

The impact of user innovation activity on entrepreneurial opportunity identification in online community

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Abstract: *From the perspective of user innovation in online communities, through data mining and text mining of online communities, the influence process of user innovation activity on the identification of entrepreneurial opportunities, as well as the moderating role of user collectivity, emotion and social capital in the influence process, is explored. The results show that in online communities, user innovation activity has a positive impact on the identification of entrepreneurial opportunities. User collectivity plays a positive moderating role in the impact of user innovation activity on the identification of entrepreneurial opportunities. User dissatisfaction and satisfaction do not play a moderating role. The social capital owned by users plays a negative moderating role.*

Keywords: *User innovation activity; Entrepreneurial opportunity recognitions; Entrepreneurial opportunity recognition; User collectivity; User emotion; Social capital*

1. Introduction

Due to the trend of diversification of user needs, enterprises are unable to fully meet user needs by internal innovation alone, more and more enterprises open their borders and absorb innovations from the outside.^[1-2] In external innovation, user innovation plays an important role in the development of new products. Enterprises can establish online communities to obtain user needs and innovation, such as Lego, Dell and other enterprises.^[3-4]

Some cases further show that there are some user innovators who finally realize user entrepreneurship through identification and development of entrepreneurial opportunities based on market demand and information asymmetry.^[5] Meanwhile, the case of Lego shows that user innovation not only enables enterprises to absorb innovations and obtain high profits for their products, but also enables many users to rely on Lego products to start businesses and form a good collaboration ecosystem.^[3]

Compared with the universality of user innovation, the ratio of user entrepreneurship is relatively low, which requires further support and incentives from enterprises. However, at present, there are few studies on the transformation from user innovation to entrepreneurship, especially the key process of user entrepreneurial opportunity identification. Thus, the support of previous studies is not sufficient. We use the data and text mining methods to explore the transformation process of user innovation to entrepreneurial opportunity identification which relies on user data in online brand communities.

At the same time, the previous researches show that the process from user innovation to entrepreneurial opportunity identification will be affected by user characteristics, experience and user community factors.^[6-7] But few previous studies have selected the collectivity of users in the community, the user emotion brought by user experience and the social capital owned by users in the community as moderators from the perspective of user innovation. To sum up, the above-mentioned factors are selected to study their moderating role in the process of the impact of user innovation activity on the identification of entrepreneurial opportunities.

2. Literature Review

2.1. *User innovation and entrepreneurial opportunity identification*

User innovation was first proposed by von Hippel, who believes that user innovators are the relevant subjects who can express their views on products and participate in product innovation.^[8] User innovation is highly active in many fields. One tenth of outdoor sports users have created product prototypes, meanwhile 85% of bank services have been used by users before the commercialization of banks, so user innovation activity is selected to study.^[9-10] Besides, as the brand-centered online community is an important external source for enterprises to directly absorb user innovation, it can gather a lot of user innovations, which is suitable for the research on the transformation from user innovation to entrepreneurship. Thus, this type of community is selected to research.

The transformation from user innovation to entrepreneurship is based on the five-stage theory of user entrepreneurship, which points out that there are some members of user innovators who share innovation through online communities or get feedback, that lets them find the market potential corresponding to innovation and identify the entrepreneurial opportunities, which promotes them to develop opportunities and finally find business.^[5] The entrepreneurial opportunity is the possibility that entrepreneurs can meet the potential needs of the market by integrating resources to achieve the purpose of enterprise growth.^[11] Whether entrepreneurship will occur depends on the degree of discovery and utilization of entrepreneurial opportunities. Entrepreneurial opportunity identification is an ability of entrepreneurs, which helps people to realize the commercialization of opportunities and achieve the purpose of increasing income or value.^[12]

2.2. *User characteristic and experience*

Entrepreneur characteristics are the stable characteristics of entrepreneurs, among which there are more studies on the user's fulfillment and confidence, showing that most of the research on user entrepreneurship is merely from the perspective of entrepreneurship.^[13-14] However, according to the five-stage theory, the transformation from user innovation to entrepreneurship can be studied more from the perspective of user innovation. Hence, user collectivity is selected as the user characteristic, which refers to the collective intention of users to participate in the community, specifically the intention that individuals belong to the collective and are willing to participate in collective activities.^[15] Both in user innovation and entrepreneurship, participating in the community is necessary. User innovation needs the help and knowledge sharing of other users in the community, while user entrepreneurship needs the feedback and collective creativity of users in the community.^[5] There are few studies on the moderating role of user's collective characteristics in user innovation and opportunity recognition, so user collectivity is selected to research.

