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Society 5.0: Shaping the future of e-commerce

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ABSTRACT

This paper explores the impact of Society 5.0, a Japanese initiative that integrates digital and physical spaces to address societal challenges and drive economic growth. It examines the role of decentralized technologies in enhancing e-commerce by adapting to consumer behavior changes and improving market dynamics. The study details the transition from Web 1.0's basic functionalities to the more interactive and social Web 2.0, setting the stage for a more integrated and intelligent e-commerce environment under Society 5.0. This new paradigm emphasizes personalized consumer experiences facilitated by AI and big data, focusing on real-time data, predictive analytics, and tailored services. The paper also addresses how Society 5.0 prioritizes sustainability and ethical practices in AI, aligning e-commerce strategies with global sustainability goals through eco-friendly practices and green logistics. The methodology involves a detailed literature review using specified databases over a defined period, applying rigorous criteria for article selection and classification to ensure comprehensive topic coverage. This research highlights the potential of cutting-edge technologies to revolutionize e-commerce by making it more secure, efficient, and aligned with consumer expectations and environmental standards. The research employs a qualitative approach, synthesizing existing literature on Society 5.0 and its potential impact on e-commerce. We explore how blockchain and big data will personalize experiences, enhance operational efficiency, and introduce new products and services. While acknowledging the limitations of relying solely on secondary literature, the paper underscores the need for future research to include empirical studies and address challenges like data privacy, the digital divide, and evolving regulatory frameworks within the e-commerce landscape.

1. Introduction

Society 5.0 (Japan 2016), also known as the "Super Smart Society," is a concept that originates from Japan's 5th Science and Technology Basic Plan, which the Japanese government proposed in the early 21st century. It represents a vision for the next stage of human evolution following hunter-gatherer societies (Society 1.0), agricultural societies (Society 2.0), industrial societies (Society 3.0), and information societies (Society 4.0). Society 5.0 aims to integrate digital technologies, like artificial intelligence (AI), robotics, the Internet of Things (IoT), and big data analytics, into every aspect of life. This futuristic society seeks to balance economic advancement with resolving social problems by integrating cyberspace with physical space. The goal is to create a human-centered society where technology is harnessed to enhance the quality of life, ensure sustainable development, and solve pressing

societal challenges such as aging populations, labor shortages, and environmental degradation.

Key Characteristics (Japan 2016):

- **Cyber-physical integration:** Blending the physical and digital worlds through technologies like IoT and immersive experiences. Society 5.0 aims to converge cyberspace (digital or virtual space) with physical space, where data collected by IoT devices in the physical world is analyzed in cyberspace and then used to provide value to the real world.
- **AI-driven decision-making:** Leveraging AI for optimized decision-making in various sectors. The backbone of Society 5.0, ICT encompasses the Internet, AI, big data, and the IoT, forming the infrastructure supporting seamless connectivity and information access.

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- Decentralization and personalization: Empowering individuals with personalized services and solutions tailored to their needs.
- Sustainability and resilience: Focusing on technologies promoting environmental and societal resilience.
- Intelligent automation and Robotics: Automating labor-intensive tasks and integrating robotics in manufacturing, healthcare, and other sectors to enhance productivity and address labor shortages.

Society 5.0 paves the way for Industry 5.0, which evolves from Industry 4.0 with robotics, digitalization, and cyber-physical systems at heart, profoundly influencing technological innovations. (Mubarak and Petraite, 2020) by weaving together human and machine intelligence. This progression aims to create synthetic environments that tackle the inequalities in resources, data, and cognitive capabilities between humans and machines. It aims to enhance human creativity and machine efficiency in a symbiotic relationship, incorporating cyber-physical-social elements into industrial processes. This new era emphasizes collaboration, digital-physical interactions, and a seamless blend of the Internet of Things, Devices, Minds, and People, promoting a future where humans and robots work together in optimized, secure, and adaptable cyber-physical systems. For a more detailed exploration, please refer to the source.

Web 1.0, emerging in the 1990s, was static web pages mainly focused on information retrieval, presenting limited interactivity later, transitioning into the 2000s, Web 2.0 marked the rise of social media and user-generated content. The advent of Web 3.0, continuing from the 2010s onwards, introduced a semantic web that integrates decentralized, secure, and intelligent technologies, notably AI and blockchain, to seamlessly connect the real and virtual worlds, emphasizing the

development of decentralized web protocols (Janani et al., 2023; Kukreja et al., 2023; Sandal et al., 2023). With significant potential for integrating AI, biotechnology, and blockchain, thus heralding a new era of web technological advancements (Ibrahim Khaleel 2021).

