

User Collective Innovation and Entrepreneurship Based on Community Network Embeddedness

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Abstract: *In this article, we investigate the influence of user community network embeddedness on collective innovation and entrepreneurship. The network embeddedness of user communities plays a crucial role in the entire process of users moving from innovation to entrepreneurship, and provides numerous benefits to users in collective innovation and entrepreneurship endeavors. Within an embedded user community, members have opportunities to share, communicate, collaborate, and provide feedback, which are all instrumental in motivating users, refining existing ideas, and testing prototypes. Additionally, this research also identifies the drawbacks associated with collective innovation and entrepreneurship in user communities, and recommends pertinent coping strategies.*

Keywords: *User Entrepreneurship; User Innovation; Network Embeddedness; Collective Creativity; User Community*

1. Introduction

Since von Hippel's groundbreaking discovery that users can serve as a primary source of innovation, numerous studies on user innovation and entrepreneurship have proliferated, leading to significant advancements in the field^[1]. In particular, the concept of collectivity has emerged as a critical theme in discussions around user innovation and entrepreneurship, with a key focus on exploring the potential of embedded user community networks to foster collective innovation and entrepreneurship among users. As such, research on collective user innovation and entrepreneurship holds immense value for further advancing our understanding of this dynamic field.

Innovation is a key driver of an industry's future and innovative users and user communities play a crucial role in shaping it. With a vast pool of users participating in innovation communities, ideas can be generated, improved, shared, and evaluated which often results in collective innovation. As a consequence, these innovations are often commercialized, leading to the emergence of new user-driven ventures based on cost-effective production technologies and innovative prototypes.

The impact of the user community is far-reaching, ranging from innovation communication to entrepreneurial development and business performance. Therefore, it can be concluded that embedded user communities have a profound positive effect on the growth and evolution of an industry.

2. User Community Network Embeddedness

2.1 User community

Accordingly, the user community is not simply a collection of disconnected individuals, but rather a dynamic network of interpersonal relationships that fulfills a range of needs, including access to information, emotional support, social interaction, shared identity, and a sense of shared purpose^[1]. Engaging in these relationships often involves direct communication and the exchange of ideas, information, and resources among individual users, as depicted in Figure 1 and emphasized by scholars such as Brown and Duguid^[2]. Moreover, the community itself embodies a distinctive social structure that fosters cooperative and sharing behavior among its members, rather than relying solely on one-to-one interactions^[3].

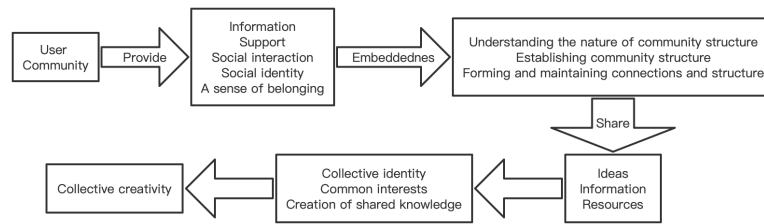


Figure 1: User community network embeddedness and collective creativity

2.2 Collective creativity

According to Jarrett^[4], the formation of collective identity, common interests, and the creation of shared knowledge play a vital role in encouraging individuals to engage in problem-solving and collaborative creativity in a community setting, as demonstrated in Figure 1. Typically, community members seek assistance from others while tackling shared issues, and are collaborated with, or provide assistance themselves.

Cuomo et al. underscore the significance of community awareness, which extends beyond the rational assets of information and knowledge to include the emotional assets of participation and trust^[5]. By fostering entrepreneurial motivation, the community also engenders the development of knowledge, both at the individual and collective level. The resulting pool of knowledge is conducive to innovation, which is subsequently evaluated against the community's standards.

