

Entry

The Prosumer

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Definition: In recent years, the concept of the prosumer has garnered extensive attention across various fields, including marketing, energy consumption, and innovation research. This attention is driven by the significant role prosumers play in developing more efficient, sustainable, and health-conscious market systems, propelled by advancements in social and technological domains. Broadly defined, a prosumer is an individual who acts as both a producer and a consumer. Originally coined by Toffler in the 1980s, the term describes individuals who blur the lines between producers and consumers by engaging in the creation of value for their own use or for others. Prosumers are seen as external partners who participate in co-creation processes with organizations, contributing to innovative outcomes and the production of the products and services they consume. The concept of the prosumer, individuals who simultaneously act as producers and consumers, has gained significant attention across various sectors. This entry explores the evolving role and impact of prosumers on sustainability, innovation, and market dynamics. A comprehensive literature review and empirical analysis were conducted to understand prosumer behavior and contributions. The findings reveal that the prosumers' roles range from significantly enhancing sustainability by generating renewable energy to promoting personalized education via teacher–prosumer models. They also drive technological advancements in fields such as 3D printing and cryptocurrency. The study concludes that prosumers have the potential to foster a more resilient and inclusive economy, although challenges such as regulatory barriers and technological dependencies must be addressed to fully leverage their contributions.



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1. Introduction

In recent years, the role of prosumers has gained increasing attention within the energy industry and the digital economy. The term “prosumer”, coined by Alvin Toffler in his seminal work, *The Third Wave* (1980) [1], refers to individuals who blur the lines between producers and consumers by engaging in the production of goods and services for their own use or for shared use within a community. Prosumers are redefining traditional economic roles by integrating consumption with production activities to create value for themselves and others. The advent of digital technologies and platforms has facilitated this dual role, enabling user-generated content, collaborative innovation, and peer-to-peer (P2P) interactions [2].

The surge of online platforms and social media has amplified the influence of prosumers, allowing them to shape product development, marketing strategies, and service delivery [3]. The phenomenon of prosumption extends beyond the digital realm, reaching various sectors including energy, healthcare, education, fashion, art, 3D printing, Bitcoin mining, and agriculture. Advances in science and technology have propelled prosumers to contribute to the creation and dissemination of knowledge and resources [4–6]. This shift in consumption challenges traditional business models and necessitates a reevaluation of value creation processes, consumer behavior, and market dynamics [7].

A key area where prosumers play a significant role is the energy industry [6,8–11]. The integration of distributed generation technologies, such as solar photovoltaic systems and wind turbines, has enabled consumers to actively participate in energy production. Prosumers not only generate energy for their own use but also supply excess power to the grid, enhancing the resilience and sustainability of energy systems. In the education sector [12], the COVID-19 pandemic has granted students greater autonomy in choosing their learning content and becoming knowledge creators, fostering a teacher–prosumer dynamic that promotes more personalized and student-centered education. In the arts, digital technologies have blurred the boundaries between artists and viewers, leading to increased collaboration in the creation of artworks, including non-fungible tokens (NFTs). However, in the fashion industry, the development of prosumption is limited by socio-cultural and class systems [13,14]. Research on certain countries reveals that, in the realm of fashion prosumption, roles such as trendsetting and narrative construction are often exclusive to technologically and socially privileged end-users/prosumers, constrained by hierarchical structures. In traditional sectors such as agriculture and emerging fields like Bitcoin mining and 3D printing, prosumers also hold significant influence. In agriculture, prosumers motivated by personal satisfaction engage in self-production and consumption [15]. Bitcoin miners, as prosumers, are primarily driven by financial incentives to enhance network security and stability [16]. Meanwhile, in the 3D printing sector, consumers gain access to printers and materials to create personalized products, transitioning into prosumers and providing customized products to the community.

Given the impact of prosumers on societal development and their importance across various fields, scholars have begun to examine the evolution of prosumer capitalism within the framework of capitalist development. Prosumers contribute to innovation, value creation, and distributed flexibility, yet they also face challenges such as exploitation, knowledge disparities, and dependency on technology. Fully harnessing the potential of prosumers is crucial for promoting green, sustainable development and advancing societal and technological progress.

2. Prosumer and Related Concepts

The relationship between prosumers, the sharing economy, co-production, self-production, and co-creation is multifaceted and can be explored through various academic lenses.

2.1. Prosumer and the Sharing Economy

The sharing economy refers to a socio-economic system built around the sharing of resources, allowing individuals to share access to goods, services, and skills through platforms such as Airbnb and Uber [17]. The sharing economy is an economic model where individuals can borrow or rent assets owned by someone else. This system leverages technology to facilitate the exchange of goods and services between individuals, often through a digital platform [5,11]. Prosumers, who actively engage in both producing and consuming goods and services, enhance the diversity and richness of these offerings. For instance, a user on Airbnb can both host travelers and book accommodations in other cities, showcasing their dual role as a prosumer [17]. The emergence of prosumers drives the development and expansion of the sharing economy. Conversely, the sharing economy, through digital platforms, enables prosumers to reach wider audiences and seamlessly participate in various economic activities, creating a synergistic relationship.

