and P2

<table>
<thead>
<tr>
<th>Patternmaker</th>
<th>Item</th>
<th>P1</th>
<th>P2 (The first)</th>
<th>P2 (The second)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>No modification</td>
<td>a concealed fastener of cuffs</td>
<td>To increase the size of the jacket armhole</td>
<td></td>
</tr>
<tr>
<td>P2</td>
<td>To lower the return point of the lapel</td>
<td>To increase the width of the jacket sleeve to reinstate the previous cuff silhouette</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P2</td>
<td>To increase the width, To reduce the length</td>
<td>To check for seam slippage</td>
<td>No modification</td>
<td></td>
</tr>
<tr>
<td>Blouse</td>
<td>To add one more pleat</td>
<td>To reduce the width of the sleeves</td>
<td>To narrow the cuff width a little</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>To add one pleat</td>
<td>To lower the position of the pocket a little</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>To narrow the cuff width a little</td>
<td>To shorten the length of the blouse a little</td>
<td></td>
</tr>
</tbody>
</table>

No modification
Effects of Working Experience of Patternmaker with a Designer on the Efficiency and Performance of Clothing Design

4. EFFECT OF PRIOR INTERACTIONS ON CLOTHING DESIGN

The effect of working experience of patternmaker with designer on clothing design is listed in the Table 5. P1, who had considerable prior experience working with the designer, was able to recognize the features of the designer’s sketches. When the designer checked the toiles, less modifications were required for P1’s patterns than for those of P2. The modifications that were requested mainly related to minor details.

P2 needed more time for patternmaking on EG1 than on EG2. Based on the interview with P2, the design features obtained from the sketch and flat drawings for EG1 did not accurately reflect the designer’s intentions, and it took more time to set the vertical dimensions such as the back and sleeve length. Moreover, the designer’s preferences and points of consideration for a garment were not well understood.

In the case of the jacket and skirt for EG2, it was possible to understand the designer’s intentions from the sketch and the flat drawings. The time required to set the dimensions was less than that for EG1 because the same dimensions could be repeated. In addition, the armhole and sleeve patterns the designer approved for EG1 were able to be used with minimal modification, which reduced the time required. However, there were numerous requests for modifications to the blouse pattern because P2 had no previous experience working on a blouse by this designer.

5. CONCLUSION

We investigated the effect of a patternmaker’s experience working with a designer on the patternmaking process. A patternmaker who had previous experience working with a designer had a high level of understanding of the design and required less verification from the designer, with few points requiring modification. Conversely, a patternmaker who had less experience working with the designer was required to seek verification from the designer on more points and was required to make more modifications following a toile check by the designer. However, when the first and second checks were compared, the number of points that the patternmaker was able to resolve using their discretion increased.

In conclusion, it was shown that increased interaction between a patternmaker and a designer made it possible for the patternmaker to more clearly understand the designer’s intentions from the design sketch. Having access to patterns retained from previous experiences working with a designer also improved the efficiency of patternmaking. Thus, a patternmaker who had extensive prior experience working with a designer was able to make a pattern that satisfied the designer quickly and accurately. In addition, the nature of the interactions between the patternmaker and the designer were clarified by this study. Experience working with a designer reduces a patternmaker’s need to proceed by trial and error.

A designer should deliver more specified information on their design for a less experienced patternmaker with the designer. However, silhouette and comfort which the designer intended were not able to be specified beforehand. Thus, a prior experience must be necessary for efficient patternmaking. This finding will improve our understanding of the effects of interactions between designers and patternmakers on efficient clothing design.

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