2.3 Community Network Embeddedness

The notion of embeddedness is comprised of two fundamental features. The first one underscores the fact that economic institutions, such as commercial enterprises, are deeply ingrained in interpersonal networks and broader social structures. The second feature highlights that these social connections constitute an uninterrupted framework, which has its own historical context. In essence, embeddedness denotes that both the organization and the network it forms are co-constructed by societal forces and historical forces^[6]. Community Network Embeddedness includes a range of activities, such as comprehending the essence of community structure, building or reviving this structure to forge fresh ties, and maintaining connections and structure consistently over time^[7], as illustrated in Figure 1.

3. User Collective Innovation Based on User Community Network Embeddedness

3.1 The important role of users in innovation

3.1.1 Users play a leading role in innovation

According to von Hippel^[1], the role of the user in the innovation process has evolved from being merely an assistant or producer to that of a major source of innovation. This phenomenon, known as user innovation, is often a collective process that takes place within the social context of an embedded community^[8], as illustrated in Figure 2.

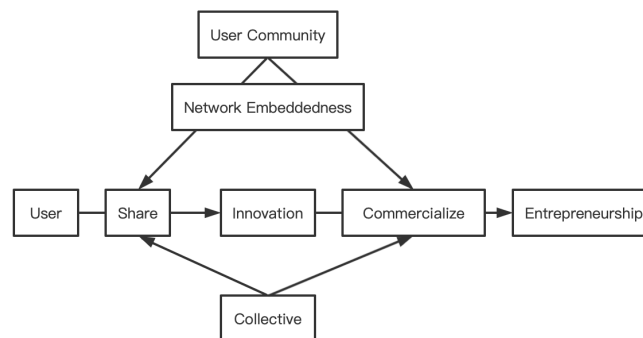


Figure 2: User Collective Innovation and Entrepreneurship Based on Community Network Embeddedness

The innovation process is mainly driven by users who actively engage in developing, sharing, and disseminating innovative ideas within their communities^[9], as depicted in Figure 3. Innovative users and user communities often have a significant impact on the future organizational structure of a given industry^[10].

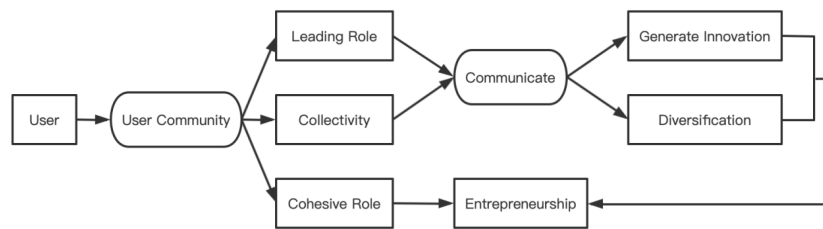


Figure 3: User Collective Innovation Based on User Community Network Embeddedness

Innovation, which is rooted within the embedded community, has greatly facilitated technological and industrial advancements across various domains. At the heart of this model resides the users, who act as the originators of new needs and engage in collaborative efforts with their peers within the innovation community. During this period, some of these innovations are even commercialized^[11].

3.1.2 Collectivity in the process of user innovation

In contemporary scholarly literature, it has been established that individuals acting as users possess the ability to not only develop but also enhance, propagate, and appraise innovations by actively engaging with the innovation community to exhibit their inventions. By partaking in this community, users are able to effectively share their inventions for other members to continue developing and refining products. In fact, a significant proportion of users create and contribute towards crucial breakthroughs within various product domains, emerging as the primary drivers of innovation^[12].

The embedded community is characterized by a user base that is dedicated to open product design, enabling users to modify the available products or services. While these communities are usually not established with the explicit aim of fostering innovation, they often perform this role effectively. The social structure inherent in such communities facilitates the acquisition of resources while encouraging resource sharing, innovation creation and dissemination. Incentive mechanisms are created within this structure, thereby promoting the development of user-driven innovation^[11], as delineated in Figure 3.

3.1.3 Users play a cohesive role in innovation and entrepreneurship

The process of entrepreneurship involves gathering feedback from potential users and subsequently adjusting their approach before establishing a formal business entity. However, within the context of a community, user entrepreneurs can play a pivotal role in advancing and disseminating innovative ideas even before the formation of enterprises, as depicted in Figure 3. Such users prioritize the advantages of community-based collaboration, such as the cultivation of trust and access to valuable information sources, while simultaneously minimizing transaction costs^[13].

