Prosumer engagement in the context of digital intelligence Transformation

Tianshu Kang (tianshuk@163.com), Beijing University of Posts and Telecommunications

Lidan Jiang (dan_li0502@163.com), Beijing University of Posts and Telecommunications

Jiaqi Liu (liujq@cass.org.cn), Institute of Journalism and communication, Chinese Academy of Social Sciences

Abstract

This paper defines prosumer engagement in the context of digital intelligence transformation. Using CiteSpace software to conduct bibliometric analysis, summarize the current research trends related to prosumer, and then synthesize the insights in these articles to deepen the understanding of prosumer engagement. Further, the interactive relationship between enterprises and users is deeply analyzed. The research shows that the digital intelligence technology enables individual behaviors to be constantly marked and identified, and is embedded in the digital intelligence network of the whole innovation system. It fundamentally changes the functional boundary and interaction relationship between the enterprise as the production end and the user as the consumer end, and makes the user change from a simple consumer to prosumer. This prosumer engagement has the following characteristics: 1. It emphasizes the immersive experience of users in the interaction between individuals and enterprises, which is based on the integration of emotion, cognition and behavior, and may lead to specific interaction behaviors after emotional and cognitive processing; 2. Behind the immersive experience, users are essentially exploited information providers. They have the characteristics of creative participation that have a far-reaching impact on the enterprise, but they may not be active or even unaware. 3. Digital intelligence technology gives platform enterprises more power to control and dominate user information, resulting in a serious imbalance in the interaction between enterprises and users.

Keywords:Digital intelligence transformation; bibliometric analysis; enterprise-user relationship;prosumer engagement

1. Introduction

Since entering Web2.0, people's lives have been seamlessly connected with network information. Work, study, social networking and entertainment all rely heavily on the Internet. We connect people in the real world through the Internet. In this dimension, the concept of "human" itself has also begun to "digitize". Nowadays, AI is increasingly showing a development trend of high complexity, strong permeability and great breakthrough power, which further promotes the arrival of Web3.0. AI empowerment enables data to become a new element for direct participation in innovation practices. As a "new oil", it begins to directly participate in industrial innovation activities. (Jiang et al., 2021)

Focus on the interactive relationship between enterprises and users in the process of digital intelligence transformation. Enterprises provide users with information about products and services. Users are also producing a large number of digital personal impressions while acquiring and consuming information (Frank Webster, 2014). These footprints are captured by the enterprise's digital intelligence devices, digital intelligence algorithms, and intelligent terminals, either actively or passively, or openly or secretly. Personal digital footprints are mined, collected, controlled, and transformed into information forms with different forms of expression (Wang H.M., 2022). Individual behaviors are constantly marked and identified, and embedded into the digital intelligence network of the whole innovation system, which fundamentally changes the functional boundary and interactive relationship between enterprises as producers and users as consumers, and makes users change from simple "consumer" to "prosumer".

Since the term″prosumer″was coined by futurist Toffler (1980), it has continued as a separate literature until today (Lang et al., 2021; Martindale & McKinney, 2020), especially valued in the research field of marketing and communication(du Plessis ,2019).From the perspective of ethology, the process of consumers' participation in the production side is considered to be the real and obvious behavior produced in the interaction (Kumar et al., 2016). Some scholars use "objectification of subject" to define the interactive relationship mentioned above. In this interactive relationship, the user subject is analyzed and evaluated by the intelligent algorithm as the object target, and is further used to strengthen the intelligent learning ability of the algorithm (Wang Haiming, 2022). This statement broadens the functional boundary of users and emphasizes the essence that users do not actively participate in production behavior. However, it is easy to ignore the development context of digital intelligence technology, which is the main body of enterprises, simply focusing on users. Therefore, based on the previous research, this paper adopts the chain analysis thinking of "production end user end", first grasps the research status of "prosumer", and defines the "producers and consumers involved" behavior under the background of digital intelligence transformation, and deeply analyzes the interaction between enterprises and users.