User experience is able to help entrepreneurs to understand users' needs and behavioral tendencies. User emotion is obtained through user experience, which is defined as the emotional attitude of users to the product and community expressed in the community, that includes user dissatisfaction and satisfaction. User dissatisfaction comes from the characteristics of lead users, who are at the forefront of market trends and thus are more likely to find entrepreneurial opportunities with market potential.^[16-17] If users are satisfied with products, they seldom want innovative products and are not at the forefront of the market, which may make it difficult to identify entrepreneurial opportunities.^[8] Above all, user dissatisfaction and satisfaction are selected for research.

2.3. *Social capital theory*

Social capital is a collection of actual and potential resources embedded in the relationship network owned by individuals or social units.^[18] According to Nahapiet and Ghoshal's division of the concept of social capital, social capital is divided into three clusters: structure, cognition and relation.^[19] The structural dimension is the connection mode between individuals. In the community, users are willing to connect with each other in the network, providing channels for users to obtain exclusive information and knowledge, so the interactive relationship between users is selected to represent the structural dimension.^[20] The cognitive dimension is the resource that enhances commonality between users. The same interests and concerns between users can be represented as the common language which is formed between user and chosen to represent the cognitive dimension.^[18] The relational dimension is the way to maintain the relationship between individuals, especially the trust relationship is important in the community, which can promote the interaction between users and increase the recognition of the

information shared in the community.^[21-22] As a result, the trust is chosen to express the relationship dimension. The social capital that users have in the community is the collection of the above three dimensions.

3. Research hypothesis

On the basis of previous studies, the user collectivity, the user emotion, as well as the combination of interaction relationship, common language and trust among users in the community which represent the social capital are used to verify how user innovation activity affects the identification of entrepreneurial opportunities in online brand communities.

3.1. The impact of user innovation activity on entrepreneurial opportunity identification

Because the existing products or services on the market cannot meet the individual needs of users, some of who will invest in costs, innovate products or services, which provides solutions to meet their own needs.^[23] If the user's innovation activity is higher, the suggestions or prototypes users put forward and share in the community will be more innovative, which are more officially adopted by other users or enterprises in the community, indicating the more innovative users are, the higher consistency between their innovations and the market demand.^[24] Thus, it will be easier for innovative users to find entrepreneurial opportunities. Furthermore, users with higher innovation activity have more professional knowledge and product-related experience, which is beneficial to the conviction, recognition and adoption of other users, implying that the needs of active user innovators also represent the needs of many other users and the broader market, that ultimately makes it easier for user innovators to find new markets and thus to identify business opportunities.^{[4][25]} In addition, the reaction of other users to user innovation helps active user innovators to perceive the development trend and scale of the future market, which strengthens the vigilance of user innovators on entrepreneurial opportunities, thus improving the possibility of identifying entrepreneurial opportunities.^[26] To sum up, the higher the user innovation activity, the easier it is to identify entrepreneurial opportunities. Above all, the following hypothesis is proposed:

H1 In online communities, user innovation activity has a positive impact on entrepreneurial opportunity identification.

3.2. Moderator of user collectivity

Active user innovators' recognition of entrepreneurial opportunities will be affected by their collectivity. Users with high innovation activity will carry out more innovation activities and generate more innovative prototypes or suggestions. Users with collectivity will think that they belong to this community and are willing to be responsible for a certain event with other users.^[27] Hence, active user innovators will share and exchange their knowledge or innovation with other users in the community, while interacting with other users in the community through informal or semi-formal communication channels, which allows user innovators to obtain direct feedback information about innovation unique to other users from the community, that boosts information asymmetry with external manufacturers to be formed.^[5] Consequently, users realize the advantages in information, find the market demand behind innovation, and accurately identify entrepreneurial opportunities.^[6] Besides, a strong sense of collectivity is able to accelerate active user innovators to contact between users and increase trust among users by sharing knowledge and innovation in the community. In this way, better information feedback and analysis quality are obtained and the information advantage of users is further expanded, so identifying entrepreneurial opportunities become easier.^[28] Beyond above points, due to a higher collective awareness, active user innovators frequently participate in collective activities, which helps them to get collective creativity in the community. The innovation achieved includes collective wisdom and needs, so as to realize greater breakthroughs in the market.^[5] Above all, the following hypothesis is proposed:

H2 In online communities, user collectivity plays a positive moderating role in the impact of user innovation activity on entrepreneurial opportunity identification.

3.3. Moderator of user emotion

Active user innovators' recognition of entrepreneurial opportunities will also be affected by their

emotions. To identify entrepreneurial opportunities, user innovators should first discover the market potential and scale behind innovation.^[6] According to the characteristics of lead users, user dissatisfaction with existing products mainly stems from their being at the forefront of the market trend, having advanced demand, which existing products not able to meet.^[16-17] Thus, dissatisfaction with existing products accelerates active user innovators to discover the potential and scale of the future market, while innovating in the light of the future market. Such innovations can not only meet their own needs, but also meet the needs of other users or even broader consumers, which finally has a broad market.^[29] This kind of user innovators is based on the market potential that has been discovered, so user dissatisfaction with existing products makes active user innovators more likely to successfully identify entrepreneurial opportunities. On the other hand, if user innovators are satisfied with existing products, they will not be at the forefront of market trends.^[8] Even if users have high enthusiasm for innovation, it is difficult for them to find the market potential and development scale behind innovation. Hence, if active user innovators are satisfied with the product, they will not increase the possibility of identifying entrepreneurial opportunities. Above all, the following hypotheses are proposed:

H3a In online communities, user dissatisfaction with existing products plays a positive moderating role in the impact of user innovation activity on entrepreneurial opportunity identification.

H3b In online communities, user satisfaction with existing products has no moderating effect on the impact of user innovation activity on entrepreneurial opportunity identification.

3.4. Moderator of user social capital

Finally, the identification of entrepreneurial opportunities for active user innovators will also be affected by the social capital that users have in the community. In the process from user innovation to user entrepreneurship identification, users will interact with other users in the community, where many advantages can be obtained, including first-hand user needs, preferences and collectivity, which help users' innovative suggestions or prototypes more to meet market needs and find market prospects, finally promoting user innovators to successfully identify entrepreneurial opportunities.^[6]

Social capital is divided into three dimensions: interaction, common language and trust between users. First, stronger interaction between users accelerates the sharing of knowledge and innovation among users in the community,^[30] which creates good conditions for active user innovators to obtain first-hand user needs and preferences, that allows them to maintain greater information advantages compared with enterprises or individuals outside the community, ultimately realizing the identification of entrepreneurial opportunities. Secondly, the common language of users in the community means that users are also faced with more similar goals, leading to mutual cooperation and joint efforts among users, which further trigger the collective creativity of users in the community, realize the reconstructive reflection and reinforcement of innovation among users, enhance the awareness of active user innovators on market demand and successfully identify entrepreneurial opportunities.^[7] At last but not least, the trust relationship between users in the community creates a relaxed and free atmosphere for the community, whose low levels and control power boost the flow of information compared with other enterprises.^[5] The innovation suggestions or prototypes shared by active user innovators are supplemented in the flow of local information between users,^[31] which better tests the user innovative products, benefits to obtain first-hand user feedback and increases collective creativity, that help to explore the possibility of marketization and commercialization of the product and ultimately realize the identification of user entrepreneurial opportunities. Therefore, the following hypothesis is proposed:

H4 In online communities, the social capital owned by users plays a positive moderating role in the impact of user innovation activity on the identification of entrepreneurial opportunities.