Blockchain technology and smart contracts are revolutionizing centralized systems by introducing Decentralized Autonomous Organizations (DAOs) across various economic sectors. DAOs operate collectively yet are decentralized, driven by smart contracts and blockchain technology. This setup grants members voting rights for decision-making, ensuring a democratic and transparent operational system. (Hsieh et al.,2018).

Wang et al. introduced a framework called Human Autonomous Organization (HAO) (Wang et al.,2023), See Fig. 1. within the context of Society 5.0 and Industry 5.0. This concept focuses on placing human needs at the core of a smart society, integrating them with smart technologies. The framework acknowledges the critical influence of socio-biological factors on cultural, social, and organizational aspects, promoting a model for decentralized collaboration. Using blockchain and smart contracts, HAOs aim to facilitate large-scale collective projects in a fair, transparent manner that aligns with fundamental human values and needs. Hence, Industry 5.0 was announced by the European Union, which emphasizes three core values: (a) supply chain resilience, (b) positive conversion impact on society, and (c) sustainability (Madhavan et al.,2022).

The conceptual framework for Human Autonomous Organizations (HAOs) integrates decentralized management and automation primarily through blockchain technology, facilitating a blend of digital operations with physical processes. This structure fosters a community-driven model where decision-making processes are democratized and

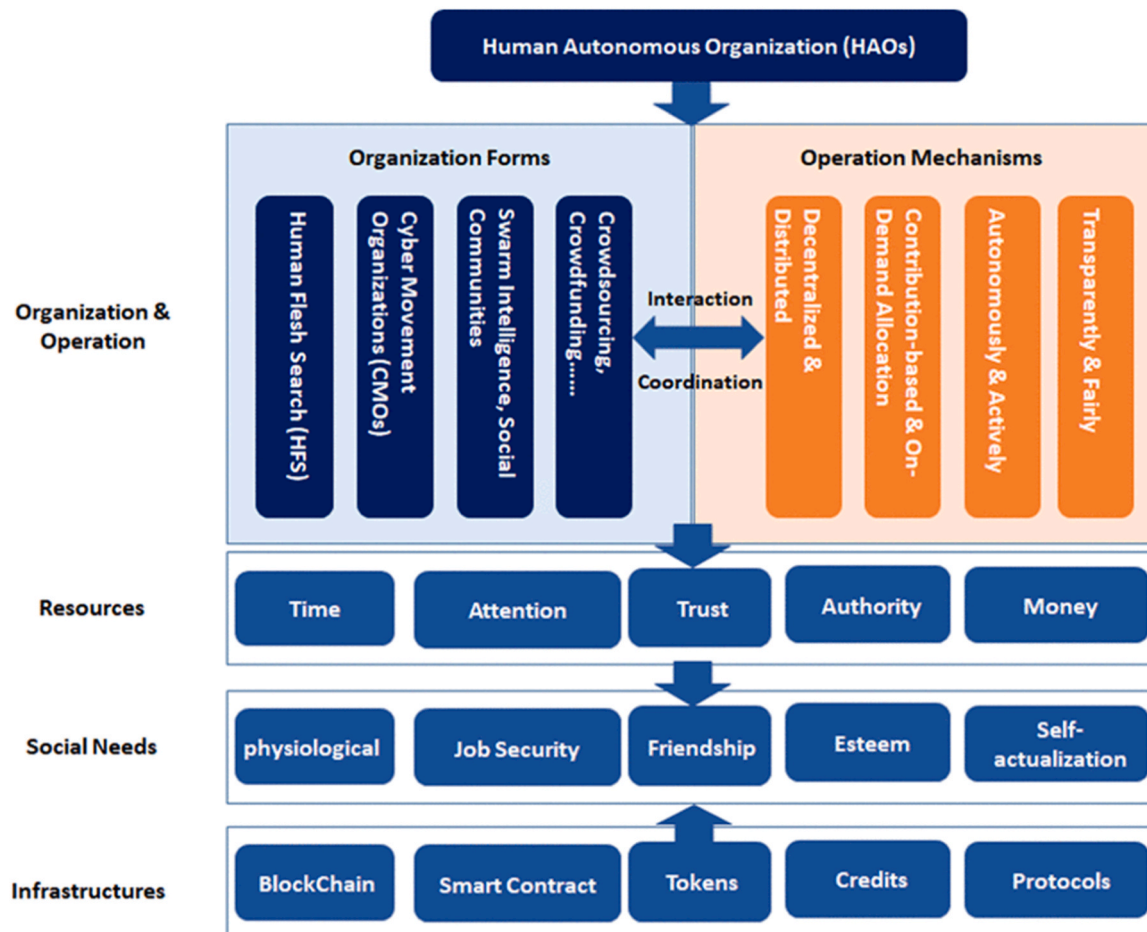


Fig. 1. Human Autonomous Organization framework. (Wang et.al., 2023).