The sharing economy involves various forms of collaborative consumption, including genuine collaborative consumption, intermittent collaborative consumption, and pseudo collaborative consumption. Genuine collaborative consumption refers to sharing goods and services with non-organizational entities (i.e., with peers), focusing on community benefits. An example is neighborhood tool libraries, where tools are borrowed and shared among community members. Intermittent collaborative consumption involves sharing goods and services, with peers or organizations, and often through digital platforms [18]. Examples include task-based services on platforms like TaskRabbit or vacation rentals through Airbnb,

where individuals and organizations can, respectively, provide services and share access to premises for a fee. Pseudo collaborative consumption resembles traditional commercial transactions where goods and services are provided primarily for profit. Examples include commercial bike-sharing Bixi or short-term car rental Zipcar, where the primary motivation is earning money rather than community sharing [5]. This makes the sharing economy partially aligned with the prosumer concept especially through genuine and intermittent collaborative consumption. Indeed, through these specific resource circulation systems individuals can shift roles from users to providers, either directly or through intermediaries such as organizations or platforms [18,19].

In sum, the nuances of collaborative consumption within the sharing economy, suggest that these platforms facilitate a dynamic interchange between the consumer and provider roles [5]. This fluidity in roles is a core aspect that aligns the sharing economy with the concept of prosumer. Besides, collaborative consumption, as highlighted by these authors, includes diverse forms of engagement, from sharing and bartering to renting and lending, which allows individuals to engage in multiple roles.

2.2. Prosumer and Collaborative Consumption

Collaborative consumption involves the reinvention of traditional market behaviors such as bartering, lending, trading, and swapping through technology and community-based platforms [20]. Both concepts, prosumer and collaborative consumption, share common ground as they enable role-switching between users, allowing consumers to become providers. According to Ertz et al. (2016, 2019), the collaborative economy suggests that an exchange system can be considered collaborative if it facilitates the users' ability to switch roles and become providers [18,19]. For example, in community-based platforms like Freecycle, users give away items they no longer need and others take them for free, illustrating the peer-to-peer nature of collaborative consumption [20].

However, the prosumer concept encompasses a broader scope. It includes not only value creation for oneself and peers but also direct interactions with organizations, which are considered as end agents. In contrast, collaborative consumption focuses primarily on interactions among consumers, either directly or through an intermediary, with the net result being inter-peer interaction, making individuals the end agents.

By distinguishing these concepts, it becomes clear that while both prosumers and participants in collaborative consumption engage in similar behaviors, the scope and nature of their interactions differ. For instance, a prosumer who contributes to a crowdfunding campaign not only supports a project but also interacts with the creators, integrating into the broader value creation process [18]. Prosumers engage directly with organizations and contribute to value creation in a wider context, whereas collaborative consumption is centered around peer-to-peer exchanges.

2.3. Prosumer and Co-Creation

In the development of prosumption, co-creation is one of the most significant features and processes. Co-creation shifts the traditional paradigm of businesses unilaterally creating products and services for passive consumers [21]. In various fields, prosumers exhibit co-creation; for example, in "Prosumption in Art", Nakajima discussed how viewers and audiences are no longer passive consumers but active participants in the creation and interpretation of artworks, co-creating with artist prosumers [22]. In the 3D printing industry, as technology becomes more widespread, more consumers transform into prosumers, co-creating customized and personalized works. Another example is the video game industry, where companies like Valve allow users to create their own game modifications or "mods", which can be shared and used by the broader gaming community. This process actively involves consumers in the development and enhancement of the games they play [23]. The emergence of prosumers naturally leads to co-creation.

2.4. Prosumer and Production

Co-production, a sub-category of co-creation, is defined by scholars as the process where inputs from individuals who are not “in” the same organization are transformed into goods and services [24]. Co-production includes the collaboration of citizens and public providers to produce services that serve the public interest, empowering citizens by involving them in decision-making and production processes. This differs from co-creation, which emphasizes personal or communal value over public value and involves individuals collaborating directly rather than organizations playing a central role. Although the concept of prosumer aligns closely with co-production, there are some key differences. Co-production primarily focuses on creating public value through collaboration between citizens and public providers, while prosumers create value both personally and communally and often interact directly with organizations and other consumers. An example of co-production is the collaborative development of open-source software, where contributions from a global community of developers enhance and expand software capabilities [24].

2.5. Prosumer and Self-Production

In contrast to co-production is self-production, which emphasizes the act of consumers creating goods for personal use or for sharing within their community, such as growing vegetables, making homemade clothing, or baking bread [25]. Self-production and prosumption both involve active engagement in creating goods and services, fostering customization and personalization. However, self-production primarily focuses on creating goods and services for personal use, driven by personal needs and self-sufficiency. Prosumption, on the other hand, involves creating goods and services for both personal use and sharing or selling to others, driven by community engagement and innovation, and emphasizing sharing and collaboration within a broader community. A community garden where individuals grow and share vegetables with their neighbors illustrates self-production. This is contrasted with a local food cooperative where people grow, share, and sell produce, reflecting a broader prosumer approach [25].