Based on the hypothesis H1-H4, the theoretical model is constructed, as shown in Figure 1:

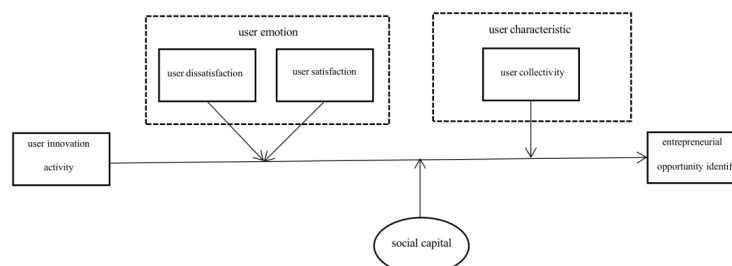


Figure 1: Theoretical model.

4. Research method

4.1. Sample selection and data collection

The MIUI comprehensive discussion circle is the user innovative community of MIUI, the Xiaomi mobile phone operating system, which has over 5 million users and 1200 MIUI developers in the community, where users exchange product experience with developers and innovate together, that indicates MIUI comprehensive discussion circle has rich data resources. Seven days in 2022 are randomly selected, and then the specific digital codes of a total of 361 active users in the seven days are collected. According to the digital code, the data of these active users can be crawled through the Selenium installed in the Pycharm integrated environment, including the content of the users' posts in the community and the number of users' circles, followers, fans, likes, etc.

4.2. Variables measurement

User collectivity and emotion measurement. The words and language styles selected by users who participate in the community in the published posts express their behavior, personality and spirit.^[32] Thus, users' collective language style and emotional language style are selected to measure user collectivity and emotion respectively. Specifically, first, for the content of user posts after Chinese word segmentation, the stopword thesaurus is used to delete the invalid words in the word segmentation. Secondly, the words that represent the meaning of user collectivity should be selected from the effective words to form a dictionary to measure user collectivity. Meanwhile, for user emotion measurement, referring to the method of rapid identification of lead user, the online post content is measured by using the emotion dictionary published on the Internet. Hence, we use the emotional vocabulary ontology database of Dalian University of Technology, from which different categories of words are selected to build the dictionary of dissatisfaction and satisfaction respectively.^[17] Finally, according to the dictionary of each variable, term frequency-inverse document frequency is adopted to measure the collectivity and emotion in the content of user posts.

Social capital measurement. The interaction is expressed by the number of users' circles, followers and fans, while the number of users' praise and questions partly shows the common language and the trust relationship.^[33-34] The collection of these indicators shows the social capital that users have in the community.

User innovation activity measurement. We count the number of innovative suggestions which are published by users in the community.

The measurement of user entrepreneurship opportunities identification. According to the innovative scale of entrepreneurial opportunities, on the basis of listening to the suggestions of experts and relevant users, we will conduct a subjective evaluation of all the content of each user's posts in the community. If the content of each user's post meets any of the four items in the scale, including the uniqueness of the product or service, the low competitive pressure faced by the market, the novelty compared with the existing service or product, and facing the emerging market, it will be determined as the entrepreneurial opportunity identified by the user.^[35] Each opportunity identified will be scored 1 point, while the multiple opportunities identified will be added up. If the entrepreneurial opportunity is not identified, it will be scored as 0. Above all, the score of each user's entrepreneurial opportunity identification indicates their ability to identify entrepreneurial opportunities.

Control variable measurement. The more theme posts users contribute in the community, the more feedback users may get in the community, which makes it easier to identify entrepreneurial opportunities. Therefore, the number of theme posts users contribute is selected as the control variable.

5. Research result

The average value, standard deviation and correlation coefficient of all variables are showed in Table 1. The correlation coefficient of most variables is not more than 0.7. At the same time, according to the VIF test, the mean value is 2.216, the maximum value is 4.338, which is less than 5, indicating that the multicollinearity between variables is not serious. Multivariate regression analysis of user entrepreneurship opportunity identification is shown in Table 2. In the test of moderating utility, there are multiple collinearity between the interaction term and the independent variable and the control variable, meanwhile the unit among the variables is not the same. Therefore, the independent and

moderating variables are centralized, while the min-max method is used for standardization to eliminate the unit effect. Then the variables are multiplied to get the interaction item. However, there is still a multicollinearity problem between the interaction items. So according to the past practice of the academic community, the interaction items are put into the main effect model one by one for test.^[36]