participatory, underpinned by a self-regulating system that manages governance internally without central oversight. Key operational mechanisms include ensuring operation completeness and accuracy through automated systems, autonomy and agency allowing for independent decision-making, and a focus on reliability and agility to adapt quickly to environmental changes. HAOs, as illustrated in the diagram, are structured to operate within environments that fuse cyber-physical systems. These organizations prioritize decentralized operations and autonomous decision-making, leveraging AI and blockchain technologies to maintain operational efficiency while emphasizing human-centric elements, highlighted by their focus on "Autonomy & Agency" and "Trustworthiness & Agility." Adopting artificial intelligence in HAOs allows for the efficient management of complex tasks, aligning with Society 5.0's goal to harness technology to enhance human abilities and societal welfare. Additionally, the foundational use of blockchain, smart contracts, tokens, credits, and protocols within HAOs showcases their commitment to advanced, decentralized, and secure technologies that foster transparency and trust—fundamental characteristics essential for merging digital and physical dimensions in Society 5.0 and Industry 5.0 environments. Resources vital to HAOs encompass time, attention, trust, authority, and money, each playing a crucial role in the organization's functionality. This framework represents a significant shift towards integrating technology in organizational management, highlighting the potential for technology to enhance operational efficiencies and foster a sustainable, inclusive environment.

The key components of Society 5.0 include the widespread use of AI to make informed decisions beyond human capability, big data to improve public services and healthcare, and autonomous vehicles and smart cities to make transportation and urban living more efficient and accessible. In the Authors' creation of Fig. 2. we can see societies in the digital timeline and their positioning in a centralized environment.

As historical societies have been described in the document (Japan 2016) Society 1.0 - Hunter-gatherer societies, where survival depended on directly gathering resources. Small, nomadic groups operated independently with minimal hierarchy or centralized authority, relying on communal decision-making processes. Society 2.0 - Agricultural societies, marked by developing farming technologies and stable settlements. This era saw the centralization of resources and early forms of governance, laying the groundwork for structured communities. The advent of agriculture introduced more centralized systems, as communities settled and formed larger groups that required coordinated farming and city planning efforts. This era saw the rise of hierarchical structures to manage resources and decision-making, centralized in the hands of leaders or governing bodies. Society 3.0 - Industrial societies,

characterized by the Industrial Revolution. This period brought about significant technological advancements in manufacturing and production. Industrialization further amplified centralization by establishing factories, urban centers, and the concentration of labor and resources in specific geographical areas. Economic and political power became highly centralized, creating large corporations and industrial complexes with top-down management styles. Society 4.0 - Information societies, driven by the digital revolution. Information technology began to permeate every aspect of human life, leading to the development of the Internet and digital communication technologies. While still centralized, the control over information and data became more dispersed than in previous societies. Society 5.0 - A super-smart society that integrates digital and physical realms, leveraging advanced technologies like AI, IoT, and big data to enhance human life and solve societal problems. IoT is emerging as a technological ecosystem that facilitates the application of computing capabilities to virtually anything, anywhere, and anytime. Due to its inherent versatility and accessibility, this network of interconnected devices and users is susceptible to cyber-attacks (Otta and Panda, 2022). Unlike its predecessors, Society 5.0 emphasizes decentralization through technologies like blockchain, which allows for more distributed and peer-to-peer interactions. However, it operates within a centralized framework by utilizing vast, interconnected networks and systems controlled by overarching technological infrastructures.

The term "Society 5.0" has gained significant traction recently, yet its definition remains nuanced and multifaceted. However, understanding its core principles and origins is crucial to assessing its potential impact on various domains, including e-commerce. The term "Society 5.0" (Deguchi et al.,2020) was coined in Japan. It was first introduced in Japan's 5th Science and Technology Basic Plan by the Council for Science, Technology, and Innovation (CSTI), which operates under the Cabinet Office of the Government of Japan. This plan was adopted in 2016, aiming to guide the country through technological innovation towards enhanced economic growth and social welfare as a human-centered society that leverages the integration of cyberspace and physical space (CPS) to achieve economic development and solve social challenges by utilizing AI, big data, IoT, and other cutting-edge technologies.

The research question (RQ) for this study is:

How does the decentralization of digital technologies influence the evolution of e-commerce technologies within Society 5.0?