2.6. Prosumer and Consumerchant

The term “consumerchant” is defined by Bernard Cova and Véronique Cova as a hybrid figure, combining the roles of consumer and merchant [26]. For example, in contrast with traditional consumers engaging in market-related activities, consumerchants promote products, on social media for example, to reach broader audiences. Consumerchants create value by promoting and selling products, whereas prosumers are empowered through production. In fact, prosumers are empowered through production-related activities, creating value by integrating consumption with production for personal use or within a community context.

More specifically, the distinction between prosumers and consumerchants lies in the scope and nature of their activities. Consumerchants are primarily focused on the selling of goods (and potentially services), operating within a commercial framework where their primary goal is market-related activity. This means their involvement is largely limited to promoting and selling products, often for financial gain [26]. In contrast, prosumers engage in various production-related activities that may not involve any direct money exchange or commercial product/service provision. For example, a person who creates and sells handmade crafts through an online marketplace, promoting their products on social media, fits the consumerchant model. Conversely, someone who makes crafts for personal use and shares them within a local community or sells them at a local market or even an online marketplace exemplifies a prosumer [26].

3. Prosumer Methodologies

Various quantitative and qualitative methodologies have been employed in the study of prosumers to measure their characteristics, contributions, and behaviors.

Chan utilized case studies to explore the complexities and nuances of prosumer activities in real-world settings [3]. This method has allowed for an in-depth understanding of specific instances of prosumer behavior, providing detailed insights into the practical implications and outcomes of prosumption. Chandler and Chen employed interviews and focus groups, both widely used methods to gather insights into the motivations, experiences, and perceptions of prosumers [4]. These qualitative techniques have enabled researchers to capture rich, detailed data directly from prosumers, shedding light on their personal experiences and viewpoints.

In addition to the methods previously discussed, other quantitative methods are also commonly used in prosumer research. Surveys allow for the collection of data from a larger sample, offering a broader understanding of prosumer behaviors and trends. For instance, Hamari et al. [5] utilized surveys to analyze the motivations for participation in collaborative consumption platforms, providing valuable insights into the behaviors and preferences of prosumers. Similarly, structured observations play a crucial role in capturing the real-time interactions and activities of prosumers, which might not be fully captured through surveys alone. Belk [27] utilized structured observations to examine user interactions on sharing economy platforms, such as Airbnb, providing a detailed view of the dynamics and challenges inherent in prosumer engagement within digital environments.

Other approaches include quantitative methods. Ciasullo [2] opted for textual analysis to examine large volumes of textual data generated by prosumers. This method has helped in identifying key themes and patterns within the data, revealing that overcoming institutional, organizational, and cognitive barriers is essential for transforming patients from consumers to prosumers. Kotler [28] applied Social Network Analysis (SNA) to analyze prosumer networks. This methodology has provided insights into the relationships and interactions within prosumer communities, uncovering the marketing challenges and opportunities faced by prosumers. Kotler's analysis reveals key challenges such as maintaining brand loyalty amid diverse preferences and increased competition among prosumers. Additionally, Kotler [28] identified opportunities for leveraging prosumer networks to develop innovative marketing strategies.

To provide a comprehensive understanding of the evolving role and impact of prosumers, we conducted a review of 42 studies. These studies were selected based on their relevance to prosumer behavior, contributions, and impacts on sustainability, innovation, and market dynamics. The selection criteria required the term 'prosumer' to appear in the title, abstract, or keywords. The literature reviewed spans publications from 1980, the year of Toffler's seminal work, to 1 July 2024.

Our analysis of the 42 reviewed studies revealed that 12 articles (29%) focused on defining the concept of prosumers, 17 articles (40%) examined prosumer behaviors, and 13 articles (31%) discussed the contributions of prosumers. Additionally, within these categories, 8 articles (19%) also addressed the challenges and contrasts faced by prosumers. This distribution underscores the balanced attention given to each aspect within the existing body of research.

4. Prosumer Theories and Models

A prosumer is an individual who acts as both a producer and a consumer. This dual role is elaborated upon in various theories and supported by research models that explain their characteristics and motivations. Firstly, Prosumption Theory (PT) highlights the role of prosumers, who are consumers that also take part in the production process, thereby becoming co-producers of products [4]. Unlike traditional consumers, prosumers are involved in various processes such as designing new products and advising in communication, which helps companies better understand their customers and adapt their offerings to meet individual needs. This theory underscores the shift from passive consumption to active involvement in product development.

