How online reviews drive enterprise innovation: the intermediary role of customer participation

Qianqian Li, Jiaying Pu
School of Management, Shanghai University, Shanghai 200444, China

Corresponding author and e-mail: Jiaying Pu, 845288198@qq.com

Abstract. With the rapid development of the Internet, online reviews have become a hot topic. Online reviews have an influence on sales, brand loyalty and consumer behavior, but there is still a lack of systematic research on whether it can drive enterprise innovation. This paper explores the dimensions of online review, constructs a theoretical model of the influence mechanism of online review on enterprise innovation, and uses empirical analysis to verify the relevant hypotheses. It is found that the professionalism, homogeneity and relationship strength of online reviews have a significant positive influence on innovation performance of enterprises, and customer participation plays an intermediary role. By revealing the function mechanism of online reviews, this paper can make managers deeply understand the inherent law of "how to effectively manage online reviews to promote enterprise innovation performance", which has a certain guiding significance for the marketing practice of enterprises.

1. Introduction

As one of the most important forms of online word-of-mouth communication, online reviews can not only drive corporate profits through recommended value, but also lay communication channels between companies and consumers (Reichheld, 2003), providing an effective interaction mode for their own development and innovation [1-2].

Online reviews in the context of the Internet are an important source for enterprises to gain market response, which can be effectively shared between customers and companies. It is also the key reference factor for other customers to decide whether to feedback their own knowledge, information, and personal needs to the company. At the same time, customers often choose the ones that match their own interests or backgrounds when they search online reviews on the Internet platform, to decide whether to accept the product [3]. Exploring the mechanism of online reviews can make companies to effectively manage online customers, enable customers to participate better and integrate into the innovation activities of enterprises. Therefore, enterprises can maximize their own innovation performance.

The current research on the mechanism of online reviews mainly focuses on the two perspectives of consumers and enterprises. There is still no theoretical basis for the dimension division of online reviews, nor does it discuss the role of customer participation as an intermediary [4-5]. Based on the existing research conclusions and perspectives, this paper further explores the impact of online reviews on enterprise innovation performance and the intermediary role of customer participation in...
the context of online shopping, and theoretically answers the fundamental question of "online reviews and its mechanism on enterprise innovation performance".

2. Literature review

2.1. Online review
The concept of online review was first proposed by Chatterjee P (2001). Bickart and Schindler (2001) believe that online review information and content are relatively easy to obtain and time-sensitive. Since the online review information published by customers is a true expression of the product or service experience, it is also more likely to be recognized by other recipients (Park & Lee, 2008).

Brown, J.et, al (2007) divided online reviews in three dimensions, namely relationship strength, homogeneity and source credibility [6-8]. Among them, the relationship strength refers to the degree of association and interaction between the receiver and originator of a comment message; homogeneity is the similarity between the review originator and the receiver; the source credibility refers to the ability of the review originator to accurately express information and reflect professional behavior perceived by the customer as a review receiver.

Therefore, drawing on previous relevant research, this paper defines online reviews as the evaluation of the current and potential customers' feelings about the use of the product, or the expression of the purchased products and related characteristics of the company. It focuses on the textual form, and effectively spread among the public through the Internet. At the same time, this study uses three dimensions of professionalism, homogeneity and relationship strength to measure online reviews.

2.2. Customer participation
From the perspective of behavior concept, customer participation and service production and delivery are interrelated (Cermak et al., 1994). Kellogg et al. (1997) pointed out from a psychological perspective that customer participation is the pursuit of higher psychological needs by customers in the transaction process. With the continuous recognition of customer participation, scholars have gradually developed customer participation’s division from single dimension to multiple dimensions. Among them, the three-dimensional division proposed by Ennew and Binks (1999) is widely recognized [9-10].

In summary, this paper defines customer participation as a form of cooperative production and interactive creation, which means that customers spare no effort to integrate their own knowledge, information, time, energy and other resources into the process of product or service production, development and sales, and ultimately create new products or services alone or jointly with enterprises.

In addition, this paper divides customer participation into information sharing, responsible behavior and interpersonal interaction. Among them, information sharing refers to customers participate in the development of new products by providing effective their self-demand, preference information, market information and development information to enterprises, and actively promote the development of marketing activities. Responsible behavior means that part of the product or service process stimulates the customer's sense of responsibility to help the enterprise. Interpersonal interaction will drive enterprises to obtain relevant information in time and clarify customers' demands and preferences.