Table 1: Correlation analysis

Variables	Collectivity	Dissatisfaction	Satisfaction	Social capital	Innovation	Contribution	Opportunity
Collectivity	1.000						
Dissatisfaction	0.226	1.000					
Satisfaction	0.347	0.396	1.000				
Social capital	0.411	0.322	0.407	1.000			
Innovation	0.531	0.210	0.314	0.559	1.000		
Contribution	0.563	0.402	0.497	0.698	0.728	1.000	
Opportunity	0.468	0.127	0.242	0.322	0.744	0.479	1.000

Model 1 is a regression model with only control variables. It can be found that the number of theme posts contributed by users has a significantly positive impact on the identification of entrepreneurial opportunities ($B=0.328$, $p<0.001$). According to model 2, adding user innovation activity on the basis of control variables, the explanatory power of the model is significantly increased. There is a positive relationship between user innovation activity and entrepreneurial opportunity identification ($B=0.864$, $p<0.001$), which indicates that the more users' innovations, the more entrepreneurial opportunities identified. Hypothesis 1 is confirmed. Model 3 is a main effect model based on independent variables and control variables, adding all moderating variables.

It can be seen from model 4 that adding the interaction items of user innovation activity and user collectivity into the main effect model, the explanatory power of model 4 is significantly higher than that of model 3, indicating that user collectivity positively moderates the relationship between user innovation activity and entrepreneurial opportunity identification ($B=0.909$, $p<0.001$), which proves hypothesis 2 is valid. According to model 5, the interaction items of user innovation activity and user dissatisfaction are added into the main effect model, which implies the explanatory power of model 5 is not improved compared with model 3. User dissatisfaction does not play a moderating role in the relationship between user innovation activity and entrepreneurial opportunity recognition, which proves that H3a is not valid. Further exploration of the community found that many users' dissatisfaction is not because they are in the forefront of the market, but they are dissatisfied with the changes or errors of some necessary functions, that is a feedback or complaint about the emotional nature of products, which has nothing to do with the identification of users' innovation and entrepreneurship. The existence of this dissatisfaction explains why the dissatisfaction of users does not play a moderating role. According to model 6, the interaction items of user innovation activity and user satisfaction are added into the main effect model, which indicates that the explanatory power of model 6 is not significantly improved compared with model 3. User satisfaction does not play a moderating role in the relationship between user innovation activity and entrepreneurial opportunity recognition, which shows that H3b is valid.

Table 2: Regression analysis results.

	M1	M2	M3	M4	M5	M6	M7
Number of contributions	0.328***	-0.091**	-0.098**	-0.041	-0.101*	-0.096*	-0.121**
Innovation activity		0.864***	0.845***	0.160	0.827***	0.526***	1.076***
Collectivity			0.079***	0.050*	0.080***	0.0821***	0.068**
Dissatisfaction			-0.002	0.011	-0.005	0.002	-0.012
Satisfaction			0.029	0.040	0.030	0.014	0.018
Social capital			-0.084*	-0.071*	-0.085*	-0.093**	-0.012
Innovation activity*collectivity				0.909***			
Innovation activity*dissatisfaction					0.085		
Innovation activity*satisfaction						0.761	
Innovation activity*social capital							-0.470***
R ²	0.230	0.563	0.585	0.616	0.585	0.589	0.606
Adj-R ²	0.227	0.560	0.578	0.610	0.577	0.581	0.535

Note: * indicates $P<0.05$, ** indicates $P<0.01$, and *** indicates $P<0.001$.

According to model 7, the interaction between user innovation activity and social capital owned by users is added into the main effect model, which implies that the explanatory power of model 7 is significantly lower than that of model 3. User social capital negatively moderates the relationship

between user innovation activity and entrepreneurial opportunity identification ($B=-0.470$, $p<0.001$), which indicates hypothesis 4 is not tenable. We deeply explore the community and find that some users in the community have a lot of social capital and innovations, but their social capital does not allow them to identify more entrepreneurial opportunities, whose innovation is more imitation or entirely out of their own experience, rather than market competitiveness. At the same time, a considerable number of users do not have a lot of social capital and innovation activity is not high, who have identified entrepreneurial opportunities. The existence of these two types of users explains the negative moderating role of social capital in the relationship between user innovation activity and entrepreneurial opportunity identification.

