TECHNOLOGY FOR ANALYSIS OF DESIRABLE PRODUCT SPECIFICATIONS BASED ON TARGET CUSTOMERS' eWOM

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ABSTRACT

In today's highly competitive business environment, the primary way an enterprise enhances its competitive advantage is to understand target customers' preferences and needs for the products. In the past, visiting customers in person or conducting questionnaires were the main measures an enterprise took to grasp customers' preferences and needs. With the development of Internet and the rising popularity of community websites, more and more consumers will post the Product Review online, which offers enterprises another way to grip consumers' preferences and needs for products more objectively. As a result, how to assist enterprises to effectively analyze a large number of target customers' eWOM on the Internet and further extracting decision-making information is one of an enterprise's major studies on increasing its competitive capability.

The purpose of the study lies in designing an IT-based method that can outline desirable specifications on the basis of target customers' eWOM. Such method is able to help an enterprise quickly adapt consumers' preferences and demands for products to product planning. In so doing, not only can an enterprise shorten its time to market, but it can also raise the target customers' satisfaction for the products. In accordance with above purposes, the main research projects include: (i) the design of a desirable product specification identification process for target customers' eWOM, (ii) the development of desirable product specification identification techniques for target customers' eWOM, and (iii) the implement of desirable product specification identification techniques for target customers' eWOM.

Keywords—Electronic word-of-mouth (eWOM), Target customers, Product Specification.

INTRODUCTION

The boom of Information and Communication Technology and the globalization of markets have enhanced the interaction between consumers and enterprises. The increasing variety of products and competitors result in tougher business environments so that an enterprise has changed the business models from product orientation to customer orientation to satisfy consumer demands. A customer-oriented business model is based on the understanding of target customers' product preference and demands. An enterprise used to understand consumer preference and demands through the interviews between salespersons and consumers or questionnaire survey. Nevertheless, the development of the Internet and the popularity of discussion communities cause more and more consumers making online comments on products. It presents that an enterprise could more objectively understand consumers' product preference and demands from an alternative channel. Consequently, effectively analyzing valuable decision information from a great deal of customers' eWOM is a primary issue for an enterprise enhancing the competitive advantages.

Current research on consumers' eWOM is divided into two categories. First, how to extract and classify customer opinions in eWOM is studied. For example, aiming at big eWOM, Zhan et al. (2008) preceded multi-document summarization to select the most representative eWOM. Chen et al. (2011) proposed to classify subjective sentences and objective sentences with Support Vector Machine (SVM) so as to accurately find out the customer opinions (subjective sentence), in a lengthy article, about products. Zhu et al. (2011) and Bafna & Toshniwal (2013) first looked for customer opinions in eWOM about products and then classified such opinions with positive and negative judgment. Second, the application of eWOM extraction is researched. For instance, Esparza et al. (2012) established the user preference model with the speech, constructed the merit/demerit model of a product with all user comments on the product, and finally compared such two models for recommending products to users. Zhang et al. (2012) analyzed user opinions about self-produced products for the drawbacks in

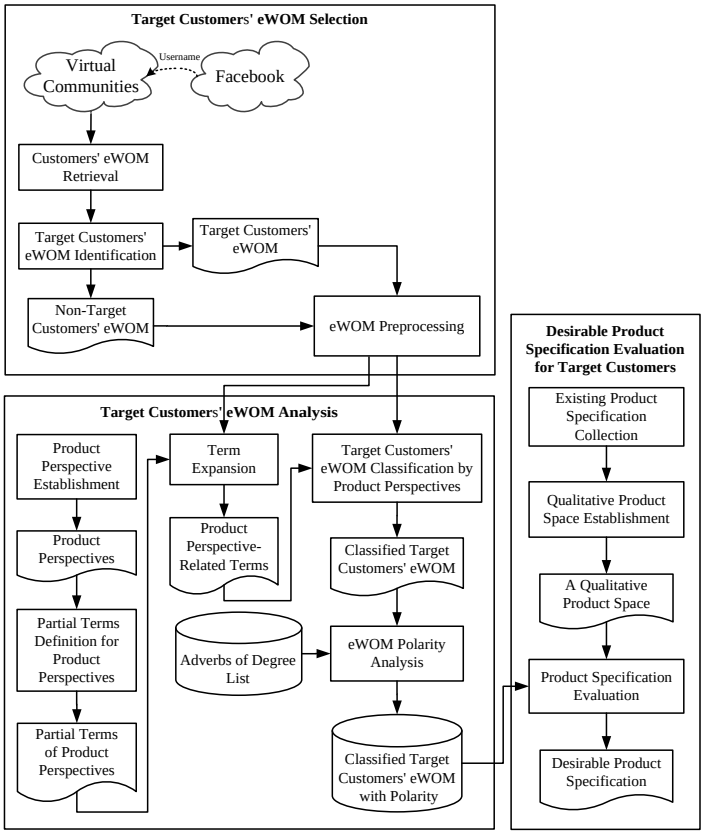
customers' eyes or the relatively weak dimensions in comparison with competitors' products. Above research on consumers' eWOM was still on the beginning stage, and most studies focused on the extraction and classification of customer opinions in eWOM, but seldom on the application of consumers' eWOM, and even rarely on the decision support for product design and development.