3.2 Motivation of user collective innovation based on user community Network Embeddedness

3.2.1 Reasons for users to share in the community

Community members and innovators engage in collaborative discussions and ideation, sharing innovation-related insights and assistance^[14]. However, to safeguard their intellectual property, most user innovators are selective in sharing their creations with external entities. Entrusting the ownership solely to third parties, as these entities could prevent further advancements and hinder innovation from users. Therefore, the community enforces measures to safeguard user-generated innovations and guarantee their accessibility and adaptability to all^[11].

Furthermore, the level of engagement in a community is often motivated by the individual's willingness to contribute positively to the welfare of others and the ecosystem. This includes acts of collaboration, support, and adoption of sustainable practices^[15]. Additionally, consumers are inclined to respond based on the signals provided by other community members who publicly utilize their commodities, which generates a sense of market demand^[8].

3.2.2 Reasons for innovation in the embedded community

Generally, the concept of user innovation is driven by the inadequacy of the company's existing products to meet their users' needs^[1]. However, research indicates that other factors influence user

innovation in embedded communities, such as personal enjoyment^[16], skill enhancement^[17], and the desire for attaining a good reputation. Reputation, in particular, has emerged as a crucial external motivation for participating in online collaborative activities and embedded user communities^[18]. The benefits of gaining a good reputation among fellow users can foster communication and sharing within embedded user communities and open-source projects^[19].

3.3 Communication among users in the embedded community promotes innovation

3.3.1 Embedded community promotes user communication

The embedded community engages in various activities, ranging from socializing with like-minded individuals to exchanging insights on how to optimize the product's use, to disseminating valuable innovations and fostering inventiveness. Irrespective of its physical proximity or dispersal, community members extend aid, advice, and constructive criticism to one another^[8]. In certain instances, embedded communities provide users with communication and interaction tools that promote the creation and sharing of innovations as evidenced by Figure 2. A salient case is the opensource software development community^[11].

A innovation user community has the potential to broaden the range of specialized knowledge applied to a problem and facilitate the sharing of experiment-driven outcomes among its members. To foster collaboration and cohesion, several user communities cultivate group-specific norms, devise strategies to recruit additional participants, and devise tools that preserve their organizational coherence across extended periods^[8].

3.3.2 The exchange of ideas between users promotes innovation

The majority of entrepreneurs are commonly classified as "accidental" as they typically stumble upon a viable business idea while utilizing a product or service for their own needs. Consequently, these users take it upon themselves to share their newfound innovation with others. As highlighted in Figure 3, user-generated and openly shared innovations serve as the fundamental building blocks for a successful entrepreneurial venture. Furthermore, community members often acknowledge and adopt valuable innovations introduced by their peers to validate their commercial viability, often preceding the user innovator's consideration of commercializing their product^[8].

Franke and Shah suggest that users often share their inventive prototypes with other members of the community, free of charge, as a way to obtain feedback for product improvement and requirements^[14]. This feedback is iterative and can guide and inform the development of the product. Moreover, the creation of novel ideas, collectively, is an essential aspect of both user innovation and user entrepreneurship. In certain cases, community-led innovation comes from the exchange of ideas and resources among peers. In doing so, members of the community gain recognition, encourage cooperation, and promote the sharing of ideas and resources through community channels, which strengthens group identification and fosters greater collaborative efforts^[8]. This notion is represented in Figure 2.

3.3.3 Knowledge exchange among users promotes innovation and diversification

The embedded user community offers several benefits, including a vast array of feedback and opportunities for matching problems with individuals who possess innovative ideas and methods to resolve them. These community members leverage their expertise in respective fields to share solutions, solve technical issues, showcase their work, and enhance and develop technology^[14]. Given the diverse and specialized skills of the participants, the user community often excels in identifying and resolving a wide range of design problems^[11], as illustrated in Figure 3.