2.Research trends of prosumer

In order to analyze the research trend of "prosumer", we use CiteSpace software to conduct bibliometric analysis.The research data comes from the Web of Science (WOS), a comprehensive online literature database in the United States. We believe that the literature published in the journals included in the above-mentioned database can reflect the current full picture of the research field in a more comprehensive and authoritative manner. Determine the final search strategy after the search test.

Use TS = "prosumer" as the search formula, the search period is from 2007 to 2021，select the social science citation index "Social Sci-ences Citation Index" (SSCI) and Conference Proceedings Citation Index-Science (CPCI-S) in Web of Science as the search source, and further use article and review. Then use the Citespace software to remove duplication. A total of 279 valid documents are obtained after duplication removal. Each document record includes title, author, keywords, abstract, year, institution, and citations.

The key words are the overall condensing of the content of the literature and the high-level summary of the research topics.Therefore, we first analyze the research trend based on keywords.

The time slice is 1 year, and the node type is set to keywords, select Pathfinder, and generate a keyword co-occurrence map.
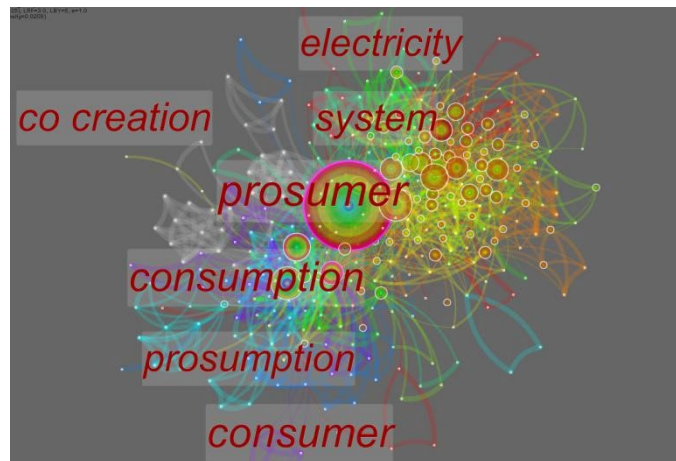

figure 1. keyword co-occurrence map

As shown in the figure 1, there are a total of 377 nodes in the keyword co-occurrence map, 1011 connections, and a network density of 0.0143. The keyword prosumer occupies a central position in the map, with a frequency of 131 occurrences. In addition, keywords such as system, consumption, prosumption, smart grid, renewable energy, consumer, generation, management, model, and technology, which represent specific application methods and combined fields, appear frequently, and collectively represent research hotspots in this field.

As another important result of keyword co-occurrence analysis, centrality is an index that measures the importance of nodes in co-occurrence networks. In the keyword co-occurrence map, the keyword with the highest betweenness centrality is prosumer (0.46), and other keywords with high betweenness centrality are consumer (0.21), consumption (0.19), capitalism (0.14), co creation (0.09), electricity (0.09), probability (0.08), and system (0.08). The above keywords have significant influence in the co-occurrence network, and can be regarded as important "intermediary" terms connecting high-frequency keywords in the field of prosumer research.

Keep other parameters unchanged, run the FindClusters function, and select the Log Likelihood Ratio algorithm for clustering. Based on the network structure and clustering clarity, the module value Q can be used to measure the stability of the generated clustering network. It is generally believed that a Q value greater than 0.3 indicates that the clustering structure is significant and the effect is better; the average contour value S can be used to measure the clustering The similarity of nodes within a cluster is generally considered to be greater than 0.5, which indicates a high degree of matching within the cluster and reasonable clustering. The Q value is 0.5658, which is greater than the critical value of 0.3; the S value is 0.8086, which is greater than the critical value of 0.5. In general, the reliability of the clustering results is high.