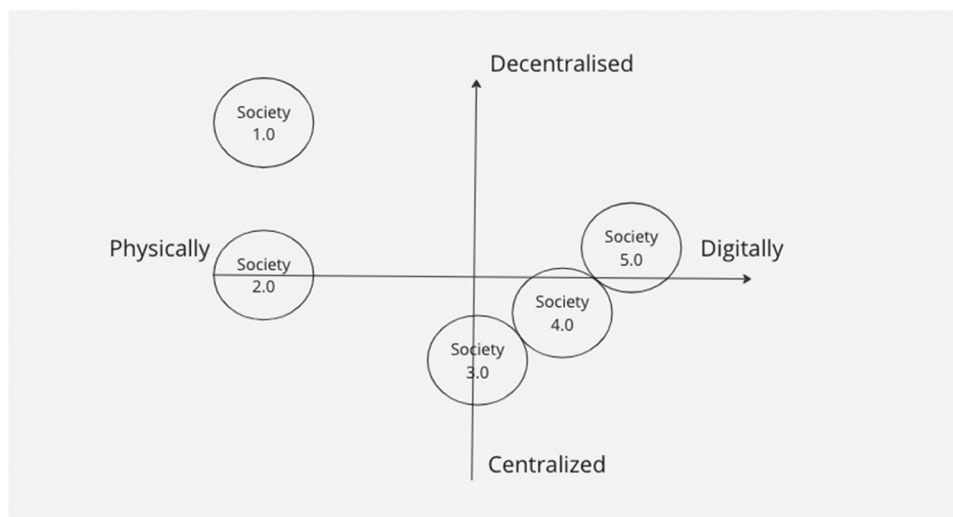


Fig. 2. Societies in the digital timeline and positioning in a centralized environment (Authors created).

2. Research approach

Researchers primarily use academic databases such as Scopus, Web of Science (WOS) to review literature. The authors used the Scopus database to search for relevant research with the keyword “Society 5.0” in the article title, abstract, or as a keyword. While researching Society 5.0 as necessary, the main literature review analysis was conducted when the authors focused on Society 5.0 in the context of e-commerce. A new literature review was conducted to analyze Society 5.0 in the context of e-commerce and Web3. For that, the authors also used the Scopus database and put keywords such as “Society 5.0” selected for the years of 2020–2023. Authors’ search yielded 658 papers on WOS (Fig. 3), with the earliest paper dating back to 2016.

Over half of these papers were related to computer science and engineering, while 77 focused on education and 36 on management. Regarding sustainable development goals, 80 studies were associated with health and well-being and 63 with education quality. Scopus revealed 370 papers on the Society 5.0 keyword, see Fig. 4. showing an increasing interest in this area, especially from 2019 to 2021, where the number of documents doubled from 16 to 97.

The articles retrieved from both search strategies underwent a rigorous selection process based on predefined inclusion and exclusion criteria. Articles were included if they focused on the concept of Society 5.0 (initial search) or the intersection of Society 5.0 and e-commerce (focused search). Were published in peer-reviewed academic journals. Were written in English. Articles were excluded if they were irrelevant to the research topic, were non-academic publications (e.g., editorials,

opinion pieces), or were not written in English.

Employing a literature review approach, the study seeks to identify and analyze these platforms within the framework of Society 5.0, a vision emphasizing human-centric solutions and technological integration. Through a rigorous review process, relevant articles will be identified and analyzed to confirm core e-commerce functionalities facilitated by blockchain technology and used to extract information about the platforms themselves. This information may include platform names, website URLs (if available), specific blockchain functionalities, and benefits and limitations discussed in the literature. After the findings, we will evaluate specific e-commerce solutions related to Society 5.0. Authors search specific cases of e-commerce solution with the Google search engine solution. Specific case studies of blockchain technology platforms, such as Uniswap, SushiSwap, Power Ledger, and Everledger, are examined to identify practical implementations of decentralization in e-commerce. These cases provide insights into the operational mechanisms, benefits, and challenges of integrating blockchain into commercial activities. The analysis aims to understand how these decentralized platforms contribute to the efficiency, security, and consumer empowerment in e-commerce. Data is collected from both primary and secondary sources. Primary data collection involves research on blockchain-based DAO platforms. Secondary data is gathered from existing research and databases to supplement and corroborate primary data findings.

