

Research on Product Family Design Based on Crowd Wisdom

Jinfa Li^{1,a}, Juping Wang^{1,b} and Hong-bing Jiang^{1,c,*}

¹School of Management Engineering, Zhengzhou University, Zhengzhou 450001

^a18806024@qq.com, ^b1005842179@qq.com, ^c 278420534@qq.com

*Corresponding author

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Abstract. Considering the lack of consideration about the rapidly changing consumer market for product family platforms, based on the needs of consumers, enterprises and the market, product family development and design optimization issues are studied, based on crowd wisdom and consumers, according to online User comments, relying on the product family platform to develop product design, combined with Textrank algorithm, Word2Vec feature word cos similarity calculation and product family feature ontology, etc., proposed a product family change model, analyzed the characteristics of the current product, and future product family development and design recommendations to better respond to the consumer market are represented to reduce design costs and corporate risks.

1. Introduction

With the development of society, the traditional product production and design standards have been difficult to meet the needs of consumers and enterprises. On this basis, it is a very effective method to achieve large-scale production through product family design, which has been widely recognized by scholars and producers[1]. Product family design can better respond to dynamic changing market and user needs, maximize customer satisfaction, and establish a good strategic orientation for enterprise product family design.

At present, one of the main research on product family is the modular design of product family. Hou Liang, Xu Yanshen and others applied the idea of generalized modularization to the design of product family[2]. They proposed to establish flexible module matrix and product matrix based on similarity feature analysis, so as to better transform the form of product modularization rapidly. On the basis of traditional product family modular design, Dong Huanhuan, Wang Weiwei and others proposed to use shape grammar to design the shape derivation of reconstructed modular units, so as to better match the product shape with the real needs of users and optimize the degree of personalized customization[3]. In the design of product family, many scholars point out that user preferences can promote enterprise decision-making[4]. For example, Mendi and Cheng Xianfu, Zhu Jin and others proposed to develop or improve product family to reduce risks from user needs [5-6]. However, in the era of web 2.0, with the development of new media era on the internet, the expression of consumer satisfaction is more inclined to comment on products or services online in enterprise or third-party platform applications, which accounts for 37.5% (from China Internet Network Information Center (CNNIC). So, how to make better use of online reviews to provide better support for product family design?

At present, the research on product family design considering customer satisfaction is more qualitative, and more complex market opinions may not flow in. Therefore, the introduction of Collective Intelligence which can aggregate online consumer reviews (OCR) can make up for the traditional product family model failing to fully consider the changing market demand and automation to a certain extent. The low degree of transformation is insufficient[7]. In this paper, deep machine learning is used to aggregate online user review data, and product specifications are used to capture the product characteristics that users pay close attention to. A product family design change model is further proposed. The product family module is divided into four parts, namely

"basic module", "platform innovation module", "basic difference module" and "special innovation module". Finally, the product family module is manufactured in MacBook. The product family is verified by an example, and the improvement strategy of MacBook product family is put forward.

2. Acquisition of Product Family Characteristic Attribute Set

Product family refers to a group of similar products with specific characteristics or functions in order to meet the personalized needs of the market segments[8]. From the definition, it can be seen that product family meets the needs of customers on the basis of specific features or functions. In order to obtain product family characteristics more comprehensively, this paper takes the more standardized product specifications as the basis, combines the group wisdom that reflects the needs of users to obtain product feature attribute sets, adds the aggregated demand features with high attention, and transforms the form of modular functional feature groups. To achieve the design and improvement of product family for physical structure.

2.1 Gathering Group Intelligence Online User Comments

In recent years, based on the efficient interaction of Web 2.0 era, the development of group wisdom network has become more and more prominent. Consumers are more inclined to publish comments and share their views. As a result, group wisdom has gradually evolved into a form of social sharing based on information sharing to enhance existing knowledge. In view of the application-oriented trend and direction of group wisdom, combined with the development of network, OCR (Online Consumer Reviews) is obtained on the electronic consumption platform. At the beginning of research and development, effective information closer to the most real needs of users is fully obtained, and diversified needs of various users are appropriately responded to in a clustered way, so as to fulfill the needs to the reality. Mapping of inter-function. However, the network information has a certain degree of uncertainty. After obtaining a large amount of information, it needs to be screened out and valuable commentary information can be screened out to better play the role of group wisdom [9]. Therefore, in order to synthesize market opinions, this paper collects online user reviews through group wisdom, and integrates consumer satisfaction into product family design, that is, to obtain product family characteristics with high attention according to comments, so as to classify product family modularly and combine with product family platform to provide reliable suggestions for product family development and design.