The user community fosters communication and interaction between members who possess diverse professional expertise^[20]. Through this exchange of ideas and knowledge, the community empowers individuals from various fields to leverage their unique skills and capabilities towards solving targeted problems^[11]. In this collaborative setting, users openly share ideas, prototypes, and resources to propel innovation, which is a regular and expected occurrence^[8].

4. User Collective Entrepreneurship Based on User Community Network Embeddedness

4.1 Embedded communities play an important role in the early stage of entrepreneurship

The phenomenon of user entrepreneurship is characterized by its suddenness and collective nature. Typically, users engage in creative activities as part of a larger community prior to the establishment of a company. These user entrepreneurs often have extensive involvement in their respective user communities, providing them with valuable feedback and information concerning commercialization in the early stages of business development. Subsequently, these individuals may leverage their embedded communities to enhance their ideas, verify initial market opportunities, or leverage the community as a cost-effective promotional channel for their products or services^[12]. These dynamics are illustrated in Figure 4.

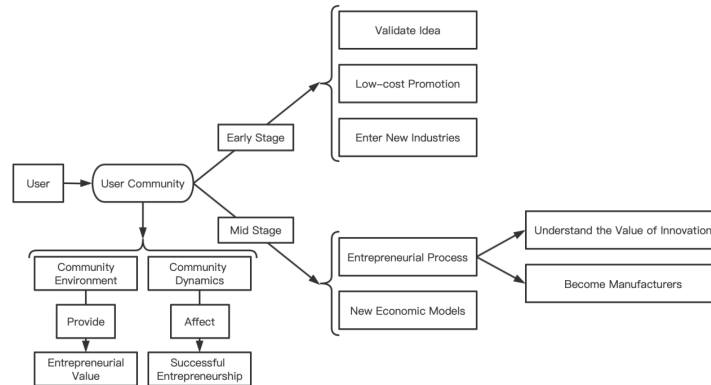


Figure 4: User Collective Entrepreneurship Based on User Community Network Embeddedness

The establishment and growth of user entrepreneurs' companies is intricately intertwined with collective social processes. These processes are characterized by problem-solving through a series of trials and errors, learning from practical experiences, and the recombination of knowledge from diverse individuals possessing varying experiences^[8]. Furthermore, user entrepreneurs are known to leverage the knowledge that exists within an embedded community to explore and penetrate new industries^[21], as highlighted in Figure 2.

4.2 Users commercialize the innovation of the embedded community

4.2.1 The process by which users commercialize innovation

Upon realizing the potential for a novel design, some exceptional users may embark upon a thorough exploration of the design space to determine the practical value of their innovative discoveries. Although the expenses of their time, effort and personal funds may outweigh the anticipated benefits of the new design, these individuals persevere in their pursuit of innovation. As the design evolves, potential buyer-users may emerge, demonstrating a keen interest in purchasing the user-generated innovative products instead of manufacturing them independently. In response to this demand, some user innovators may evolve into user manufacturers, utilizing cost-effective, low-capital methods to meet community demands and satisfy their own personal interests^[10], illustrated in Figure 4.

In light of the concreteities of business enterprises coupled with the academic science realm, accessibility and transparency are key attributes that are imbued in their respective processes. There is ample room for the genesis and scrutiny of multiple ideas, which may occur owing to independent or collaborative efforts. Within such an ecosystem, it is those individuals boasting expert knowledge in their fields that are more likely to unveil avenues for user innovation and entrepreneurship^[22]. This tenet is exemplified in Figure 2.

4.2.2 User innovators enter the market

Scholars have highlighted the significant role played by "leading users" in the creation of innovative products that possess commercial value and appeal. Such users are typically positioned at the forefront of critical market trends and leverage innovation to address their primary interests^[14]. While some user entrepreneurs are known to develop incremental product improvements for commercialization purposes, others are responsible for introducing breakthrough new products that often serve as the impetus for the creation of new industries^[12], as depicted in Figure 4.

