Application of Design by Customer in Tile Decoration Business

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Abstract. The new concept of Design By Customer (DBC) has been introduced recently to increase customers' satisfaction by providing maximum involvement channels to the customers so that the customers do not reduce their requirements to meet with the specifications of available products. It is foreseen that if DBC concept is applicable for tile business, it will encourage customers to involve actively in pursuing their own decorative designs. Thus, this research has investigated the potential to apply Design By Customer concept in tile decoration business which requires the following two main issues to be answered. The first issue is on the readiness of technologies at this moment to support the production of different decorative tiles quickly. The second one is on customers' interest in tile decorative design.

Keywords: design by customer, tile decoration, conjoint analysis

1 Introduction

Tile has been used for surface covering since ancient time. Not only can it provide good surface protection but also allows aesthetic value to be created on the surface from arrangement of its different colors, shapes and sizes. However, in today tile business, manufacturers only allow customers to select or create their decorative designs from the available on shelf tiles. The manufacturers typically offer tiles with various designs, and may display a few tile decorations to attract customers. The customers who like these decorations can resemble by purchasing similar tiles while others are required to mix and match available tiles to create their own designs. Customized decorative design may be available, but at high cost and long waiting time. Therefore, what has happened is the opportunity for the customers to involve in designing their decoration is limited. Moreover, most of them unavoidably relax their requirements to select only available choices that manufacturers offer instead of pursuing their designs.

Recently, Design By Customer concept (DBC) has been introduced in order to encourage manufacturers to increase customers' satisfaction by letting customers

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engage in a value creation as many channels as possible [1]. The customers are encouraged to select the products that best match with their requirements, costs and waiting time. The level of involvement (CIDP) then, varies from mass production to individual personalization as illustrated in Fig. 1, depended upon the capability and readiness of manufacturers, customers' interest, and engineering constraint [2].

Therefore, applying DBC in tile decoration business might be applicable to increase customers' satisfaction level. As illustrated in Fig. 1, if the customers do not have specific requirement, they can involve in a value creation chain by selecting typical standard products. Furthermore, the customers are able to mix and match some components before assembling and/or manufacturing phase. Lastly, they can participate in designing the products by using the tools that manufacturers provide such as google sketch up, adobe illustrator, also photos and sketches as initial designs. In order to allow customers to participate in various channels with fast response, tile production technologies must support DBC concept. In addition, the product attributes must not violate the manufacturers' capability and crowdscreening can be implemented in order to extract the top rank components and products. Furthermore, the customers themselves should express their interests to participate in designing the products; otherwise, providing these channels will not bring success to the business. Therefore, this paper presents the investigation of two key elements: available tile production technologies and customers' interest.

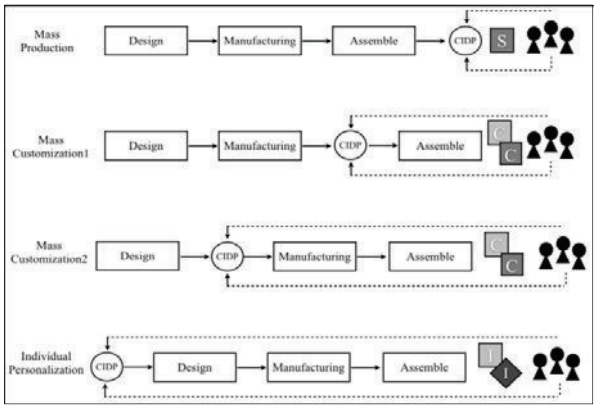


Fig. 1. Channels for customers' involvement in Design By Customer (DBC)

2 Review of tiling technologies

Tile production typically consists of eight steps as illustrated in Fig.2 [3], Raw materials including clay, water, minerals and chemical substances are prepared. These materials are weighted according to the types of tiles before being mixed and grinned together in a mixer until the mixture looks smooth. The fine clay is sent to spray drying process in order to remove the excess water. Once the condition of the fine

clay is appropriate, the forming process is started. Various methods i.e. dry pressing, extrusion and punching and pressure glazing are available for making tiles in different sizes and shapes. These tiles are dried in the next step which needs several days to remove the humidity slowly to avoid cracks and shrinkage. Lastly, the dried tiles are glazed before sending to the furnace to increase the strength which also takes several days.

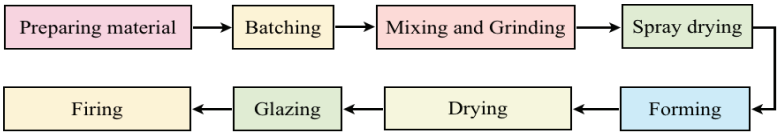


Fig. 2. Tile production process (reprinted from http://www.madehow.com/Volume-1/Ceramic-Tile.html)

The value of tiles increases when they are assembled to express a design. Tiling of a customized decorative design can be done by using ready-made tiles or by fabricating new tiles and their capabilities to support DBC are reviewed in the following subsections.