2.3. Innovation performance
The most representative of the relevant research on innovation performance elements and systems is that innovation performance refers to the quality, speed and results of innovation in the process of innovation. Specific evaluation indicators include the overall performance technical performance and business performance of new products (Cordero, 1990). Innovation is a continuous process, which not
only involves the conversion of scientific research results into products or technical systems, but also relates to the opening up new market areas [11-12]. Therefore, the innovation performance of this paper specifically refers to the production of new products or new processes, including product innovation and process innovation, which includes the comprehensive process of integrating production factors, research and development, production and manufacturing to successful marketing. Its purpose is to develop new markets, obtain commercial benefits, and obtain core competitive advantages.

3. Theoretical model and research hypothesis

3.1. Theoretical model

This paper mainly discusses the impact of online reviews on enterprise innovation performance, emphasizing the positive impact of online reviews on customer participation, which can improve the enterprise's own innovation performance. Based on literature review and theoretical review, a graphical depiction of the theoretical model is provided in Fig. 1.

![Figure 1. Theoretical model.](image)

3.2. Research hypothesis

3.2.1. Online review and customer participation. The professionalism of online reviews includes the reviewer's product knowledge, product use experience and purchase experience (Bansal& Voyer, 2000), which tends to be more persuasive. It is found that the homogeneity of review information, as a major determinant of recommendation effect, has a driving effect on the participation behavior of information recipients [13]. Some studies have also shown that the relationship strength of online reviews has a positive impact on consumers' purchase decisions, and it also drives customers to participate in innovation. In addition, the social masses prefer to pass product knowledge to their friends, and they are more friendly to friends' suggestions. In the process of dissemination of review information, it also promotes the behavior of customer participation in innovation.

Based on the above arguments, we propose the following hypothesis.

- H1: Professionalism of online reviews is positively related to Customer Participation.
- H2: Homogeneity of online reviews is positively related to Customer Participation.
- H3: Relationship Strength of online reviews is positively related to Customer Participation.

3.2.2. Customer participation and innovation performance. In the process of enterprise production activities, customers participate as a major production factor, which has a positive impact on the improvement of customer satisfaction and the reduction of merchants' operating costs (Gummesson, 1998). Customer's own knowledge reserve also has a significant role in promoting the innovation performance of enterprises [14], which will drive the innovation and commercialization of enterprises. In addition, the breadth and depth of customer participation also have a positive driving effect on the innovation performance of new products. Customers with a higher level of participation will attribute
their dissatisfied results to themselves due to a deeper understanding of the service (Silpakit & Fisk, 1985).

Based on the above arguments, we propose the following hypothesis.

H4: Customer Participation is positively related to Innovation Performance.

4. Methods

4.1. Sample and procedure
We tested our hypotheses with data collected mainly from college students and corporate personnel through a questionnaire survey. In this process, a total of 395 questionnaires were distributed and 378 were recovered, with a recovery rate of 95.7%. Among them, 330 were valid and the pass rate was 87.3%. The respondents were 45.4% male, 54.6% were female, and 65.9% were college students. The average monthly income of 34.7% is 1000-3000 yuan, and the age of online shopping is 38.7% for 2-4 years.

4.2. Measures
The measurement tools used in this research are mainly revised by drawing on the scale of domestic and foreign researchers. According to the actual situation of online shopping, the authoritative scale is revised and adjusted, and the final questionnaire is formed.

4.2.1. Online review. The professionalism draws on the research of Bansal& Voyer (2000) and we design a total of 5 questions, an example item is “The reviewers are familiar with the product”. Using the research of Brown et al. (2007) and Gerard Prendergast et al. (2010), homogeneity was measured by designing five questions, such as “the person who comment and I share common values”. The relationship strength is measured with reference to the research of Bansal& Voyer (2000), and it is measured by four questions, such as “I often get information from people who comment”.

4.2.2. Customer participation. Based on the research of Ennew and Binks(1999), we uses information sharing, responsible behavior and interpersonal interaction to measure customer participation. The information sharing is measured with 5 questions, such as “I will provide information about my needs and preferences to enterprises”. And the responsible behavior is measured with 5 questions, such as “I am willing to maintain a good cooperative relationship with the enterprise”. Finally, there is interpersonal interaction, which is measured by five questions, such as “I consider problems from the standpoint of the enterprise” and “I trust the staff of the enterprise”.

4.2.3. Innovation performance. Based on the mature scale of Rindfleisch & Moorman (2001), we design five questions to measure innovation performance. Sample items of this scale included “the company that I purchased the product continues to launch new products” and so on.