In this case, a desirable product specification identification mechanism, aiming at target customers' eWOM, is developed in this study to assist an enterprise in rapidly transforming target customers' product preference and demands for products into the product planning to further shorten the time to market for products and enhance the customers' product satisfaction. Accordingly, the research items include (i)the design of a desirable product specification identification process for target customers' eWOM, (ii)the development of desirable product specification identification techniques for target customers' eWOM, and (iii)the implementation of desirable product specification identification mechanism for target customers' eWOM. The development of desirable product specification identification techniques for target customers' eWOM covers target customers' eWOM selection, target customers' eWOM analysis, and desirable product specification for target customers.

METHODOLOGY

Aiming at target group's eWOM, a desirable product specification identification process is developed in this chapter, including target customers' eWOM selection, target customers' eWOM analysis, and desirable product specification for target customers.

Figure 1
Desirable Product Specification Identification Process forTarget Customers' eWOM



2.1. Design of a Desirable Product Specification Identification Process for Target Customers' eWOM

Aiming at target group's eWOM, a desirable product specification identification process is developed in this chapter, including target customers' eWOM selection, target customers' eWOM analysis, and desirable product specification for target customers.

2.1.1. Target Customers' eWOM Selection

With the popularity of Facebook, online discussion communities often allow users directly using the Facebook account as the community account, for the sake of convenience. Users therefore could make comments with the Facebook identity. In this study, Facebook users are judged as target customers with the personal data (such as age, gender, and working place) so as to identify their eWOM. Target customers' eWOM and non-target customers' eWOM are further preprocessed in order to keep the nouns, adjectives, and adverbs in eWOM for analyses.

2.1.2. Target Customers' eWOM Analysis

eWOM appraisal refers to target customers commenting on some dimensions of a target product. As a result, the analysis of target customers' eWOM aims to analyze the product dimensions from eWOM. First, a user would define the target product and the concerned product dimensions. For example, a user establishes a target product as "smartphone" and the product dimension as "camera". Based on the defined product dimension "camera", related seed terms are artificially defined, such as pixel and taking pictures. Nonetheless, such seed terms related to the product dimension might be insufficient that the related terms, based on such seed terms, should be expanded so as to acquire more sufficient related terms. Furthermore, the eWOM preprocessing result in (1)Target Customers' eWOM Selection is preceded the product dimension classification, based on such related terms. As the example of "This mobile phone is expensive" in an eWOM, the term "expensive" often appears with the seed term "price" that the product dimension of "price" is included in the related term stock after term expansion. In this case, even though the term "price" is not mentioned in eWOM, the term "expensive" in target customer's eWOM is still classified into the product dimension "price". Moreover, the related term stock would be adjusted the weight according to the frequency of the term appearing with several product terms, e.g. an eWOM "The camera of a mobile phone is great" in the camera dimension, an eWOM "The battery endurance of this mobile phone is great" in the battery dimension, and another eWOM "The memory of this mobile phone is great, presenting 64GB" in the hardware dimension. The adjective "great" simultaneously appears with several product terms that the adjective "good" in camera, battery, and hardware dimensions would be reduced the weight. Finally, the classified target customer eWOM, according to the product dimension, is analyzed the positive/negative appraisal so that target customers' eWOM present the value for product specification review.