Secondly, Lang et al. [29] discussed the value co-creation theory, emphasizing the prosumers' active participation in the creation of value. Prosumers do not merely consume

what is offered to them but actively participate in creating and enhancing the value of those offerings. This theory illustrates the collaborative nature of value creation, where prosumers contribute ideas, feedback, and even labor, resulting in products and services that are more closely aligned with their preferences and needs. Similarly, the Prosumer Creativity and Focus Model (PCFM), proposed by Seran [30], links prosumer creativity with company innovation efficiency. The co-creation between prosumers, who are active consumers participating in the production process, and companies' marketing strategies brings additional value through creativity and innovation. This model highlights how prosumers' creative contributions can drive innovative outcomes and enhance market offerings.

Another important one is the MOA model proposed by Xiang et al. [31]. The MOA (Motivation, Opportunity, Ability) model is a widely recognized framework used to analyze and predict prosumer behavior. This model examines how service attributes influence consumer responses in P2P accommodations through the following three interrelated factors:

1. "Motivation" refers to the inner drivers that propel prosumers to engage in service activities. These motivations can be both intrinsic (such as personal satisfaction and enjoyment) and extrinsic (such as financial rewards). In the context of P2P accommodation, economic motivation plays a significant role as prosumers seek the financial benefits by sharing their resources.
2. "Opportunity" encompasses the external contextual elements that either constrain or facilitate prosumers' ability to provide services. Technological advancements, such as online platforms like Xiaozhu.com, provide the necessary infrastructure for prosumers to offer their services. Additionally, financial capital and available resources are crucial in enabling prosumers to engage in the sharing economy.
3. "Ability" pertains to the skills and knowledge that prosumers possess, which enable them to deliver services effectively. Prosumers' service knowledge, such as understanding customer needs and managing shared properties, significantly impacts the quality of service provided. The ability to manage these aspects effectively is essential for maintaining high levels of consumer satisfaction.

Studies utilizing the MOA model have revealed insights into prosumers' economic motivations, service flexibility, and knowledge levels, thereby enhancing the understanding of prosumer–consumer exchanges. The research conducted by Xiang demonstrated that prosumers' economic motivations, service flexibility, and service knowledge levels have distinct effects on consumers' transactional-based and relational-based participation. Furthermore, the moderating role of shared property management was found to amplify or attenuate these effects, providing a comprehensive understanding of how prosumer attributes influence consumer responses.

These theories and models clearly delineate the role and characteristics of prosumers. They show how prosumers' involvement in production processes transforms them into vital partners in the value creation chain, fostering innovation, personalization, and enhanced customer satisfaction. The integration of prosumers' creativity and active participation with companies' strategic initiatives results in co-created products and services that better meet consumer demands and drive market success.

5. Facets of Prosumer Role

Understanding the multifaceted role of prosumers in modern economies involves examining their behavior, relationships, motivations, characteristics, and the concept of prosumer capitalism. Each of these facets provides valuable insights into the dynamics and impact of prosumers.

5.1. Prosumer Behavior

In various fields, prosumers engage in distinct actions and activities that can be classified into mutually exclusive categories. Prosumer behaviour is broadly classified into self-production, P2P trading and sharing, collaborative creation (or co-creation), and knowledge creation and sharing.

(1) Self-Production and Consumption

In certain sectors, prosumers engage in production primarily for their own use, blending production and consumption in a self-sustaining manner. For example, prosumers in agriculture produce food mainly for their own consumption, driven by personal satisfaction rather than community sharing [15]. This form of prosumption highlights an individualistic approach to food production and consumption. Meanwhile, the agricultural prosumer may also share produce with other community members.

(2) Peer-to-Peer Trading and Sharing

Peer-to-peer (P2P) trading and sharing are significant activities for prosumers, especially in the energy sector and digital currencies. In the energy sector, prosumers generate and store their own electricity, such as through solar power, and sell excess energy via community networks. This P2P trading not only enhances energy efficiency but also promotes sustainability by integrating decentralized, renewable energy sources into the grid [32]. Furthermore, Bitcoin miners validate transactions by solving complex mathematical problems using high-performance hardware and software, earning new Bitcoins as rewards [16]. These prosumers, driven by financial incentives, contribute to network security and stability, forming communities to share information and trade Bitcoins.

(3) Collaborative Creation

Prosumers also engage in collaborative production, where they work together with others to create products or services. In the arts, artists and their audiences collaboratively create artworks, utilizing digital platforms and social media to reach global audiences and receive immediate feedback [22]. This interaction blurs the traditional boundaries between artists and consumers, emphasizing the participatory nature of contemporary art practices.

And in the realm of 3D printing, consumers gain access to 3D printers and materials. They are actively involved in the production process by creating, selling, and buying 3D printed objects and are transformed into prosumers by gathering buyers' needs and feedback to meet personalized consumer demands [7]. They co-create 3D products with the consumers.

(4) Knowledge Creation and Sharing

Prosumers often take on the role of knowledge creators and sharers, particularly in education and arts. Students, utilizing digital resources and platforms, transition from passive recipients of teacher-centered instruction to active creators of knowledge. They engage in the co-creation of educational content, collaborate with peers, and share their insights, fostering a more dynamic and interactive learning environment. This shift towards a student-centered approach reflects the increasing autonomy and participation of students in the educational process [12].