Individuals who innovate and ultimately become user manufacturers already possess a repertoire of product and process designs. Capitalizing on their presence within the user community, user manufacturers can employ cost-saving word-of-mouth marketing strategies. Such manufacturers can make use of their innovative designs to create products within the community. Crucially, regardless of the demand for these designs and the time required to complete them, user manufacturers can turn a profit from inception^[10].

The potential for users to launch a business venture can be influenced by opportunity cost. Due to possessing an intuitive understanding of user demands and feedback, as well as having access to cooperative assistance from fellow community members, user creators possess a distinct information advantage. Additionally, manufacturers may possess supplementary resources such as brand recognition, established distribution networks, and production infrastructure^[12].

4.3 Embedded communities affect the entrepreneurial process

4.3.1 Community environment provides entrepreneurial value

Entrepreneurship involves the creation and extraction of value from the environment, and it is strongly influenced by embedded communities^[7], as depicted in Figure 2. Embedded communities contribute to the competitive advantage of entrepreneurs since community members are skilled at innovating and organizing entrepreneurial ventures, which can take advantage of evolving talents, products, and network resources^[23]. By identifying social resources, entrepreneurs can create robust organizations^[24], yet their actions may be limited outside the community network^[25]. The level of embeddedness in a local environment hinge on the connections, relationships, and networks of entrepreneurs, which highlights the importance of community networks as a mechanism for embeddedness. Such networks offer mutual benefits, providing entrepreneurs with connections, resources, and knowledge^[7].

4.3.2 Community dynamics affect successful entrepreneurship

In contemporary business, community dynamics are a fundamental component. The dynamics of a community can have a major impact on groups that serve as both consumers and community members. Moreover, such processes can also influence the internal decision-making of a company. The strength of the community has increased rapidly, and the community holds an exceptional ability to affect society and businesses^[26]. As illustrated in Figure 4. To engage with the community, it is crucial to understand the key processes of interaction^[27]. Other categories of entrepreneurs may have varying approaches, and it is reasonable to assume that a lot of individuals might profit from their interaction with their respective communities^[8]. Currently, corporations are vested with both economic and social power, and consequently, enjoy stronger ties to their communities^[26].

4.4 Motivation of users' collective entrepreneurship based on user community Network Embeddedness

4.4.1 Economic motivation

Entrepreneurs can acquire a distinctive competitive edge due to their Community Network Embeddedness, which enables them to become an integral part of the local structure and facilitates a dynamic relationship with it. Although such a structure does not necessarily yield power, it presents a milieu of opportunities, which can be identified and capitalized on by embedded startups. By being embedded in the community, entrepreneurs gain the ability to leverage available resources to their advantage^[7].

Shah and Tripsas noted that profitability estimates for users and manufacturers exceed their respective profit thresholds, but the manufacturer typically seeks a higher financial return than the user. Under these circumstances, the user may authorize the innovation to the manufacturer, or both parties may enter the product market. Alternatively, if expected profits exceed the user's threshold but not the manufacturer's, only user entrepreneurs are likely to enter the market. Finally, when commercialization value exceeds both parties' profit thresholds, but users value the innovation more highly, user entrepreneurs take the lead in market entry. However, in cases where the intellectual property system is weak, manufacturers may also participate in the market^[12].

4.4.2 Non-economic motivation

Scholars have found that aside from economic rewards, numerous entrepreneurs are driven by

non-economic aspirations. According to extensive research, these individuals obtain satisfaction from self-employment or working in an area they find enjoyable^[28]. Consequentially, entrepreneurship can serve as a means for user innovators to attain such objectives. As a result, user innovators may prioritize indulging their passion over financial gain ("love" instead of "money")^[29].

The pathway towards entrepreneurship for a user innovator diverges from the conventional entrepreneurial route. In comparison to the latter, user innovators are more likely to identify problems within their own lives, devise solutions to address these challenges, and potentially disclose their concepts to the public before monetizing their creation. Oftentimes, user innovators inadvertently become entrepreneurs due to their primary goal of fulfilling a personal need rather than pursuing commercial success^[12].