2.1 Decoration from ready-made tiles

For this group, a pattern similar to the design is created by modifying and arranging the ready-made tiles. Mosaic and profile-cut tiles are in this group.

Mosaic tile

Mosaic is the arrangement of small pieces of tile to form the pattern. Recently, the automation tiling system has been developed to support the mosaic tile industry [4][5]. The process starts from rendering an input image to a mosaic-like image that its pixels are matched with available color tiles. The identified tiles are released from storages and sorted automatically before assembling in the final step. According to [5], a 1m x1.5m custom mosaic can be produced in approximately two hours.

Profile-cut tile

This type of decoration involves cutting and assembling the ready-made tiles. Recently, researchers have introduced rapid cutting for tile pattern creation [6]. The process starts from tracing the contours on the image of a design. The tile colors are selected next by matching the colors on the image with the colors available in a stock. These pieces of tiles are cut rapidly on a waterjet machine that toolpaths are generated directly from the obtained contour without writing a single G-code [7]. The decorative area is formed by assembling these cut tiles. In case that the contour is larger than the tile, the system will calculate the new toolpath and identify the number of tiles before the cutting process starts [8]. Since the toolpaths can be generated quickly, tiles for the decorative area of 1m x 1.5m can be cut within one to two hours.

2.2 Decoration by fabricating new tiles

Another group of the customized tiles is related to the creation of a design on tiles in the production process. Additional steps are introduced into the process. This group consists of molding and printed tiles.

Molding tile

Molding tile includes an embossed design on ceramic and sandstone tiles. For molding ceramic tiles, moulds are made at the beginning before preparing the materials and moving to the other steps as in Fig.2. However, for sandstone tiles, the process is more complicate. The design is created and drawn on a paper that is used to form the clay to a pattern. Once the clay is set, the craftsman will construct a prototype by casting plaster and curving the details by hand. The mold is then constructed from the fine prototype [9]. According to local manufacturers, making a standard molding tile in any size takes at least three weeks. Therefore, the waiting time will be much longer for the custom decorative design.

Printed tile

Tile printing is the screening of pictures on the ceramic tile surface. This extra step is done before the glazing step. Furthermore, printing on glass tiles has been developed and recently introduced to the market. The production process is divided into three main steps. First, the image is customized according to the customer preference. Next, the input image will be printed on the glass surface and lastly dried to ensure that the screen is stacked tightly on the surface. The resolution of the image was about 300 dpi [10] and the largest tile size is limited to 24" x 36". According to the local manufacturers, making a customized product takes about three weeks.

3 Survey of customers' interest

Regarding to the current technologies, the manufacturers are able to offer various tile decoration methods but at different response times. Therefore, the survey of the customers' interest has been conducted by using one-to-one interview and conjoint analysis. In the first part of the survey, the participants were asked about their interest on tile decoration and on designing the tile patterns by themselves. They were also asked to rank tile decoration methods from most to least preferable (most =4, least =1) for different types of pictures as showed in Fig.3 and to support their ranking with rationale.

(a) (b) (c)

Fig. 3. Pictures for tiling method survey (a) http://www.umarin.com (b)www.renders-graphiques.fr (c) http://justbeingmysel.blogspot.com

Table 1. Tile decoration methods

1) Printed tile decoration1: The picture is formed by assembling 8”x12” printed tiles with the gap of 3 mm.	
2) Printed tile decoration2: The picture is printed on one 24”x36” large tile that is cut along the picture profile. It is assembled with 8”x12” background tiles with the gap of 3 mm.	
3) Mosaic tile decoration: The picture is displayed by arranging small pieces of tile (1.5-2.5 cm^2) with the gap approximate 2-3 mm.	
4) Profile-cut tile decoration: 24”x36” solid color tiles are cut and are assembled with 8”x12” background tiles to form a picture. The gap is 3 mm.	

Since molding tile has long processing time, it is not suitable for DBC. Therefore, only the other three types were used in the survey. Four options created from the other three types as shown in Table 1 were presented to participants.

Furthermore, conjoint analysis was used to identify the customer preference and key attributes by letting the participants take every combination of attributes in consideration rather than a single factor [11]. The important attributes are classified into five groups and three levels each as followings:

1. Surface: Glossy, Matt, Rough
2. Design: Picture, Tracy, Plain
3. Material: Ceramic, Glass, Stone or Sand
4. Size: Small (2x2cm.), Medium (20x20cm.), Large (60x60cm.)
5. Waiting time: Within three days, Within two weeks, More than two weeks

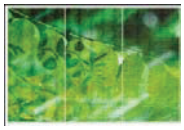
These attributes can be combined into 243 profiles; however, the combinations were reduced to eighteen profiles by using orthogonal design in SPSS in order to avoid confusion when the participants rank the cards [12]. The examples of conjoint cards are showed in Fig. 4.