In the arts, prosumers contribute to the creation and dissemination of artworks. Artists collaborate with viewers, audiences, and other artists, using information and communication technologies (ICTs) to co-create art [22]. This collaborative approach transforms viewers from passive consumers to active participants who provide feedback and influence the artistic process.

5.2. Prosumer Relationships

Prosumer relationships involve dynamic interactions between prosumers and companies, as well as within prosumer communities. These relationships are characterized by collaboration, trust, and mutual benefits. In the context of energy prosumption, for example, prosumers form community groups to enhance efficiency and reliability in energy provision [13]. The socio-economic and technological context significantly influences prosumer relationships, with factors such as government policies, market structures, and technological advancements shaping how prosumers interact within the grid [9,14,31,33].

5.3. Prosumer Motivations

For consumers, the following six key drivers prevail in their prosumption decision: economic benefit, actor self-efficacy, perceived risk, specific assets required, perceived opportunism, and monitoring of providers [34]. For prosumers themselves, the motivations are multifaceted, including both individual and social factors. Financial incentives, independence from traditional suppliers, and pro-environmental actions are significant motivators [14,16], with environmental concerns being a distinguished factor driving individuals to become prosumers. Additionally, the desire for self-actualization, quality concerns, and the aspiration to contribute to community well-being play crucial roles [22]. Prosumers are also motivated by the ability to personalize and customize products, thereby enhancing their satisfaction and engagement [7].

5.4. Prosumer Characteristics

Prosumers typically exhibit certain distinct characteristics. They tend to be well-educated, financially secure, and technologically adept individuals. These traits enable them to actively participate in both consumption and production processes. The development of digital platforms has significantly shaped these characteristics, making prosumers integral to various fields. In the energy sector, for instance, prosumers often have higher incomes, live in rural areas, and possess newer houses with individual heating systems. Their proactive and creative nature drives them to seek opportunities to innovate and contribute to the development of products and services.

The rise in technologies such as 3D printing and Bitcoin mining underscores the importance of education and technological proficiency among prosumers [7,16]. In these areas, prosumers need a strong educational background to understand and effectively use advanced technologies. Beyond mere consumption, their activities often involve the dissemination and sharing of knowledge and viewpoints, necessitating a solid foundation of knowledge and learning capabilities. This is evident not only in the digital and technology-driven fields but also in the broader landscape of prosumption.

Although agriculture remains an exception where prosumption primarily involves self-sustained production for personal use [15], most prosumer behaviors today are characterized by active participation in knowledge sharing. For instance, in the 3D printing realm, prosumers are not just creating and using products; they are also sharing designs and innovations with the community. Similarly, in the cryptocurrency sector, Bitcoin miners must continuously update their knowledge to keep pace with technological advancements and market dynamics [33,35]. This trend highlights that, apart from agriculture, the modern prosumer's role typically extends beyond production to include the spread and exchange of information thus requiring a well-rounded educational background and a strong propensity for learning.

6. Opportunities and Challenges of Prosumer

Prosumers can create value in various fields in different ways. From the perspectives of economic development, technological innovation, and environmental sustainability, prosumers can bring more creative and efficient solutions to various industries. Obviously, prosumers play critical roles in energy, educational, agricultural, industrial, or fashion value networks, contributing to innovation, value creation, and distributed flexibility. They act as "Engineers" (valuing technology), "Green Users" (prioritizing sustainability), and "Value Seekers" (focused on economic benefits) [9]. However, despite their benefits, the emergence of prosumers also introduces several challenges, such as inefficiencies due to current regulatory inadequacies and ethical considerations regarding data privacy and intellectual property within prosumption capitalism [7,16,35].

6.1. Opportunities

As consumers and producers transition to prosumers, the following opportunities are significant:

(1) Economic Benefits

Prosumers can achieve significant cost savings by producing their own goods or services, such as generating their own electricity through solar panels. This reduces dependence on traditional utility providers and lowers monthly expenses [10].

In addition, prosumers in various sectors, including agriculture and fashion, actively engage in local markets and community-supported initiatives. For example, local markets and community-supported agriculture (CSA) initiatives offer economic opportunities for small-scale producers [36], fostering more resilient local economies. In fashion, prosumers drive market engagement through unique and personalized products, providing valuable consumer insights and fostering authenticity and trust.

(2) Environmental Sustainability

By engaging in activities such as food self-provisioning and renewable energy generation, prosumers adopt and promote sustainable practices. In agriculture, this leads to environmental benefits such as reduced carbon footprints and less reliance on industrial agriculture [15]. By exchanging, repairing, repurposing, upcycling, recycling, composting, or downcycling tangible goods, prosumers contribute to product lifetime extension. Overall, the adoption of renewable energy sources and sustainable practices by prosumers contributes significantly to reducing resource extraction, pollution, and greenhouse gas emissions, and combating climate change.