2.1.3. Desirable Product Specification Evaluation for Target Customers

eWOM makes comments on current products; the real specification information of a product must be acquired to make the eWOM appraisal valuable. For instance, a target consumer comments the screen of smartphone A being too small. The real screen size of smartphone A should be acquired in order to clearly know the target consumer's dissatisfaction with the screen size. Web Spider is therefore utilized for collecting current product specification information in this study. Furthermore, such product specification information is established a prototype of Qualitative Product Space (QPS) according to above (2). Finally, the prototype of Qualitative Product Space (QPS) and the product comments in target customers' eWOM analyzed in (1) are evaluated in order to adjust the specifications of current products and further acquire satisfactory product specifications for target customers.

2.2. Development of Desirable Product Specification Identification Techniques for Target Customers' eWOM

Based on the identification process for desirable product specifications in target customers' eWOM described in Section 2, the relevant core methods, including target customers' eWOM selection, target customers' eWOM analyses, and desirable product specification evaluation for target customers, are developed.

2.2.1. Target Customers' eWOM Selection

Target customers' eWOM selection covers customers' eWOM retrieval, target customers' eWOM identification, and eWOM preprocessing, as detailed below.

A. Customers' eWOM Retrieval and Target Customers' eWOM Identification

In order to effectively retrieve and identify target customers' eWOM, eWOM of a target product announced in various virtual discussion communities which are registered with Facebook IDs is first retrieved, such announcers are further judged the personal data for being target customers, and such retrieved eWOM are identified as target customers' eWOM. The identified eWOM is divided into target customers' eWOM and non-target customers' eWOM.

B. eWOM Preprocessing

Target customers' eWOM and non-target customers' eWOM identified in step A. are preprocessed. First, some blanks or special symbols which could result in misjudgment are trimmed. CKIP Client (Academia Sinica, 2011)is utilized for sentence segmentation, word segmentation, and part of speech tagging in order to acquire nouns, adjectives, and adverbs in eWOM.

2.2.2. Target Customers' eWOM Analysis

Target customers eWOM analysis aims to classify the target customers' eWOM of products acquired in Section 2.1 and judge the positive and negative appraisal. Target customers' eWOM analysis mainly involves in five steps, namely product perspective establishment, partial terms definition for product perspectives, term expansion, target customers' eWOM classification by product perspectives, and eWOM polarity analysis.

A. Product Perspective Establishment

Products involved in target customers' eWOM are broad that the product specification dimensions covered in target customers' eWOM should be artificially established before the analysis for the product specification appraisal. For example, the smartphone specification appraisal of a target customer might be defined the dimensions of camera pixel, screen size, and memory capacity. Acquiring the real specifications according to such product specification dimensions, the product specification appraisal in target customers' eWOM could be acquired.

B. Partial Terms Definition for Product Perspectives

According to above product dimensions, synonyms are artificially tagged online (Kuantung Hsieh, 2003)(Ministry of Education, R.O.C. ,1994) in order to look for the related terms as the seeds for the expansion. For instance, some synonymous words related to the battery dimension of a smartphone, including standby time, endurance, battery life, quantity of electric charge, milliampere, and charging, could be defined.

C. Term Expansion

First, according to the nouns, adjectives, and adverbs acquired from the preprocessing in Section 3.1, C-value method is used for selecting important and common terms in daily life. The calculation is shown as Equation (1).

$$\text{C- value(a)} = \begin{cases} \log_2(|a|) \times \text{frq(a)}, & \text{a is not nested.} \\ \log_2(|a|)(\text{frq(a)} - \frac{1}{P(T_a)})\sum_{b \in T_a} \text{frq(b)}), & \text{otherwise.} \end{cases} \quad (1)$$

where a is the candidate string, $\text{frq}(.)$ is its frequency of occurrence in the corpus, T_a is the set of extracted candidate terms that contain a, and $P(T_a)$ is the number of these candidate terms.

Second, such selected terms and the related terms defined in product specification dimensions are proceeded correlation comparison in order to expand the related terms in the product specification dimensions. The calculation is shown as Equation (2).

$$\text{RlogF(t)} = \text{logfrq(t, T)} \times \text{R(t, T)} \quad (2)$$

where RlogF(t) is the relevance between the term and the product specification dimension, T is the related term in the defined product specification dimension; frq(t, T) is the number of times the term t simultaneously appearing with the related term T in the product specification dimension, and R(t, T) denotes $\text{frq(t, T)} / \text{frq(t)}$.