This methodological framework ensures a robust understanding of how Society 5.0’s integration of decentralization principles can transform e-commerce, highlighting both the transformative potential and

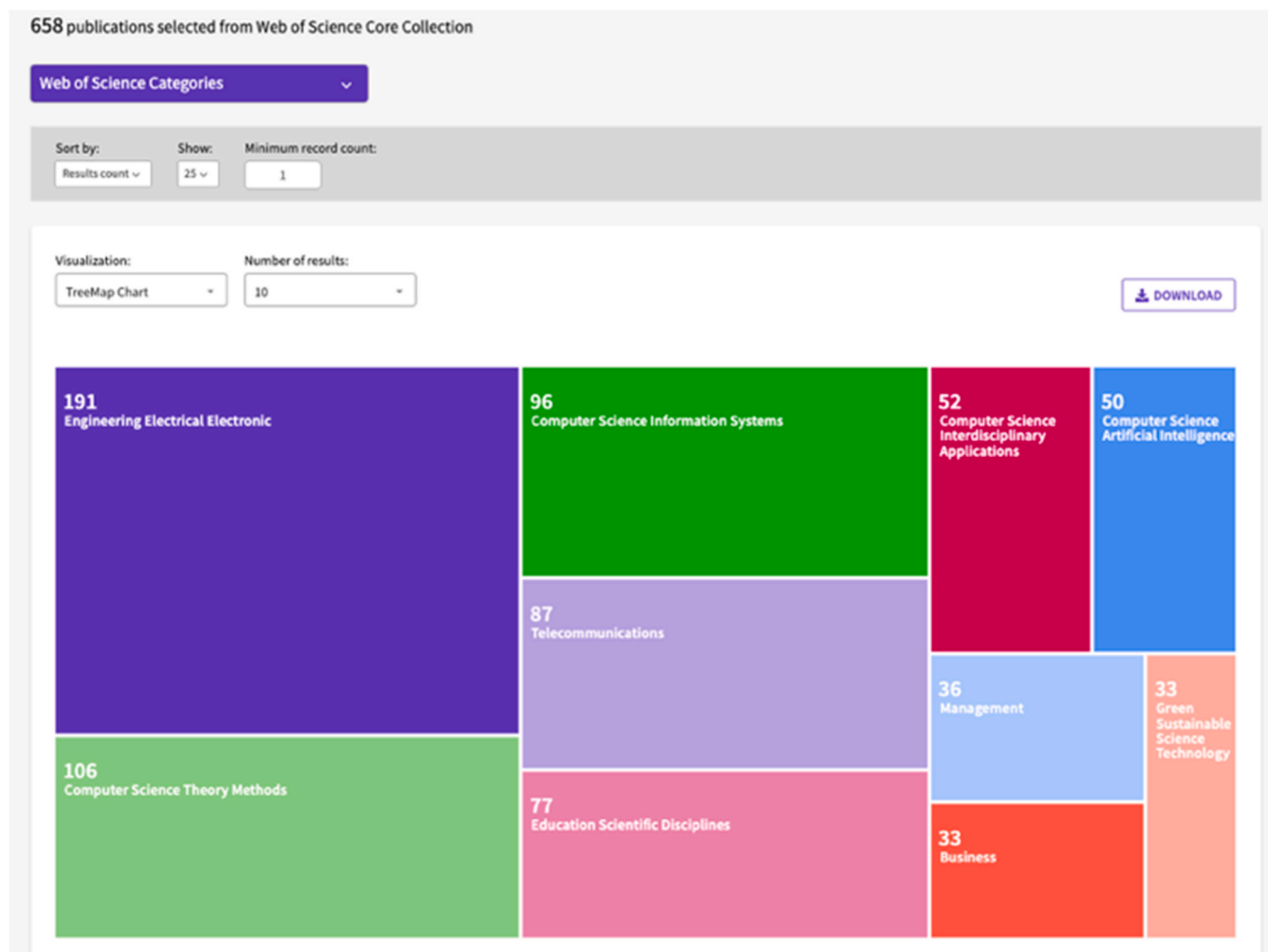


Fig. 3. Society 5.0 research on Web of Science.