(3) Technological Innovation

In the energy sector, prosumers are early adopters of innovative technologies such as smart grids, energy storage systems, and home automation. This accelerates the diffusion of new technologies and fosters technological advancements [32]. The creativity and resourcefulness of prosumers lead to the development of unique solutions and DIY innovations. These grassroots innovations can inspire broader technological progress and new market opportunities [23].

(4) Community Building and Social Benefits

Prosumers engage in educational activities, teaching new users about the technical and economic aspects of their respective fields. For instance, in Bitcoin mining and the teacher-prosumer pattern, prosumers provide educational opportunities and share knowledge to foster community engagement and ecosystem development.

(5) Enhanced Network Security and Stability

In Bitcoin mining, prosumers' participation helps distribute the mining power more evenly across the network, reducing the risk of an attack where a single entity could gain control of the network [16]. This decentralization ensures a more robust and reliable verification process, enhancing the overall security and stability of the Bitcoin blockchain.

(6) Marketing Opportunities

Kotler [28] has identified several significant opportunities for companies leveraging prosumer networks. These include the development of innovative marketing strategies that directly involve prosumer feedback, which can lead to more engaging and effective marketing campaigns. Additionally, integrating prosumer input into product development processes ensures that products are closely aligned with consumer needs and preferences. Strengthening consumer relationships through collaborative marketing efforts can also foster a sense of loyalty and advocacy among prosumers, enhancing brand loyalty and long-term customer engagement.

6.2. Challenges

The rapid expansion and development of prosumers also introduce the following uncertainties:

(1) Initial Costs and Technology Adoption

Setting up the necessary infrastructure to participate in prosumer activities, such as blockchain-based markets or renewable energy systems, involves significant initial costs and investments [6,16,33,35]. This financial barrier can be a deterrent for many potential prosumers. Moreover, the complexity of these advanced technologies requires a high level of technical proficiency and ongoing education, which can hinder the development and widespread adoption of prosumer systems. The high initial costs and the need for continuous learning can exacerbate socioeconomic disparities, limiting access to those with adequate financial and educational resources.

(2) Regulatory Issues and Uncertainty

The legal and regulatory landscape for prosumer activities is often unclear and inconsistent, varying widely across different jurisdictions. For example, the regulatory status of cryptocurrencies and Bitcoin mining activities can create uncertainty and potential legal risks for prosumers [16,35]. Similarly, existing energy regulations are primarily designed for traditional consumers and producers, lacking the specificity required for prosumers. This regulatory ambiguity can make it challenging for prosumers to navigate compliance requirements and can limit their influence compared to larger corporations. The lack of a clear regulatory framework can also discourage investment and innovation, as prosumers may face legal challenges that traditional entities do not encounter.

(3) Intellectual Property and Regulatory Compliance

The rise in technologies such as 3D printing has led to challenges in protecting intellectual property [7], with increased risks of counterfeiting and piracy. Prosumers must ensure compliance with intellectual property laws to safeguard their innovations. Additionally, regulatory compliance regarding product quality, safety, and environmental impact adds another layer of complexity. Navigating these regulatory frameworks is crucial to ensure that prosumer activities are sustainable and legally sound. The threat of intellectual property theft can disincentivize creativity and innovation among prosumers, as their unique creations may be easily replicated without the proper legal recourse.

(4) High Operational Costs and Environmental Impact

Prosumers, especially those involved in Bitcoin mining [16], face high operational costs due to the significant investments required in hardware and the large amounts of electricity consumed. This high energy consumption not only leads to elevated costs but also contributes to carbon emissions and environmental degradation. Balancing economic participation with environmental sustainability is a major challenge for prosumers, as they strive to reduce their carbon footprint while maintaining operational efficiency. The environmental impact of prosumer activities can undermine the sustainability goals that many prosumers aim to achieve, presenting a paradox in their contributions to green initiatives.

(5) Marketing Challenges

Kotler [28] has highlighted several key marketing challenges faced by prosumers. Maintaining brand loyalty is particularly difficult in a market dominated by prosumers with diverse preferences. The increased competition among prosumers further complicates the marketing landscape. Engaging prosumers in co-creation processes can be complex due to varied and sometimes conflicting inputs. These challenges necessitate companies to adopt more flexible and adaptive marketing and product development strategies to effectively manage prosumer relationships and expectations. The diverse and fragmented nature of the prosumer market can lead to inconsistent customer experiences and dilute brand identity.

In the future development of prosumers and current capitalist frameworks, the appropriate regulatory changes and market operation adjustments are necessary to ensure that prosumers can fully realize their potential. Addressing these challenges requires a multifaceted approach, including supportive policies, technological advancements, and community initiatives to foster a more inclusive and sustainable prosumer environment.

7. Specific Applications of Prosumer

Examining specific cases of prosumer participation helps illustrate how this concept is applied in real-world scenarios across various industries and sectors. This section delves into significant examples of prosumer involvement in academic research, focusing on key sectors.