According to the clustering situation, the high-frequency keywords in this research field in the SSCI database are mainly concentrated in seven clusters: prosumption; demand response; prosumers; energy storage; net metering; peer-to-peer energy trading; crowdsourcing, as shown in the figure 2.
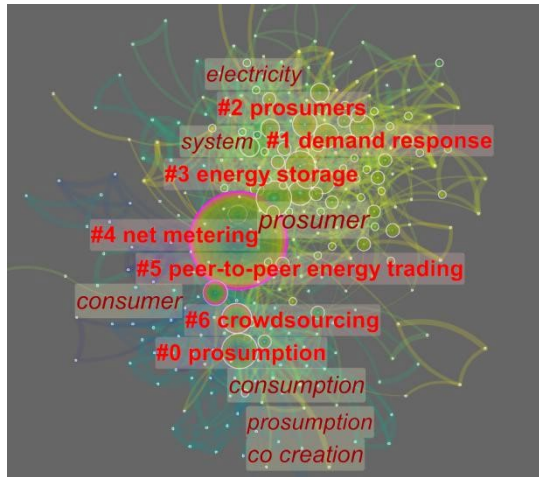
Figure2. Keyword clustering graph

In order to further analyze research hotspots and future trends, this article also conducts a prominent analysis of keywords. That is to say, in a certain period of time, the sudden and intensive appearance of research in a certain field can be regarded as a research hotspot in a certain stage. Through the mutation rate detection, we can understand the relatively active literature in a certain period, and track the future trend of the research according to the change trend of the literature.

This article uses CiteSpace to characterize and analyze the intensive occurrence of keywords in a certain period of time, keep other parameters unchanged, and run the "Citation/Frequency Burst History" function to generate sudden keywords in the research field in the SSCI database from 2007 to 2021. A list to analyze the frontier trends in the field of conflict management research in different periods. The following figure shows the relevant information of the emergent keywords, including keywords, appearance year, emergence intensity, emergence start year and end year.

Top 20 Keywords with the Strongest Citation Bursts

Keywords	Year	Strength	Begin	End	2007 - 2021
web 20	2007	3.59	2009	2014	
prosumption	2007	3.33	2010	2015	
internet	2007	2.65	2010	2014	
challenge	2007	3.2	2017	2018	
impact	2007	2.68	2017	2019	
smart grid	2007	4.65	2018	2021	
system	2007	4.16	2018	2021	
storage	2007	4.12	2018	2019	
management	2007	3.28	2018	2021	
electricity	2007	3.24	2018	2019	
market	2007	3.13	2018	2021	
power	2007	2.76	2018	2021	
generation	2007	2.63	2018	2019	
renewable energy	2007	6.49	2019	2021	
model	2007	3.86	2019	2019	
framework	2007	2.93	2019	2021	
demand	2007	2.93	2019	2021	
microgrid	2007	2.79	2019	2021	
community energy	2007	2.6	2019	2021	
blockchain	2007	2.74	2020	2021	

Figure3.Burst Keywords Analysis of Hotspots.

Figure 3 shows the emergence of keywords in this research field since 2007. We can see that web 2.0 began to emerge in 2009, lasting for five years, and the emergence index is relatively high. Prosumption and internet began to emerge in 2010 and ended in 2015. smart grid, sytem, management, market; renewable energy, demand, framework, and microgrid emerged in 2018 and 2019 respectively, and continue to this day. The emergence period of these keywords has not disappeared, indicating that the research on these keywords is still continuing. Academic research is always ahead of or closely following the reality of economic and social development, and the emergence and continuity of relevant research hotspots are inseparable from economic and social development and reform trends.

Further burst keywords analysis of hotspots, we can find that the burst of the three keywords of web2.0, prosumption, and internet almost overlap in the same period, and the emergence index is high. This is an important turning point in the field of research and represents symbiosis. New phenomenon. Because prosumers have physical boundaries in the real world, they chose the internet. Online they can create applications and communities with unprecedented freedom of speech. (Seran & Izvercian, 2014) However, after 2015, in the field of prosumer research, scholars' research on the online field has stopped abruptly, and the research is still inadequate.