4.3. Reliability and Validity
The Cronbach’s alpha for the whole scale is 0.941, which proves that the scale has good internal consistency. Among them, the KMO and Bartlett test results of online reviews show that the KMO value is 0.91, indicating that the sample is high in adequacy and suitable for factor analysis; the significance probability of the Bartlett spherical test is 0.000, indicating that the data can be factor analyzed. The results of factor analysis showed that the online review variable could be aggregated into three dimensions, and there was no multiple load in each variable. The load value of each factor was greater than 0.5, and the cumulative variance interpretation percentage reached 66.78%, indicating that the online review scale has good structural validity. Similarly, exploratory factor analysis (EFA) of customer participation and online review is representative.

At the same time, the confirmatory factor analysis (CFA) of latent variables was carried out. The results showed that the fitting index of the measurement model was shown in Table 1, and all the
values were within the acceptable range, indicating that the measurement model has a good degree of fitting with the data and has good convergence validity. In addition, based on the evaluation of the overall measurement model of seven variables, this paper tests the convergence validity and discriminant validity of the measurement items of the research model. The results are shown in Table 2. Each evaluation index verified the fitting superiority and conciseness of the overall measurement model. The AVE of each variable was greater than 0.5, indicating that the convergence validity of the measurement is good. The square root of each variable AVE was greater than the correlation coefficient between the variable and other variables, indicating that the discriminant validity was good. Therefore, this measurement has good convergence validity and discriminant validity.

### Table 1. Fitting index of confirmatory factor analysis model.

| Latent Variable          | CMIN | DF  | CMIN/DF | SRMR | GFI   | AGFI  | NFI   | IFI   | TLI   | CFI   | RMSEA |
|--------------------------|------|-----|---------|------|-------|-------|-------|-------|-------|-------|-------|
| Professionalism          | 6.195| 5   | 1.239   | .0162| .993  | .978  | .991  | .998  | .996  | .998  | .0263 |
| Homogeneity              | 12.754| 5   | 2.551   | .0199| .986  | .959  | .986  | .991  | .982  | .991  | .0673 |
| Relationship Strength    | 5.107| 2   | 2.553   | .0154| .993  | .964  | .992  | .995  | .985  | .995  | .0673 |
| Online Review            | 79.961| 74  | 1.081   | .0277| .970  | .957  | .967  | .997  | .997  | .997  | .0153 |
| Information Sharing      | 10.671| 5   | 2.134   | .0193| .988  | .964  | .986  | .993  | .985  | .993  | .0573 |
| Responsible Behavior     | 7.217| 5   | 1.443   | .0147| .992  | .976  | .992  | .998  | .995  | .998  | .0363 |
| Interpersonal Interaction| 12.592| 5   | 2.518   | .0214| .986  | .958  | .983  | .990  | .980  | .990  | .0663 |
| Innovation Performance   | 13.375| 5   | 2.675   | .0175| .985  | .955  | .987  | .992  | .984  | .992  | .0703 |

### Table 2. Evaluation results of overall measurement model.

|                  | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|------------------|---|---|---|---|---|---|---|
| Professionalism  |   |   |   |   |   |   | 1 |
| Homogeneity      | .496**| 1 |
| Relationship Strength | .451**| .476**| 1 |
| Information Sharing | .452**| .455**| .497**| 1 |
| Responsible Behavior | .480**| .468**| .446**| .386**| 1 |
| Interpersonal Interaction | .439**| .458**| .461**| .338**| .382**| 1 |
| Innovation Performance | .358**| .346**| .331**| .386**| .456**| .407**| 1 |
| Mean             | 4.01| 4.24| 4.26| 4.23| 4.49| 4.40| 4.21 |
| Standard Deviation | 1.389| 1.456| 1.441| 1.644| 1.72| 1.674| 1.693 |
| CR               | .8473| .8826| .8605| .8687| .8865| .8644| .9030 |
| AVE              | .5280| .6026| .6070| .5716| .6110| .5614| .6513 |

**Note:** **, p<0.01, bold boldface value is square root of AVE

5. **Analytical strategy**

In this paper, we use AMOS23.0 to study the relationship between latent variables and get the following figure 2. The results show that GFI, AGFI, NFI, TLI, IFI and CFI all reach the standards of more than 0.9, SRMR is less than 0.08, RMSEA is less than 0.05, and each fitting index accords with the general research standard, so it can be considered that the model has a good fit.
Next, this study uses the method of Bootstrapping to verify the intermediary effect. The research shows that if the bootstrap confidence interval does not contain 0, then the corresponding indirect, direct or total effects exist. Using the Bootstrap method to run 5000 times in AMOS23.0 to get the horizontal values of Bias-Corrected and Percentile at 95% confidence (as shown in Table 3). It can be seen from the table that, Professionalism-Information Sharing-Innovation Performance indirect effect, Professionalism-Responsibility Behavior -Innovation Performance indirect effect, Professionalism-Interpersonal Interaction-Innovation Performance indirect effect, Homogeneity-Information Sharing-Innovation Performance indirect effect, Homogeneity-Responsibility Behavior-Innovation Performance indirect effect, Homogeneity-Interpersonal Interaction-Innovation Performance indirect effect, Relationship Strength-Information Sharing-Innovation Performance indirect effect, Relationship Strength-Responsibility Behavior-Innovation Performance indirect effect and Relationship Strength-Interpersonal Interaction-Innovation Performance indirect effect are all $\geq 0.05$, which does not include 0 in the value range of Lower and Upper of Bias-Corrected and Percentile95%CI, indicating the existence of indirect effect, and assuming that the mediating role of H4 customer participation is verified.