5. The Disadvantages and Its Countermeasures of Users' Collective Innovation and Entrepreneurship Based on User Community Network Embeddedness

5.1 "Free rider" behavior in the community

5.1.1 Mutual assistance is not guaranteed

Virtual communities often fail to achieve a level of tacit understanding comparable to face-to-face communication^[30]. In comparison to the market system, the voluntary community system presents a significant disadvantage in that it is susceptible to opportunism and free-riding. The success of the system rests solely on the willingness of individuals to extend help to one another on a voluntary basis. However, rational choice, social exchange, and evolutionary theories argue that the general exchange is less plausible due to the potential for any individual in the exchange system to free ride without offering any reciprocity^[31], as illustrated in Figure 5.



Figure 5: The Disadvantages and Countermeasures of Users' Collective Innovation and Entrepreneurship Based on User Community Network Embeddedness

In contexts characterized by inadequate intellectual property protection, as well as in situations where the community has failed to resist the activities of commercial entities, the unimpeded exchange of knowledge will render it possible for other parties to reap financial benefits from innovation. The mobilization of communities to voice their concerns in connection with the potential commercialization of innovations generated by community members has been reported^[14].

5.1.2 The standardization of the community needs to be developed

Over an extended period, the established norms are disseminated throughout a community, and individuals are compelled to comply with them, reducing their focus on self-interest^[32]. Conversely, in recently formed communities, the time needed to disseminate and implement these norms may be insufficient, as illustrated in Figure 5. Furthermore, the associations between members of the community may be too tenuous, resulting in the norms having little impact.

5.1.3 Strengthen systems to reduce the "free rider" behavior

In order to maintain a community's degree of freedom, it becomes necessary to establish community systems and norms. This is essential as freedom needs to be controlled within a certain range or degree, as depicted in Figure 5. If individuals are not aided, they may flout community norms and face chastisement or even exclusion from the community. On the other hand, if assistance is withheld, an individual may be perceived as an "unfair" person by others in the community, which may negatively affect their ability to seek help when needed^[31]. Moreover, enforcing laws and regulations on intellectual property rights can establish more formal user communities, empowering them to have a greater impact.

5.2 Embedded relationships diminish the impact on innovation

Building relationships with knowledge-based customers is a critical way for suppliers to enhance innovation prospects. Nevertheless, such partnerships may be vulnerable to risks as the bond deepens over time, particularly when the customer possesses significant expertise. In this regard, two challenges may arise, including heightened issues of partner opportunism and greater acknowledgment of knowledge redundancy^[33]. As depicted in Figure 5, these factors could have significant adverse effects on the industry's collaborative efforts.

5.2.1 Redundant knowledge increases

Redundant knowledge refers to the level of similarity in knowledge, abilities, and skills among partners^[34]. Embedded relationships are characterized by partners having high levels of redundant knowledge^[35]. As embedded systems become more prevalent, suppliers receive innovative knowledge from customers, which is utilized to tailor products and marketing activities to meet customer demands^[36, 37]. This results in a situation where suppliers may believe they possess a wealth of knowledge that customers can offer. Conversely, in non-embedded relationships, the amount of information that is shared between customers and suppliers decreases.

5.2.2 Over-embeddedness

To a certain degree, there appears to be a growing inclination towards forming partnerships within the business sphere, albeit accompanied by a potential drawback of excessive interconnectedness^[23]. Correspondingly, companies confront a dwindling number of opportunities for inter-firm collaborations. This phenomenon of hyper-interconnectedness poses a risk of creating an environment of reduced partnership formation proclivities across various hierarchical levels^[38].

Over-embeddedness reduces the flow of new information into the network, because redundant relationships with the same network partner means that few or no external members contribute innovative ideas. In this case, the network becomes rigid and out of touch with the demands of the environment, which eventually leads to recession. Over-embedded networks can sometimes release strong resentment and negative feelings of revenge, and make the company fall into a self-defeating behavior loop^[23].