In order to accurately extract the high attention feature of product family, a series of processing is needed for online user comment source data: noise reduction, elimination of non-contributing statements, de-duplication, de-stop words, word segmentation and so on. Firstly, in order to obtain online reviews, Python 3.5 is used to crawl OCR source data. However, due to the openness of the network, there are many noises in the original OCR data information of products directly obtained within the product family[10]. Direct application will have an intuitive impact on the results of processing. At this time, it is necessary to pre-process the source data: (1) Noise reduction, in the initial OCR data set, priority should be given to filtering out the content whose semantics are totally unrelated to the corresponding products, otherwise it will increase later. Continuing unnecessary processing capacity, its association characteristics will also have an impact on the results. (2) Analyzing and judging the initial OCR information, eliminating the commentary sentences that have no contribution to the results, such as those without product feature attributes. (3) For each comment information separated from each other, the duplicated content is simplified.

2.2 Product Family Feature Attribute Set Acquisition

In order to accurately acquire product family feature attributes, this paper uses Textrank algorithm to extract attributes from text reviews after word segmentation and tagging. This algorithm is different from document topic generation models, such as LDA, HMM and other models. It does not need to train multi-text corpus, and the extraction effect of key attribute feature words is better

[11]. Through the iterative analysis of the comment corpus text, some words with relatively high weight but little influence on the results are screened out, and the initial candidate feature set is obtained.

This paper mainly through one of the product specifications to get more standard feature languages and construct the ontology of product feature system. After obtaining the product specifications, the consistency between the initial candidate feature set and the product feature system ontology is compared and classified directly. For the remaining feature terms, Word2vec is used to train corpus in the initial candidate feature set and product feature system ontology, and feature words with high similarity are selected and merged into product feature system ontology. According to the weight value, the product feature group with high attention is obtained. In addition, the skip-gram model is used to obtain the relevant words of the context environment, and the semantic similarity is calculated. The problems of the product are found from the more concerned feature groups, which can be used as the basis for further improvement of the product family.

3. Product family design change model

When dividing the product platform of product family, the whole product is divided according to the modular structure, and the product family design replacement model is constructed. It mainly includes three dimensions: dimension one represents platform dimension, which divides product platform into universality and individuality; dimension two represents technology dimension, which updates and iterates with the extension of the dimension; dimension three represents time dimension. On the basis of the main product concept, product family is constantly updated and successive, and subsequent serialization changes constitute generational product family[12]. Among them, dimension 1 and dimension 2 constitute the development of a series of products or product lines within the family. The product family design change model form is shown in Figure 1.

In each single product plane composed of technology update dimension and platform dimension, product family replacement model is divided into four regions according to the high change frequency, low change frequency and the universality and individuality of platform module. Among them, the feature modules with high versatility and low technology change frequency are located in the "basic module" area, which is the core common part of the product family. In the process of product family development and design and improvement, the feature modules with high versatility and high technology change frequency are located in the "platform innovation" area, although they are in this area. Generally designed modules, but products on the same product line need to be constantly changed to meet the changing market demand due to the update of time and technology; the feature modules with high personality and low technology change are located in the "basic difference" area, where the functional characteristics are often diversified but the technology is relatively stable, and will not change quickly, so it is necessary to meet the needs of users quickly. Rapid change; High personality and rapid technology change feature module is located in the "special innovation" area, which is the focus of product developers and the most expensive part of product family design. Compared with the "basic difference" region, technology is relatively stable and the cost of product replacement is lower, but the functional characteristics of the "special innovation" region need to be almost completely new design. At the same time, this region is the part reflecting the advantages of product family, which can meet the diverse needs of different users to the greatest extent.

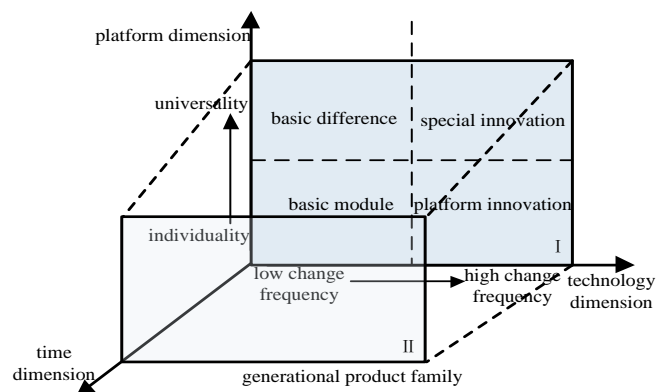


Figure 1 Product family turnover model

4. Examples Verification: MacBook Product Family as an Example

4.1 MacBook Product Family Feature Attribute Set Acquisition

According to the concept and development of product family, it is found that the updating and iteration of portable notebook computers in the computer market often evolve in the form of product family. Therefore, this paper chooses MacBook product family of Apple Inc. as the research object. Taking Jingdong, a professional online shopping mall, as a third-party comment publishing website, and taking MacBook Pro15.4, New MacBook (MNYF2CH/A), MacBook Air13.3 (MQD32CH/A) as the research objects, 7835 OCR data of the target website were obtained. Among them, 3304 original OCR data of MacAirBook, 2162 New MacBook and 2369 MacBook Pro were obtained.