The related terms in the product specification dimension would be sequenced RlogF, and the terms with larger RlogF are regarded as the related terms in a new product specification dimension. However, the RlogF sequencing

could stands for the relevance between terms and product specification dimensions. Consequently, related terms in the dimension need to be adjusted the RlogF sequence in other dimensions. First, the RlogF sequence is quantified with Equation (3). Second, related terms which need to be revised φ because of the RlogF sequence in a different dimension are calculated (Equation (4)). Finally, the correlation between related terms and product specification dimensions acquired with Equations (3) & (4) are calculated with Equation (5). The product specification dimension with the highest relevance is the one in which the terms belong.

$$\eta_i(t) = 1 - \frac{\gamma_i(t)}{|S_i|} \tag{3}$$

where $\eta_i(t)$ is the quantified value of the RlogF sequence, S_i is the set of related terms in the product specification dimension, $|S_i|$ is the quantity of related terms in the product specification dimension, and $\gamma_i(t)$ is relevance sequence of related terms in the product specification dimension.

$$\varphi(t) = \frac{-\sum_{i=1}^{m} \frac{\gamma_i(t)}{\sum_{1\le j\le m}\gamma_j(t)} \log \frac{\gamma_i(t)}{\sum_{1\le j\le m}\gamma_j(t)}}{\log m} \tag{4}$$

where m is the number of product specification dimensions correlated with related terms in the product specification dimension.

$$\text{score}_i(t) = \eta_i(t) \times (1 - \varphi(t)) \tag{5}$$

D. Target Customers' eWOM Classification by Product Perspectives

Target customers' eWOM classification mainly segments and classifies sentences of related terms in the product dimension in the preprocessed eWOM. For example, "The camera pixel is good, the screen size is small, and the resolution is not bad, but the battery endurance is bad" in an eWOM, three product specification dimensions, camera, screen, and battery, are mentioned. Such three dimensions are segmented into "the camera pixel is good", "the screen size is small, and the resolution is not bad", and "but the battery endurance is bad" for product specification classification to analyze the positive and negative appraisal. The segmentation and classification equations for target customers' eWOM are shown as Equation (6) and Equation (7).

$$U^* \overset{\text{def}}{=} \arg\max_{U} J(C, U) \tag{6}$$

$$J(C, U) = \sum_{1\le i\le k}\left[\delta(u_{i-1}, u_i) \times \text{score}_{a^*}(u_i)\right] = \sum_{1\le i\le k}\left[\delta(u_{i-1}, u_i) \times \sum_{t\in u_i}\text{score}_{a^*}(t)\right] \tag{7}$$

where C is the set consisting of *n* sub-sentences, $C = \{c_1, c_2, c_3, ..., c_n\}$, U is the set of *k* paragraphs, $U = \{u_1, u_2, u_3, ..., u_k\}$, $J(C, U)$ judges whether the clauses in the same product specification dimension is segmented into the same segment, u_i, u_{i-1} are the sub-sentences in different product specification dimensions that $\delta(u_{i-1}, u_i) = 1$ when the two sub-sentences are in different product specification dimensions, or $\delta(u_{i-1}, u_i) = 0$, and a^* is the most representative product specification dimension of u_i.

E. eWOM polarity analysis

We manually construct a polarity dictionary includes both of positive sentimental words(good, beautiful, nice, etc.), negative sentimental words(worse, dirty, etc.), and antisentiwords(not, never, etc.)(Shengchieh Kao ,2014).By referring to this polarity dictionary, if this eWOM contains positive sentimental word, it would be judged a positive eWOM, if it contains both of positive sentimental word and antisentiwords, it would be considered a negative eWOM.

2.2.3. Desirable Product Specification Evaluation for Target Customers

According to the product specification appraisal in target customers' eWOM analyzed in Section 2.2.2, a desirable product specification evaluation is developed in this section to derive the product specifications conforming to target customers' preference. Such a desirable product specification evaluation contains existing product specification collection, qualitative product space (QPS) (J.N Lewis et al., 2010) establishment, and product specification evaluation.

A. Existing Product Specification Collection

Based on the product specification dimensions established from product perspective in Section 2.2.2(A), the detailed specifications for current product specification dimensions (such as the camera dimension for a mobile phone iphone 6 with 8 million pixels and 1GB RAM) are manually collected, and a product specification database is constructed.

B. Qualitative Product Space (QPS) Establishment

An empty QPS is established based on the above product perspectives. Product specifications collected in step (A) are then filled in the empty QPS to form the product QPS.

