Transdisciplinary Engineering: A Paradigm Shift
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Modern Chair Innovative Design Approaches and Paths Based on Economic Considerations

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Abstract. To design driven innovation strategy furniture firms, diversified product design can improve the market competitiveness on the one hand, and may cause the disturbance of the brand identity and the increase of production cost on the other hand. How to effectively reduce the production cost on the premise of increasing product diversity and remaining the brand identity is one of the major challenges faced by the modern furniture manufacturing enterprise. In this paper, a total of 199 types of chair products from 8 international well-known furniture enterprises were selected as research objects. Case studies were applied to investigate the relationship between the three indicators mentioned above. On this basis, modern chair innovative design approaches and corresponding realization paths were discussed.

Keywords. Chair, Innovative Design, Economic Considerations

Introduction

Design driven innovation strategy was proposed by R. Verganti at 2003, and is regarded as the third and the latest innovation strategy [1]. Differing from the two traditional innovation strategy including technology push innovation strategy and market-pull innovation strategy, design is taken as the innovative driving source in this strategy. The strategy is not only profitable for traditional industries, but also serves deeper purpose in enhancing the lives of individuals. At its best, the design movement seeks to bring innovations-sometimes radical innovations-to product language that have to adapt to new circumstances of economic competition, patent user needs, social expectation and deeper cultural understanding [2]. Referring to literatures, more and more traditional furniture firms adopted this strategy to upgrading in recent years [3].

To design driven innovation strategy enterprises, the high market competitiveness was mainly achieved by developing a strong brand identity through designing diversified products. However, diversified product design may create a disturbance on the brand identity on the one hand, and cause the increasing of production cost on the other hand, both of which conversely reduce the market competitiveness. Hence, to effectively reduce the production cost on the premise of increasing product diversity and remaining the brand identity is one of the major challenges faced by the modern design driven innovation strategy enterprises [4].

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Up to now, a limited number of papers address the relationship between diversified product design on the premise of specific brand identity and the production cost, which do not match with the significance of the problem [5]. In addition, to the best of our knowledge, modern chair innovative design approaches based on the economic considerations mentioned above were never discussed in previous studies.

In this paper, a total of 199 types of chair products from 8 international well-known furniture enterprises were selected as research objects. Case study was used to analyze the relationship between product diversity, brand identity and production cost. Further, modern chair innovative design approaches and paths to realize diversified product design on the premise of coherent stylistic brand identity with controlled production cost were discussed herein.

1. Research method

Case study was performed in this work. Chair products from representative design driven innovation furniture firms were selected as cases firstly. CMF tool, which refers to the abbreviation of three key words, color, material, and finishing, was then launched to analyze the relationship between product diversity, brand identity and production cost of all chair products in each firm. On this basis, modern chair innovative design approaches were discussed. Subsequently, case cards for each chair products were prepared, and 5W1H tool, which is also an abbreviation of six key words including who, where, when, why, what and how, was used to extract the information concerning about innovative design paths and corresponding production costs. Through comparing the collected information mentioned above, paths to realize diversified product design on the premise of coherent stylistic brand identity with controlled production cost were discussed.

1.1. Case selection

Italy modern furniture is famous all over the world for its high quality and extraordinary design. The distinctive development pattern also becomes to be the template for small and medium-sized furniture enterprises [6]. In this paper, a total of 199 chair products from 8 Italian furniture firms were selected as cases based on Milan design week field study [7]. The detailed information is listed in Table 1.

Table 1. Chair case cards summarization.

No.	Brand name	Chair sample number
1	Arflex	24
2	Driade	41
3	Edra	16
4	Kartell	28
5	Lago	4
6	Moroso	44
7	Porro	9
8	Zanotta	33

1.2. Case study

As mentioned above, CMF tool was used to investigate the relationship between product diversity, brand identity and production cost of all chair products in each firm [8]. Further, 20 experts from institutes and industries were invited to perform the questionnaire survey for the three indicators based on the CMF analysis results. Figure 1 shows the survey results to Porro.

As shown in Figure 1, each indicator were divided into 5 grades. The higher grade to the three indicators indicates the higher product diversity, brand identity and the lower production cost, respectively.The triangle area shown in the Figure can then be used to evaluate the relationship between the three indicators. That is, the bigger triangle area indicates the better balance of the three indicators. Further, through analyzing the common approaches to achieve the balance of the three indicators, potential design approaches were suggested.