In this paper, MacBook Air product is taken as an example. Taking the feature "resolution" as an example, such as Table 1 the feature description "display" with the highest corresponding similarity is selected, and the candidate feature words are classified into the corresponding feature system ontology.

Table 1 Schematic tables for similarity comparison of feature words "resolution"

candidate feature words	Feature system ontology	cos similarity
display	operating system	0.1701010577711677
display	processor	0.1330599920998691
display	appearance	0.09508046545269558
display	heat dissipation	0.2755141367576101
display	price	0.213780788930702
display	display	0.7732336533735849
display	memory	-0.4375533462619491

After a series of processing, the improved product feature system ontology of MacBook Air is obtained, which covers 15 relevant feature groups: operating system, processor, appearance, heat dissipation, price, memory, hard disk, display, input device, graphics card, sound system, power supply, accessory, main body and use. Among them, because this article is based on the group wisdom of OCR to analyze the product family, and mainly divides the relevant modules according to the characteristics of the product family, it does not make the primary analysis of the information of the product seller's reputation or service attitude, logistics, quality of the genuine product and its use.

4.2 Result analysis

According to the improved product feature system ontology, the comprehensive ranking of each feature group is carried out, and the threshold of product feature criticality is set through

experimental analysis to obtain the feature set most concerned by users. The feature group with weight over 0.3 is set as the high-concern feature index of this product. Based on skip-gram model, For MacBook Air, the "operating system", "display", "appearance", "price", "heat dissipation" and "memory" are predicted and analyzed according to the value ranking of feature groups and the threshold of feature criticality.

Table 2 MacBook Air High Concern Feature Group Describes Prediction Results

feature	Predictive descriptors	Correlation degree
operating system	Fluent	0.6081134676933289
	sensitive	0.5536726808547974
	Unskilled	0.5436395311355591
	No use	0.5265512466430664
	Adapt	0.5063521862030029
	Dual system	0.5121965408325195
	Difficult to use	0.4427327752113342
price	Cheap	0.5999657678604126
	Cost performance	0.51186190366745
	Value for money	0.45399466156959534
heat dissipation	poor	0.6974220871925354
	Too hot	0.652131199836731
	Deficiencies	0.6144672727584839
memory	not enough	0.716240644454956
	Want to install	0.6781266927719116
	extend	0.6313598155975342
	Too small	0.6301255226135254

For the MacBook Air "display" feature set, users focus more on the screen and resolution. Most users think that the screen resolution is too low and the screen is blurred. It is inferred that the reason is that the screen is not equipped with a higher-definition retina display screen, which makes the overall screen feel very granular and the display effect is relatively ordinary. With regard to "operating system", Mac OS system is superior in fluency and operation intuition. However, due to the different adaptability of most users to different systems, many users will consider installing dual systems on the basis of the original Mac OS system. With regard to appearance, MacBook Air's slim features are obvious. Both ontology description and similar descriptive features highly evaluate its slim appearance with a high probability of more than 0.65. In addition, for the "price" feature group, more commentary information indicates that its price is cheap and value-for-money; however, it shows deficiencies in heat dissipation performance, which is associated with "heat dissipation" by more than 61% probability in the commentary as the "shortcomings" of this product. Similarly, in terms of "memory", the main manifestation is insufficient memory, 63% - 67% of users want to expand memory.

4.3 MacBook Product Family Development Strategy

As far as the whole product family is concerned, first of all, the operating system is concerned. The unique Mac OS system has great advantages of simplicity and high fluency. However, in user reviews, each product line has a probability greater than 0.7 that it needs to adapt to learning the system. In addition, there are some software compatibility problems. When improving the design of the whole product family platform, we can focus on the optimization of the system, which is a highly concerned feature, and also reduce the situation of users applying dual systems. In addition, it makes Mac OS compatible with more professional software sources and enables users to experience consistency in different operating systems. In addition, the overall improvement of the appearance of the product platform is that the magnesium-aluminum alloy shell is prone to scratches, so it is necessary to replace the material or add protective coating to protect the notebook fuselage. In the heat dissipation part, there is too much compromise between the appearance and the light design, and the fan with the duct setting and conservative will reduce the heat dissipation

capacity, so further adjustment is needed. In order to occupy more product markets, we can open up new product lines or improve and expand existing product lines based on the conclusion of comprehensive analysis of group wisdom. According to the extensive demand of market users for excellent performance and portability, we can optimize MacBook product lines to effectively control the market.

5. Summary and Prospect

In this paper, aiming at the trend of product family research, we propose to integrate the networked application of group wisdom into the design of product family. Through the acquisition and aggregation of OCR, the feature groups of product family with high concern are extracted, the product family turnover model is constructed, and the vulnerabilities of product family are found by predicting Association words, which provides effective suggestions for the development and design of product family.

Due to my limited level, there are still many knowledge to be studied in depth. When choosing the experimental objects of the product family, three representative products of the main product lines are selected. The scope of the research needs to be expanded, and experimental samples are added to obtain more abundant differences.

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