5.2.3 Differentiated competitive strategy to reduce redundant knowledge

Organizations can enhance their core competitiveness by utilizing the innovative content that is shared within the community. It is important to employ differentiated competition strategies to both "seek common ground" and "preserve differences" with competitors in the same industry, as depicted in Figure 5. An effective strategy is to select one or more characteristics that are highly valued by users and establish a unique position that caters to the specific needs of users. However, it is imperative to note that utilizing the embedded community should not entail mindlessly "following" or "imitating", but rather, it should aid organizations in discovering and developing their true "self" using the abundant information and resources available.

5.2.4 Broaden community boundaries to reduce over-embeddedness

Figure 5 demonstrates that expanding the boundaries of embedded communities is a useful strategy in preventing over-embeddedness. By utilizing various measures to attract diverse user groups and invigorating the community, it can be sustained and thrive. Additionally, fostering synergistic growth between the community and the external environment through collaboration with a wide range of user groups is also important.

5.3 Competition reduces the willingness to share freely

5.3.1 Increased competition within the community

In the academic realm, it is widely acknowledged that innovations are often disseminated freely within the community. Typically, innovators are willing to share their novel ideas and concepts with their peers without expecting monetary compensation. However, it is worth noting that in the face of heightened competitive pressures, the degree of free, accessible support has diminished over time. Consequently, the incidence of free aid and innovation disclosure has decreased^[14], as evidenced by the data presented in Figure 5.

5.3.2 Innovators become competitors

A significant concern for suppliers is the possibility that customers may leverage supplier information to engage in vertical backward integration and compete directly with suppliers. This risk, illustrated in Figure 5, is well-recognized by suppliers^[33] and has led them to guard sensitive

information. Unfortunately, the more suppliers take steps to protect their information in response to this risk, the less likely they are to benefit from customer innovation knowledge or leverage it to support their own innovation efforts^[39]. This risk is especially pronounced when customers possess a high level of innovation knowledge, as they are more likely to engage in independent innovation and may provide more information to suppliers, heightening the risk of competition^[40]. When user innovators transition into user manufacturers or collaborate with established manufacturers and vie for the same customer resources, they inevitably transform into competitors. This shift in role and the ensuing rivalry significantly diminishes their incentive to participate in the community and share knowledge^[10].

5.3.3 Win-win cooperation to reduce vicious competition

In the progression of transforming innovation into entrepreneurship, an extensive array of resources must be utilized to foster growth in various realms. Expressly, users who freely innovate suffer from a substantially lower success rate in entrepreneurship when compared to those who are professionals in innovation. Consequently, the selection of a cooperative approach yields a remarkably superior rate of success in entrepreneurship over independent competition. A supplier-user partnership can promote the maximization of user innovation in the embedded community, resulting in mutual benefits for both parties involved, as depicted in Figure 5.

6. Conclusions

The importance of user innovation and entrepreneurship lies in the role played by user community Network Embeddedness and collective creativity. The presence of a well-embedded user community creates a significant and beneficial impact on collective innovation and entrepreneurship. Users within the embedded community assume leadership roles in driving innovation and contribute to the development of entrepreneurial ventures. The embedded community also fosters user communication, leading to greater diversity and creativity in innovation.

Collective entrepreneurship is facilitated by the commercialization of innovations fostered by the embedded community. Moreover, the embedded community has a positive impact on the entire entrepreneurial process, and its position in the embedded network can significantly impact the success rate of entrepreneurship. In the process of collective innovation, an open and participatory community benefits users by enabling free expression and community participation. In collective entrepreneurship, users enjoy a unique information status and a sense of community trust. The embedded relationships within the community can also serve to improve entrepreneurial performance.

Although there may be drawbacks associated with user community Network Embeddedness, these can be managed through targeted response strategies that capitalize on challenges as advantages.

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