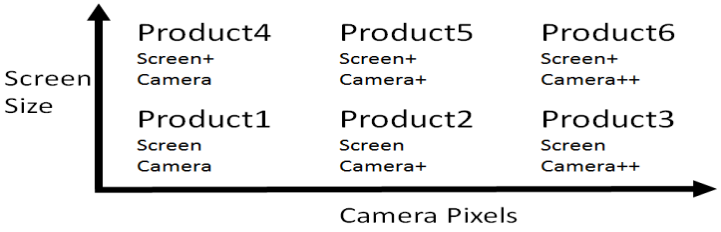
(1) Empty Qualitative Product Space (QPS) Establishment

The above product perspectives are independently established an exclusive coordinate as the product QPS.

(2) Qualitative Product Space (QPS) Establishment with Product Specifications

Product specifications are retrieved from the product specification database, in which the product QPS is filled according to the specifications, Fig. 2.

Figure 2
Filled qualitative product space example



(3) Product Specification Evaluation

Randomly selecting a product in the established QPS as the initial point of the rapid product navigation (J.N Lewis et al., 2010), parts of eWOM are randomly selected from the database to be the target customers' opinions. Based on such opinions, existing products in QPS are navigated till the product QPS does not move (convergent). Finally, the stayed product specifications are those conforming to target customers' preference. The algorithm for rapid product navigation is designed by C#, Table 1.

Table 1
Algorithm for Rapid-Product-Navigation

INPUT: Random eWOMs in one perspective, which is represented $E = \{e_1, e_2, e_{3\ldots} e_n\}$.
Product means a product's specification in one perspective.
Define theQualitative product space in all perspective, which is represented by$QPS = \{q_1, q_2, q_{3\ldots} q_n\}$.
T_d and T_p are consts.
OUTPUT: A desirable product specification.

```
1.  int count = 0
2.  foreach q_i in the QPS
3.  while (true)
4.    if |positive in E – negative in E| < T_d
5.      count++;
6.    if positive in E > negative in E && positive in E – negative in E > T_d
7.      Product LEVEL DOWN;
8.      count = 0;
9.    if positive in E < negative in E && negative in E – positive in E > T_d
10.     Product LEVEL UP;
11.     count = 0;
12.   if count >= T_p
13.     break;
14.   Random another eWOM set E;
15. return Product;
```

Result

This research use smart phone as a case to implement, and choose students as target customers. After Rapid-Product-Nevigation, the desirable smart phone specification for students in Taiwan as follows: Screen 5 inches, Camera 20 mega pixels, Ram 3GB, Rom 32GB, Battery 2600mAh.

We sent out the online questionnaire to evaluate our result and received 325 completed questionnaires. and rated their satisfaction of the perspective specification on a five-point hedonic scale (1 = unsatisfied extremely, 5 = satisfied extremely).

Table 2
Mean specification satisfaction ratings

Perspective	Satisfaction rating
Screen	4.15
Camera	4.56
Ram	4.39
Disk	4.20
Battery	3.00
Overall	4.06

As the result, expect the battery, other perspectives' mean scores are all higher than 4, camera's score even reach 4.56, and overall's score is 4.06. So this methodology is worth consideration for product development.

Conclusions and Perspectives

A novel technology for identifying a desirable product specification in target customers' eWOM is developed in this study, aiming to assist an enterprise in rapidly changing target customers' preference and demands into the product planning so as to reduce the time to market for products and enhance production satisfaction of target customers. The main results and contributions of this study are concluded as follows.

(1) Desirable product specification identification model for target customers' eWOM. Aiming at target customers' eWOM, a desirable product specification identification model is designed in this study for an enterprise rapidly transforming target customers' preference and demands into the product planning so as to enhance the product satisfaction of target customers.

(2) Desirable product specification identification method for target customers' eWOM. According to the desirable product specification identification model, a related desirable product specification identification method, including target customers' eWOM selection, target customers' eWOM analysis, and desirable product specification evaluation for target customers, is developed for the implementation of desirable product specification identification mechanism.

(3) Desirable product specification identification mechanism for target customers' eWOM. This mechanism could real-time acquire target customers' opinions about product specifications on online communities, objectively analyze and generate desirable product specifications for the reference of product design and development, as well as satisfy target customers' demands.

The research outcomes could implement the desirable product specification identification mechanism for target customers' eWOM and enhance target customers' satisfaction with product specifications so as to satisfy target customers' demands for product specifications and further promote the product competitiveness of an enterprise in the market.

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