Prosumption is a process involving consumers and businesses. Prosumpion is not only a connection between production and consumption, but also requires a certain degree of engagement and creativity (Seran et al., 2013). We call this process "prosumer engagement". A prosumer will expand his role by creatively participating in company activities (Seran & Izvercian, 2014). In a sense, they have gained specific control over the product and affected the development direction of the product. (Brabham, 2012). Contemporary prosumption is manifested as enterprises compete by letting prosumers participate in the process of knowledge exploration, creation of innovation and co-creation of value (Ziemba & Eisenbardt, 2013).

3.Defining " prosumer engagement " in the context of digital intelligence transformation

To better understand the concept of prosumer engagement, we need to figure out prosumer and engagement separately.

3.1. From consumer to prosumer

With regard to the concept of prosumer, it is the new generation consumers who are not only engaged in corporate activities but also enough to make consumer contributions to open innovation projects (Füller et al., 2006). Looking at customer-enterprise relationship in the past, while enterprises have always sought to hear the " voice of the customer " , customers have traditionally tended to play a passive role as recipients of the firm's activities (Sawhney, Verona, Prandelli, 2005). Earlier interaction with the customer was limited to maintenance and call centers.

While the consumer role evolved due to the empowerment of the Internet and Web 2.0 applications into the social customer, customer-enterprise interaction systems merged with social media technology, giving way to a new social customer-enterprise relationship. At that time ,　Consumers are active information providers, and they can choose to provide or not provide their information.

With the intensification of the transformation process of digital intelligence, the degree of intelligence of enterprise technology and products increases, and the behavior of individual users is constantly marked and identified, and embedded into the digital intelligence network of the whole industrial system. Consumers have changed from active information providers to objects that are monitored, mined, collected, controlled and consumed, into information forms with different forms, and ultimately affect the product form of enterprises. Consumers are actually exploited information providers. They have the characteristics of creative participation that have a far-reaching impact on enterprises, but they themselves may not be active or even unaware. On the other hand, this kind of mining behavior for user information is also beneficial, which provides the possibility of creating products that are more in line with user expectations. The involvement of producers and consumers is an important step to realize the non personalized interaction between enterprises and users.

3.2. Engagement, involvement and participation

In the existing literature, there are many expressions similar to engagement, such as involvement and participation. However, at present, few researches distinguishing the differences among them are made. In this study, we attempt to differentiate the meanings of engagement, involvement and participation, so as to more clearly support the discussion of the interaction between enterprises and users in the context of digital intelligence transformation.

（1）Engagement

With regard to the concept of engagement, the individual's "immersion" and "being there" psychological experience state is known as engagement in psychology. Specifically, "immersion" is an experience completely surrounded by another real scene, and " being there" refers to a subjective feeling of existence formed by highly immersing in the scene environment.
Engagement often occurs in the interaction between two subjects. For example, when the user interacts with the attractive information/things, they will be "immersed" in the psychological state surrounded by the sensory information created by the media, resulting in a feeling of "being there" in the scene created by the information (Slater, Wilbur, 1997). Higgins (2006) argues that engagement emphasizes the approaching psychological response to stimuli, which is opposite to avoidance psychological response. Calder and Malthause (2008) define engagement as the sum of an individual's psychological experience of something, which is composed of internal goal motivation (that is, viewing product experiences as a goal) and external goal motivation (that is, viewing product experiences as a means to achieve external goals). They believe that engagement focuses more on internal goals, especially the experience and perception of product content, rather than on whether external goals can be achieved.

(2)Involvement and participation

Many scholars have noticed that engagement and the other two similar constructions are often confusing, namely "involvement" and "participation" (Spielmann, Richard, 2013).

With regard to the concept of involvement, it was created by social psychologist Sherif in 1947 and used to evaluate individual attitudes in social judgment. It represents a state of interest or driving level aroused by stimulating information. Researchers often use the term "involvement" to describe

the degree of individual perceived or constructed relevance experience, and use it as a moderator to explain the attitude formation mechanism during information exposure.