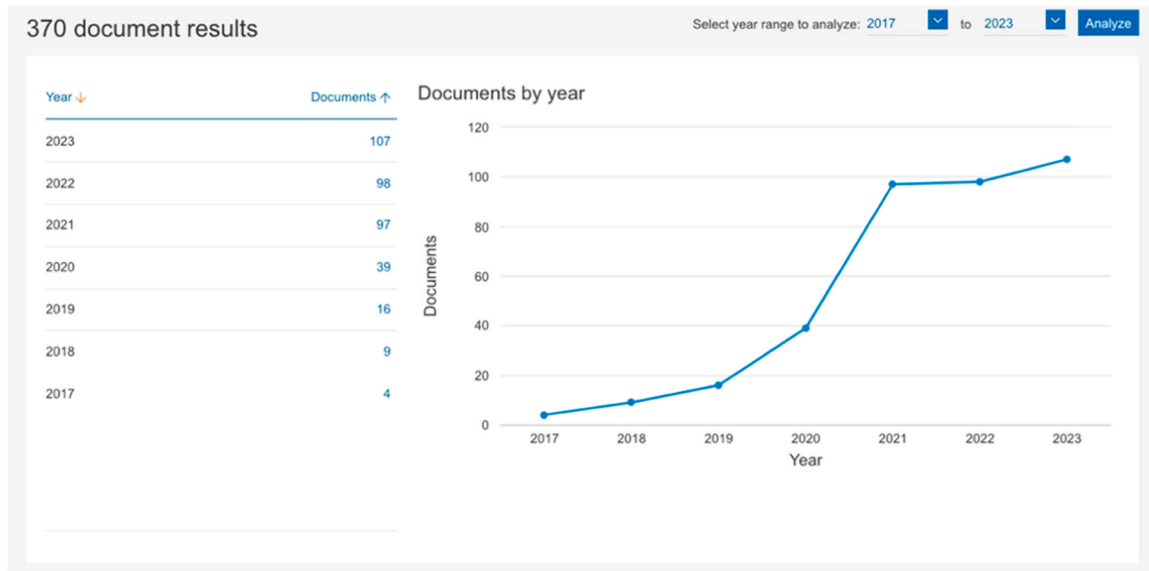


Fig. 4. with keyword Society 5.0 documents on Scopus.

the complexities of adopting these technologies.

While technological advancements in the blockchain and Web3 sectors are significant, there is a substantial gap in consumer understanding, which could impact the adoption and integration of these technologies in various markets. This research aims to investigate consumer awareness regarding blockchain and Web3 technologies and assess the market implications of these technologies' maturation. Data for this study was collected using a multi-source approach to gain a comprehensive understanding of the global awareness and perceptions of blockchain and Web3. Primary data: the research utilized findings from multiple global surveys conducted by reputable organizations such as Harvard Business Review, Consensus, and the Coinbase Institute. Secondary data and industry reports from Gartner and GlobalData provided projections for the growth and maturation of blockchain-related technologies and market valuations.

The study synthesized data from different sources to present a coherent analysis of the current state of consumer knowledge and the

potential trajectory of blockchain and Web3 technologies. This included integrating survey data with market growth predictions to assess how consumer awareness could impact market developments.

The key steps of the literature are summarized in Fig. 5. The remaining articles were then thoroughly reviewed and make research. The authors selected key papers that provided insights into Society 5.0 and e-commerce.

The authors employ a structured methodology that incorporates three primary search strategies. First, using pre-determined keywords, an Academic Database Search is conducted across prominent databases such as Scopus, Web of Science, and Google Scholar. The search outputs are tailored to feature articles from the social sciences and business sectors from 2017 to 2023, prioritized by their relevance. Secondly, a practical application search is executed using the Google search engine, aiming to identify e-commerce solutions that align with Society 5.0 principles and showcase features of decentralized autonomous organizations. The search terms include "decentralized autonomous

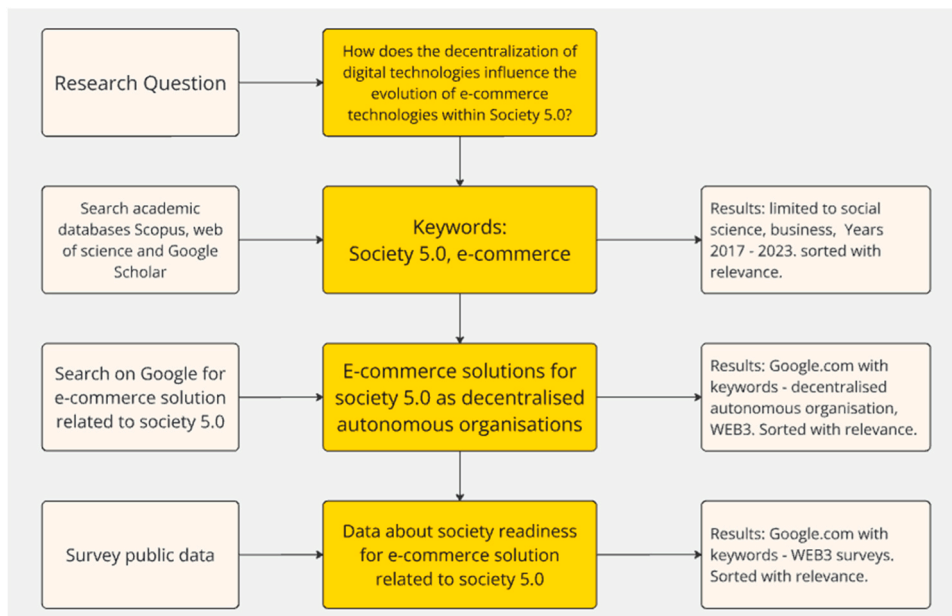


Fig. 5. The research process of the articles.