(a) Card No.2

Surface: Glossy Design: Tracy

Size: Medium Material: Ceramic

Waiting time: Within 2 weeks



(b) Card No.7

Surface: Rough Design: Picture

Size: Large Material: Glass

Waiting time: More than 2 weeks

Fig. 4. Example of cards (a) http://freevectorsb.wordpress.com (b) www.cotto.co.th

4 Result and Discussion

From the interview of thirty-two participants who have planned for tiling or experienced in tiling, thirty people were interested in tile decoration of which twenty-six participants preferred to engage in designing tile decoration by themselves. The ranking score in Table 2 reveals that the participants preferred the printed tile decoration 2 most for all three pictures. Most of the participants claimed that this decoration method has only a few tile grouts on the picture which make it looks dominant and realistic. The printed tile decoration 1 came second. Some participants preferred this method because it looked smooth like a printed picture on a paper. The profile-cut tile decoration came last since they felt that it doesn't provide realistic pictures.

From processing scores in SPSS program, the card number2 as shown in Fig. 5(a) had the highest utility score of 11.227 (Y_2 = 10.2+0.261+1.133+0.694+0.139-0.7-0.5). The utility score is referred to the preference of each attributes. Thus, higher utility result refers to higher preference from the view point of the participants [12]. Furthermore, as illustrated in Table 3, design is the most important among five attributes from the customers' point of view. Therefore, the customers tend to take design in consideration as the key factor before making a decision.

Table 2. Survey result on tiling method preferences

Decoration method				Average score
Printed tile decoration 1	23.67%	25.33%	26.67%	25.22%
Printed tile decoration 2	32.33%	35.00%	33.67%	33.67%
Mosaic tile decoration	22.67%	20.00%	22.33%	21.67%
Profile-cut tile decoration	21.33%	19.67%	17.33%	19.44%

Table 3. Importance Values

Importance Values	
Surface	17.778
Design	33.759
Size	23.972
materials	16.178
Waiting_time	8.313

Regarding to the manufacturers' capabilities and the customers' interests in Table 4, DBC has the potential to be applied in tile decoration business. However, the levels of customer involvement will be varied depending on the manufacturers' capabilities which are discussed as followings.

4.1 Printed tile

According to the survey, printed tile is the most preferable to customer as it provides a realistic picture but the printed tile decoration 2 will not be available for large decorative area due to the available size of tile. The attractiveness of the printed tile decoration 1 is lower and is not much higher than mosaic decoration. Furthermore, due to the long lead time, approximately three weeks, the design from customers at the beginning phase is not recommended. The offering channels should be limited to only mass production and mass customization1. The customers are allowed to choose the standard products from the stores or customize each design of tiles by themselves rather than design the new one.

4.2 Mosaic tile

Some groups of the customers are interested in this decoration method. The smaller the tile size and the gap size are, the more attractive, this method will be. Regarding to assembling the ready-made tiles group, the lead time is shortened to only a few hours. Therefore, the manufacturers can open all four channels to the customers to involve. As a result, the customers can participate from selecting the final products to design the new one themselves. However, the technology is not ready to allow the variation of the size and shape of tile.

4.3 Profile-cut tile

The fast response of the available technologies allows manufacturers to open all four channels to the customers even though the limited number of the customers has interest in this decoration method. This method might be an attractive choice for abstract picture and the picture of cartoon character that display by solid colors.

4.4 Molding tile

According to the slow response, the customers can hardly involve in the designing process. Therefore, the manufacturers are suggested to open only two channels, letting the customers participate in selecting standard products, and mixing and matching components.

Table 4. Assessment of manufacturers' capability and customers' interest

Category	Decoration method	Customers' interest	Mass production	Mass customization1	Mass customization2	Individual personalization
Using the ready-made tiles in a pattern	Mosaic tiles	21.67%	x	x	x	x
	Profile-cut tiles	19.44%	x	x	x	x
Fabricating new tiles	Molding tiles	-	x	x		
	Printed tiles	25.22%	x	x		

5 Conclusion

This paper presents the potential to apply DBC in tile decoration business. From the study, customers are interested in custom decorative design, but their involvement will be varied depending on the manufacturers' capabilities. The manufactures will be able to offer four channels from mass production to individual personalization for tile decoration methods that use the ready-made tiles, but for printed tile decoration that the customers prefer most they will be able to offer only two levels; mass production and mass customization1 due to the slow response time. If the manufacturers can turn customers' interest to mosaic, both sides will benefit most from DBC. Therefore, future research will focus on applying choice architecture to direct customers' interest to the decoration methods that use the ready-made tiles.

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