With regard to the concept of participation, it is often used in the field of public politics. With the emergence of "public participation", "citizen participation", "political participation" and other expressions, it means that the public pay more attention to their own civic values and rights awareness. Besides, "participation" also reflects that with the democratization of social ecology, the public has been given more political discourse and supervision rights, and has the opportunity to carry out more direct dialogue with the government, exert influence on the decision-making of public administrative activities to defend their own interests. When the main positions of the public to express their attitudes and participate in political activities are transferred to cyberspace, the traditional offline "participation" evolves into "network participation" or "network political participation" (Reddick, Anthopoulos, 2014), showing the extension and supplement of traditional political participation.

（3）Subtle differences among engagement, involvement and participation

Concerning the difference between "involvement" and "engagement", on the one hand, from the perspective of antecedent motivation of behavior, "involvement" is a kind of result, which is often associated with many contextual motivational factors, including previous state or cognitive basis. In other words, if you lack interest in the subject before, you will not be involved. But "engagement" is a kind of state, which emphasizes the instant attraction between the two subjects and forming a close "mutual locking" relationship. Antecedent motivation of engagement is not a necessary condition. In other words, even if you lack interest in the subject before, you can also be engaged (Kim, Hanssens, 2017). On the other hand, from the perspective of the consequences of behavior. Many scholars (for example, Yoon et al., 2018; De Langhe, Fernbach and Lichtenstein, 2016) argue that although "involvement" has represented a high level of effort response to stimulation, "engagement" has a higher level of effort and a stronger ability to trigger follow-up intention. Forrest and McHale (2011) even directly believe that "involvement" is the initial stage of "engagement".

Concerning the difference between "participation" and "engagement", "participation" emphasizes the role of the public in assisting government management activities, and describes the phenomenon that citizens have the right and opportunity to exert influence at all stages of government decision-making (including the formulation and implementation of public policies). "Participation" reflects the role of the subject in promoting the expected results, for example, to achieve a specific goal, or to improve a situation. Moreover, from the perspective of hierarchy theory, many scholars try to divide participation behavior into several progressive behavior levels, such as the participation level framework of e-enabling (including information release behavior), e-engaging (including policy consultation behavior) and e-empowering (including active participation), which is proposed by Islam (2008). Although different research does not completely agree on the hierarchy of participation behavior, most studies have reached a consensus that "engagement" is an intermediate stage of "participation". It can be seen that "participation" is a result-oriented effort, and the driving force of "engagement" on the result is explicitly lower than "participation". It may directly or indirectly affect the decision-making results, but the outcomes are not the decisive reason for individual engagement behavior.

Comprehensively, the emergence of "involvement" behavior depends on the basis of antecedent factors, which emphasizes the basic cognition and motivation of individuals before the occurrence of behavior. The emergence of "participation" behavior depends on the expectation of consequence, which emphasizes the individual's clear expected goal before the occurrence of the behavior, as well as the promoting influence in the process of achieving the goal. The generation of "engagement" behavior focuses on the psychological experience and feeling state of "at the moment" and "being there". In a word, through the analysis of similar concepts, it is found that there are indeed differences among "engagement", "involvement" and "participation", which will help to clarify the boundaries of this study.

To sum up, we use the term "prosumer engagement" to define the interaction between enterprises and users in the context of digital intelligence transformation. This interactive relationship has the following characteristics: 1. It emphasizes the immersive experience of users in the interaction between individuals and enterprises, which is based on the integration of emotion, cognition and behavior, and may lead to specific interaction behaviors after emotional and cognitive processing; 2. Behind the immersive experience, users are essentially exploited information providers. They have the characteristics of creative participation that have a far-reaching impact on the enterprise, but they may not be active or even unaware. 3. Digital intelligence technology gives platform enterprises more power to control and dominate user information, resulting in a serious imbalance in the interaction between enterprises and users.