Moreover, to obtain the corresponding paths to achieve the approaches proposed above, case cards for each chair products were prepared, and 5W1H tool was used to extract the core information concerning the production process.

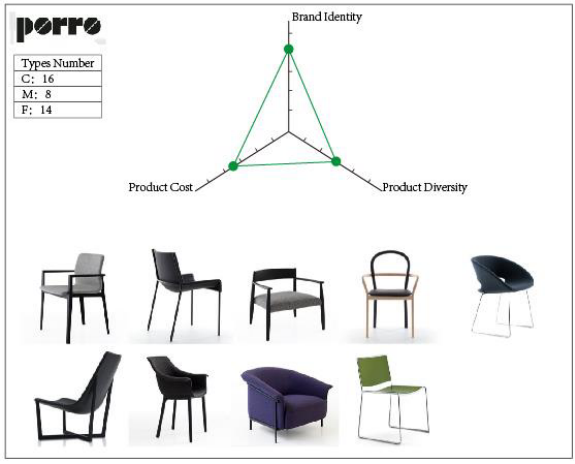

Figure 1. Sample for CMF analysis.

2. Results and discussions

Based on the investigation on each firm, the following two approaches have been put forward to reduce production costs on the premise of high product diversity and brand identity.

2.1. Optimization design approach

The optimization design approach is to seek rational design strategy that can im-prove the product diversity on the premise of meeting the product requirements. This design strategy is established on the basis of optimization theory on mathematics and solved by means of computer programming. Case studies based on the above design strategy give the following three design paths:

1. Seeking alternative materials and hardware.
2. Determining reasonable product size and improving the utilization rate of material.
3. Developing alternative production process.

The corresponding discussions for the 3 paths are listed in Table 2.

Table 2. Design optimization approach.

Design methods	Supporting cases
1.Seeking alternative materials and hardware.	 Case 15 from brand Zanotta: Designer Marco Zanuso was the first furniture designer who tried to replace the original fabric and sponge material by plastic and foam as the filler in sofa.
2. Designning product in a reasonable size to improve the utilization rate of materials.	 Case 02 from brand Lago: By calculating the dimension of the chair and basing plate size, designer maximized the utilization rate of panel sheet.
3. Developing alternative production technology	 Supplementary case: VÄRDE collection in IKEA. IKEA developed the fiberboard painting technology. It reduced costs and was suitable for low-cost products with low scalability surface materials.

2.2. Family design approach

Product family design serves the dual purposes of improving product diversity and reducing production cost. Application of components with the same or low varia-bility is the key to reduce the production cost, and the product diversity is mainly realized by the combination of different components and changes on background environment. The essential concept of designing family is to follow the "mushroom" model. With respect to this design method, the above cases were studied and the fol-lowing seven kinds of chair product family design paths were suggested:

1. Derivative design and development under the same theme. Namely, design of series of products with different appearance under the same theme.
2. Replacement of component materials. For example, the surface material of chair product can use different textile of leather.
3. Changes on components. For instance, chair with caster wheel is suitable for office space, and ordinary chair can be set in other interior space.
4. Changes on external color.
5. Changes on pattern of the back and the seat of chair.
6. Extension of product function to meet the requirement of public space environment.
7. Changes on size. Such as the adjustment in height and seat surface of the chair can satisfy the demands of different users.

The corresponding discussions for the 7 paths are listed in Table 3.

Table 3. Product family design approach.

Design methods	Supporting cases
1.Designning a collection with the same DNA	 Moroso case 40
2. Replacing component materials of the original chair.	 Zanotta case 27
3. Replacing some elements	 Driade cases 26 and 27
4. Changing on external color	 Kartell case 05

5. Transforming the pattern

Kartell case 14

6. Extending chairs in one direction

Kartell case 28

7. Changing size

Moroso case 02

3. Conclusion

To seek design approaches to improve the product diversity on the premise of high brand identity and low production costs, a total of 199 chair samples from 8 well-known Italy furniture firms were taken as samples. Then, CMF tool was used to investigate the relationship between the three indicators of all chair products in each firm and subsequently proposed the potential design approaches. Further, case cards for each chair products were prepared, and 5W1H tool was used to extract the infor-mation concerning the production process. Finally, a total of 10 potential paths to realize the two approaches were discussed.

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