7.1. Energy Market

Prosumers significantly impact renewable energy production by installing solar panels, wind turbines, and other renewable systems [32], contributing to green energy generation and reducing reliance on fossil fuels. This decentralized approach enhances the resilience of the energy grid and accelerates the transition to a sustainable energy system, as seen in Germany's Energiewende policy. Prosumers also play a vital role in smart grids [6,9], where real-time data exchange with utility providers optimizes energy distribution and reduces wastage. By supplying excess energy back to the grid, they support grid stability and reduce peak load pressures. Additionally, prosumers engage in peer-to-peer (P2P) energy trading, fostering a decentralized energy market and potentially leading to more competitive energy prices.

For instance, in Germany, prosumers install solar panels on their rooftops, generating electricity for personal use and feeding excess power back into the grid. This practice not only reduces reliance on fossil fuels but also poses challenges such as grid stability and the need for advanced energy storage solutions. Prosumers benefit from reduced energy costs and environmental contributions, but they also face challenges related to initial investment costs, maintenance, and regulatory hurdles [10,29]. A detailed analysis of these aspects provides a comprehensive understanding of the practical implications and challenges in the energy sector.

7.2. Healthcare

The prosumer model in healthcare significantly empowers and engages patients, enabling them to take an active role in managing their health through digital tools like wearable devices or trackers, mobile health apps, and online communities. This active participation allows patients to monitor their health, access medical information, and communicate with peers and professionals in real time, leading to better-informed decisions and improved health outcomes. Additionally, the model facilitates the co-production of healthcare services, where patients collaborate with providers to design personalized care plans, enhancing care quality [2]. Prosumers also contribute to preventive and predictive health by using digital tools to engage in proactive health management, leveraging data to detect early signs of health issues and identify potential risks, thereby reducing chronic disease incidence and healthcare costs.

7.3. Education

In the education sector, students have transformed from traditional passive consumers of a teacher-centered instruction into active participants in the creation and dissemination of knowledge. The development of the teacher–prosumer dynamic, as mentioned in the Introduction, is a direct result of the increased autonomy students have gained during the COVID-19 pandemic. This dynamic promotes a collaborative relationship where teachers and students co-create educational content. This shift has led to a more personalized and student-centered education, where students not only learn but also actively participate in the creation of knowledge alongside their peers and educators [12]. Teachers act as mentors, providing resources and support while allowing students to explore topics of interest deeply [12]. This approach caters to individual learning styles and enhances critical thinking and problem-solving skills. The teacher–prosumer dynamic represents a significant shift towards a more engaged and collaborative learning environment [12].

7.4. Agriculture

In agriculture, prosumption involves individuals producing food primarily for their own consumption, blending production and consumption in a self-sustaining manner [15]. This form of prosumption is often driven by personal satisfaction rather than community sharing, highlighting a more individualistic but also more resilient and possibly sustainable approach to food production and consumption.

7.5. Art

In the arts, the integration of information and communication technologies (ICTs) has significantly altered the relationship between artists and their audiences [22]. Artists increasingly engage with viewers, audiences, and fellow artists to co-produce artworks, breaking away from the traditional model of isolated creation. This collaborative approach has transformed viewers and audiences from passive consumers into active prosumers who provide feedback and contribute to the artistic process. Digital platforms and social media enable artists to reach a global audience, receive immediate feedback, and connect with diverse communities, further blurring the lines between creator and consumer. For example, platforms like DeviantArt and Behance allow artists to share their work and receive feedback from a global community. This interaction not only helps artists improve their work but also creates a collaborative environment where ideas and techniques are exchanged. Challenges in this space include protecting intellectual property, managing online reputations, and navigating the commercialization of art in digital spaces [22].

7.6. Fashion

In the fashion industry, prosumption is influenced by socio-cultural and economic factors [13,14]. Transnational prosumers engage in luxury reselling to achieve autonomy, flexibility, and mobility, creating a global circuit of luxury goods. The behavior of fashion prosumers is thus heavily influenced by societal and cultural factors, with fashion trends often dictated by the elite and ruling classes rather than the prosumers themselves. Prosumers in fashion often participate in designing and customizing their own clothing, leveraging platforms like Instagram and Etsy to share and sell their creations. This participation drives innovation but also presents challenges such as intellectual property issues and the sustainability of custom-made items. Detailed case studies reveal how prosumers navigate these challenges while contributing to the fashion industry's evolution [13,37].

7.7. 3D Printing

The advent of 3D printing technology has empowered consumers to become prosumers by providing access to 3D printers and materials. Motivated by financial rewards, personal satisfaction, and the desire for customization and personalization, these prosumers create, sell, and purchase 3D-printed products. This transformation has enabled individuals to actively participate in the production process, offering tailored solutions to consumer needs and fostering innovation within the community [15].

7.8. Bitcoin Mining and Cryptocurrency

Bitcoin mining exemplifies a technologically driven form of prosumption. Miners, equipped with high-performance hardware and software, validate transactions by solving complex mathematical problems, earning new Bitcoins as rewards. This lucrative activity transforms Bitcoin buyers into miners who contribute to network security and stability while reaping financial benefits [16]. Prosumers in this domain form communities to share information and trade Bitcoins, enhancing the overall robustness and interconnection of the Bitcoin ecosystem.