organization" and "WEB3." Lastly, a survey of public data is undertaken to assess the societal preparedness for implementing e-commerce strategies pertinent to Society 5.0. This survey also utilizes Google.com, employing keywords specific to WEB3 surveys and sorting the results by relevance to ensure the collection of the most relevant data.

3. Literature review and the theoretical framework of the research

The theoretical framework of a research project on literature review provides a structured foundation that guides the analysis of previous studies, linking them with broader theoretical propositions and helping to shape the research focus. In exploring decentralized e-commerce platforms via a literature review, the theoretical framework might integrate elements from information systems, decentralization theory, and consumer behavior. This research leverages this theoretical framework to examine how e-commerce solutions can be designed to align with the principles of Society 5.0. The literature review will explore how emerging technologies like blockchain can be integrated into e-commerce platforms. This theoretical framework and methodological approach enable a comprehensive understanding of the existing body of knowledge on decentralized e-commerce platforms, facilitating a structured exploration of how these platforms can be optimized better to serve businesses and consumers within the digital economy. By analyzing how these technologies contribute to a human-centric and technologically integrated e-commerce landscape, the research aims to provide insights for businesses developing solutions within the framework of Society 5.0. The objectives of the research are to assess the influence of digital technologies' centralization on the evolution and positioning of societies along the digital timeline, to evaluate the impacts of decentralization on the development and effectiveness of e-commerce technologies under the framework of Society 5.0, to determine the current level of societal understanding regarding Web3 technology.

3.1. The historical digital timeline of the influence of digital technologies' centralization on societies' evolution and positioning

E-commerce is undergoing a significant transformation as Society 5.0, characterized by cyber-physical integration and advanced technologies, unfolds. Integrating advanced technologies, a hallmark of Society 5.0, has allowed e-commerce to become more personalized, efficient, and customer-centric. The advent of big data analytics, AI, IoT, and blockchain has enabled businesses to offer highly customized shopping experiences, predictive analytics for inventory management, and secure, transparent transactions. Early stages of E-commerce technologies:

- Web 1.0 (1990s): Simple websites, basic transactions, limited interactivity (Kollmann and Lomberg, 2010). Web 1.0, or the "Document Internet," was characterized by static web pages and a hierarchical structure (Stapelkamp, 2010). It was primarily focused on information retrieval and lacked later versions' interactive and social features (Nath et al., 2014).
- Web 2.0 (2000s): Rise of social media, user-generated content, personalized experiences (Wigand et al., 2008). The transition to Web 2.0 introduced user-generated content, social networking, and a shift towards a read-write ecology (Rosen and Nelson, 2008).
- Web 3.0 (2010s onward): Semantic web, decentralization, AI-powered interactions (Janani et al., (2023)). Web 3.0, the next generation of the internet, is characterized by its decentralized, secure, and intelligent nature (Kukreja et al., 2023) and is envisioned to bridge the gap between the real and virtual worlds (Silva et al., 2008). The use of blockchain and token-based economy is a key focus of Web 3.0 and is also associated with developing decentralized web protocols (Sandal et al., 2023).

- WEB 4.0 (21. century): There must be a clear definition for Web 4.0, a 4th-generation web technology, in the literature. Web 4.0 has multiple dimensions, as seen in the first examples. Big data, augmented reality, machine-to-machine (M2M) communication, cloud computing, and artificial intelligence (AI) technologies, as well as smart agents, will be able to integrate in the future years (Ibrahim Khaleel 2021). Integrating AI, biotechnology, and blockchain could usher in a new era of web technology advancements.

Digital transformation has profoundly impacted e-commerce, shaping everything from customer experiences to business models. Studies have shown positive effects, such as increased efficiency, improved customer engagement, expanded market reach, and revenue growth (Purcarea, 2020). Digital transformation presents various challenges for organizations, particularly in software engineering (Gebhart et al., 2016). These challenges include the need for new business models, the impact of digitization on software development, and the development of mobile devices and the Internet of Things applications (Heavin and Power, 2018). Further identifies managers' dilemmas in operationalizing digital transformation, proposing a decision support guide to address these challenges (Kozak-Holland and Procter 2020). Emphasizes the role of project management in enabling digital transformation, highlighting the potential for project failure due to the scale of transformations.