6. Conclusion and discussion

6.1. Research conclusion

Through data and text mining of online communities, this paper studies the relationship between user innovation activity and entrepreneurial opportunity identification, meanwhile discussing the moderating role of user collectivity, emotions and social capital. The specific research conclusions are as follows: First, in online communities, user innovation activity has a positive impact on entrepreneurial opportunity identification. Second, user collectivity plays a positive role in moderating the impact of user innovation activity on entrepreneurial opportunity identification. Third, in online communities, user dissatisfaction and satisfaction do not play a moderating role in the impact of user innovation activity on the identification of entrepreneurial opportunities, which indicates that user emotions in the community are dispersed by other content rather than related to innovation, squeezing users' innovation space. Fourth, in online communities, the social capital owned by users in the community plays a negative moderating role in the impact of user innovation activity on the identification of entrepreneurial opportunities, that shows in the community, the users possess the small number of innovation and the social capita, but can identify entrepreneurial opportunities. At the same time, it is also found that in the community, there are many active users who have a lot of social capital and many innovations, but are difficult to identify entrepreneurial opportunities, while the existence of them improve communication in the community and enlivens the atmosphere in the community.

6.2. Management inspiration

First of all, enterprises should encourage users in online communities to actively participate in product or service innovation. The more innovations, the more opportunities to identify entrepreneurship will be, which allows enterprises to find more opportunities to start a business again, fundamentally improves the competitiveness of enterprise products or services and also guides users to start a business. The establishment of enterprises can be invested or supported by enterprises, forming an enterprise ecosystem, which becomes an important advantage that competitors cannot duplicate.

Secondly, enterprises can firstly test the imperfect system in the enterprise and advance the preparation time of the new system, leaving sufficient time for the release of the system, that prevents some system errors from being widely discussed in the community through the internal or public beta, which will compress the innovation space of users in the community and focus users' attention on content unrelated to innovation. At the same time, enterprises conduct the internal or public test in the community, which also reduce the scope of participation of personnel and limit the conditions of participants. Too much participation of personnel will lead to more feedback information accepted by the community, which may cause the information explosion, letting the community unable to deal with better innovative suggestions or innovative entrepreneurial opportunities which may be put forward by other users.

Third, enterprises need to cultivate the collectivity of user innovators in the community. Users who have participated frequently but stopped recently, or have made sincere or useful suggestions but have not responded or adopted in time can be directly invited to participate in the internal or public beta according to the user data in the past, which increases their collective awareness of the community and help user innovators better identify entrepreneurial opportunities.

Finally, for those users who have little social capital and innovation, but have market sensitivity and identify entrepreneurial opportunities, enterprises should to further encourage them to actively participate in community activities. They may be less involved in community activities due to time or other reasons, so this kind of people need the community to seize the opportunity to respond positively

when they put forward suggestions or invite them to increase their sense of belonging to the community, which let them think more about market prospects and entrepreneurial opportunities from the perspective of enterprise development. For those users who have high enthusiasm for innovation and a lot of social capital, but can't identify entrepreneurial opportunities, they also need to be closely contacted by enterprises to jointly create valuable topics, which helps businesses to create a good innovation and entrepreneurship atmosphere.

6.3. Limitation and prospect

Although some research results have been achieved, there are still limitations: first, the user data contained in social capital in online communities is not rich enough. In the future, researchers can further search for online communities with rich data and content information to better represent social capital. Secondly, the identification of entrepreneurial opportunities also requires manual evaluation, which is inefficient, greatly limiting the identification of users who propose entrepreneurial opportunities. In the future, researchers should promote the further integration of business management and artificial intelligence, which includes establishing a dictionary database related to the future development trend and updating it dynamically over time, so that enterprises can find users who are able to identify entrepreneurial opportunities more efficiently and implement the entrepreneurial opportunities proposed by users, which can further ensure that the massive data in the online community is fully utilized and provide a basis for the research and development of user entrepreneurship.

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