The specific applications of prosumers in the various fields illustrate their potential to drive significant advancements in these fields.

8. Future Outlook on the Prosumer

Discussing the future development of prosumers inevitably involves examining their relationship with contemporary capitalism. Some scholars have explored this issue in detail, with a small group expressing a pessimistic outlook [38]. They argue that the shift from producer capitalism to consumer capitalism and then to prosumer capitalism leads to dual exploitation within the economic system. This shift results in power imbalances and economic disadvantages for prosumers. Factors such as knowledge disparities, power differentials, dependency on technology, ethical considerations, and competitive pressures may eventually cause prosumers to revert to being merely producers or consumers. Knowledge disparities among prosumers can create inequalities in the ability to effectively navigate and utilize prosumer systems, disadvantaging those with limited resources or expertise. Power differentials in regulatory environments often favor larger corporations over individual prosumers, limiting their influence and hindering their development [13]. Dependency on advanced technologies, which are complex and require ongoing education, can also be a barrier [16]. Ethical considerations, including data privacy and intellectual property rights, raise significant concerns [7]. Finally, competitive pressures from traditional producers and large corporations can make it difficult for small-scale prosumers to establish and maintain a foothold in the market, leading to stress and potential burnout.

However, other scholars hold a more optimistic view [39], considering prosumption as primordial and potentially more fundamental than production or consumption in human nature. They argue that a new form of capitalism is emerging—unpaid labor, free products, and an abundance that replaces scarcity, with a focus on effectiveness rather than efficiency [37]. This new capitalism is characterized by the following [37]:

1. The combination of production and consumption.
2. Increased centrality in the modern economy, driven by the Internet and Web 2.0.
3. Control and exploitation dynamics.
4. Abundance over scarcity; prioritizing effectiveness over efficiency.
5. Resistance to capitalist control.
6. A unique relationship with capitalism, where companies interfere less with prosumers producing and consuming content.
7. The freedom and creativity of consumers.
8. Challenges for traditional capitalism, such as the cyber-libertarian ethic and resistance from prosumers towards capitalist control.

In the context of rapid technological development, landmark changes such as the rise of the Internet and social networking sites are expected to expand prosumption. The decline in traditional production in developed countries has increased prosumption practices. Despite current ethical issues and capitalist exploitation hindering prosumer development, many scholars believe that improvements in regulations and rules, along with innovations and technological advancements, will likely promote more prosumption. Web 2.0 platforms like social media, content-sharing sites, and user-generated content on the Internet will continue to foster a prosumption culture [35].

From a sustainability perspective, the development of prosumers is expected to enhance renewable energy technologies [40] and construct blockchain and decentralized energy markets, which will improve market efficiency and competitiveness. Prosumers will also drive grid modernization and infrastructure development [41]. From a social development perspective, prosumers will promote growing environmental awareness and improve community engagement and collaboration, thereby driving technological development.

From the perspective of other emerging technology industries, prosumers transitioning from consumers play a pivotal role in shaping the future of 3D printing, who have transformative potential in driving innovation, customization, and decentralized manufacturing practices within the 3D printing industry [7].

Overall, the future outlook for prosumers is promising, driven by technological advancements, supportive regulatory frameworks, and evolving societal attitudes. However, realizing the full potential of prosumerism will require addressing various challenges,

including technological risks, market dynamics, and scalability barriers. With the right policies, investments, and community engagement, prosumers can play a pivotal role in creating a sustainable, resilient, and inclusive social landscape.

9. Conclusions and Prospects

Since Alvin Toffler formally introduced the concept of the prosumer in 1980 [1], prosumption has undergone significant development, ultimately blurring the lines between producers and consumers and generating new ideas beyond the traditional production–consumption dichotomy. The transformative role of prosumers in society underscores their potential to contribute significantly to sustainable development, innovation, and enhanced service delivery. The journey of prosumerism, from its theoretical foundations to practical applications, reveals a dynamic interplay of technological advancements, regulatory evolution, and societal changes.

In the realm of renewable energy, prosumers are pioneering a shift towards decentralized energy systems [32,40,42]. By adopting renewable energy technologies, participating in smart grids, and engaging in peer-to-peer energy trading, prosumers are reducing dependence on centralized power plants and enhancing grid resilience. The future of energy prosumerism looks promising with the integration of artificial intelligence, blockchain, and the Internet of Things (IoT), which will further optimize energy production, distribution, and consumption.

Looking ahead, the future of the prosumer concept is promising, with several emerging trends poised to shape its trajectory. Technological advancements, such as artificial intelligence, blockchain, and the IoT, will further empower prosumers by providing them with sophisticated tools for participation and co-creation. These technologies will enable more seamless and secure interactions, fostering greater trust and collaboration between prosumers and organizations. By addressing the challenges and leveraging the opportunities, prosumers can contribute to a more resilient, equitable, and sustainable future.

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