![Figure 2. Analysis diagram of structural equation model.](image)

**Table 3. Indirect Effect.**

| Standardization Effect Size | Bias-Corrected Lower | Bias-Corrected Upper | Percentile Lower | Percentile Upper |
|-----------------------------|----------------------|----------------------|------------------|------------------|
| Professionalism-Information Sharing-Innovation Performance indirect effect | 0.05 | 0.022 | 0.093 | 0.018 | 0.087 |
| Professionalism-Responsibility Behavior -Innovation Performance indirect effect | 0.097 | 0.054 | 0.155 | 0.051 | 0.148 |
| Professionalism-Interpersonal Interaction-Innovation Performance indirect effect | 0.061 | 0.022 | 0.12 | 0.019 | 0.115 |
| Homogeneity-Information Sharing-Innovation Performance indirect effect | 0.039 | 0.015 | 0.078 | 0.013 | 0.074 |
| Homogeneity-Responsibility Behavior-Innovation Performance indirect effect | 0.066 | 0.029 | 0.127 | 0.025 | 0.119 |
| Homogeneity-Interpersonal Interaction-Innovation Performance indirect effect | 0.054 | 0.017 | 0.107 | 0.014 | 0.102 |
| Relationship Strength-Information Sharing-Innovation Performance indirect effect | 0.071 | 0.03 | 0.138 | 0.027 | 0.132 |
| Relationship Strength-Responsibility Behavior-Innovation Performance indirect effect | 0.071 | 0.027 | 0.143 | 0.024 | 0.138 |
| Relationship Strength-Interpersonal Interaction-Innovation Performance indirect effect | 0.072 | 0.028 | 0.139 | 0.026 | 0.133 |
Finally, we take the three dimensions of online reviews as independent variables and the three dimensions of customer participation as dependent variables for regression analysis. Professionalism, homogeneity and relationship strength have a positive impact on the three dimensions of customer participation. The regression coefficients are: 0.241, 0.19, 0.34, 0.311, 0.213, 0.229, 0.242, 0.213 and 0.286, all of which are significant at the 0.001 level. It is assumed that hypothesis 1, hypothesis 2 and hypothesis 3 are all verified. At the same time, we take the three dimensions of customer participation as independent variables and innovation performance as dependent variables for regression analysis. The results show that information sharing, responsibility behavior and interpersonal interaction have a positive impact on innovation performance. The regression coefficients are: 0.208, 0.311 and 0.252, and the hypothesis 4 is verified.

6. Discussion
In this paper, through literature review and empirical research, hypothesis 1, hypothesis 2, hypothesis 3, hypothesis 4 have been verified. We believe that online reviews can have a positive impact on the willingness of customers to participate, thus improving the innovation performance of enterprises. In other words, online review has a significant positive impact on the innovation performance of enterprises, in which customer participation plays an intermediary role.

In terms of theoretical significance, this paper constructs and empirically tests the conceptualization model of online review on enterprise innovation performance, explores the internal law of online review practice in the context of online shopping, and deeply reveals the essence of online review and the mechanism that drive the improvement of enterprise innovation performance. In addition, in terms of management practice, this paper makes online review searchers have a deep understanding and cognition of its mechanism, and then make more rational and reasonable product purchase decisions and behaviors. At the same time, through the feedback information of customers’ online reviews, enterprises can capture the key points in time, find their own problems and shortcomings, respond to customer expectations through positive improvement, and actively and effectively interact with customers, so as to improve the innovation performance of enterprises and obtain more economic benefits.

Due to the limitations of research conditions, there are some limitations in this paper. For example, different types of products purchased by the respondents lead to differences in their perceptions and experiences of online reviews in the online shopping context, and the respondents have a specific understanding of online reviews, all of which have a certain impact on the integrity of the research conclusions. In the future research, we can use the experimental method to improve the respondents' perception and understanding of the product review information by setting specific product types, thereby improving the integrity and accuracy of the research.

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