The Web2.0 era, characterized by platforms benefiting from significant network effects, culminated in major BigTech entities controlling extensive data volumes, thereby dominating the Cloud services market. This data control enables these platforms to offer quasi-trust services, integrating deeply into digital transactions. The omnipresence of Big-Tech in authentication and data validation processes underscores the competition with traditional trust institutions. Addressing this, regulatory and innovative measures aiming at decentralization and the advancement of Web3 are crucial for diversifying digital verification methods and reducing data monopolies. For more insights, consider exploring sources discussing the evolution of digital platforms and regulatory frameworks (EBSI, 2023).

Digital transformation has reshaped e-commerce by introducing various technologies that have changed how consumers shop and interact with brands. Transformation impacts many areas, such as data-driven decision-making, leveraging big data and analytics for personalized marketing, dynamic pricing, and integrating various technologies such as the Internet, mobile applications, data analytics, and artificial intelligence (Azaryan and Makhnonosov, 2023). This transformation has led to the emergence of new business models and the need for a culture of innovation and disruption (Purcarea, 2020). It has also expanded the role of the Internet in retailing, going beyond e-commerce to include digital services, mobile devices, and social media (Hagberg et al., 2014). As a result, customer behavior has evolved, shifting towards online purchasing and using digital devices in the purchasing process (Deng, 2022). The implications of digitalization for physical stores have also been highlighted, with the need for retailers to adapt to the changing landscape (Hagberg et al., 2017). The impact of digital technology on retailing has been discussed, with the need for retailers to build a presence and organize around their consumers' consumption and lived reality (Reinartz and Imschloss, 2017).

3.2. The impacts of decentralization on the development and effectiveness of e-commerce technologies under the framework of Society 5.0

Society 5.0 brings forth a vision of a human-centric society, leveraging advanced technologies to solve societal challenges while achieving economic growth. This vision fosters the emergence of new business models that are sustainable, inclusive, and innovative. Blockchain technology enables businesses to develop decentralized platforms, transforming traditional operations by providing enhanced transparency, bolstering security, and greater user autonomy. Blockchain

enables direct peer-to-peer transactions without the need for traditional intermediaries. This capability simplifies processes, reduces transaction costs, and increases transaction speed. It opens new possibilities for international transactions by minimizing the complexities and costs associated with currency exchange and cross-border transactions.

Smart society will be engaged with smart cities. The study (Yun and Lee, 2019) shows that the future Smart City model is as follows: 1) a new Smart City model that is based on the perspective of costs/benefits that is consistent with the 4th Industrial Revolution, rather than the existing model that is costs-based, 2) to realize the self-organizing Smart City, the 4-stage smart transformation strategies that are based on Smart City social and technology models. It is also suggested that national strategies are needed to pursue constructing Smart City 4.0. This study is valuable because it presents a new way to calculate and maximize the value of a smart city. The formula for it is the size of the city \times connectivity \times entrepreneurship. DAO is one of the key technology resources for creating Smart cities.

Decentralized exchanges (DEXs): Platforms like Uniswap (Uniswap, 2024) and SushiSwap (Sushi, 2024) allow users to trade cryptocurrencies without centralized intermediaries. This offers greater financial freedom and control. By engaging with DEXs, users benefit from enhanced security, as the decentralized nature of these platforms reduces the risk of hacking and fraud associated with centralized exchanges. Additionally, DEXs often provide access to a broader range of cryptocurrencies and innovative financial products, enabling users to diversify their portfolios and explore new investment opportunities. The peer-to-peer trading mechanism inherent in DEXs also ensures that users retain full custody of their funds, promoting a sense of autonomy and trust in the digital asset ecosystem.

Platforms like Power Ledger (Powerledger, 2024) transform the energy sector by enabling individuals to buy and sell renewable energy directly within their communities, bypassing traditional energy providers. This shift introduces a new level of empowerment and autonomy for e-commerce consumers, who can now participate actively in the energy market. By facilitating peer-to-peer energy transactions, consumers access more sustainable and potentially cost-effective energy sources, fostering community engagement and environmental responsibility. Additionally, this model promotes energy independence and resilience, as consumers are no longer solely dependent on large-scale providers and can instead choose where their energy comes from. The ability to trade energy within a community democratizes access to renewable resources and encourages the adoption of green technologies, contributing to a more sustainable and eco-friendly energy landscape.

Everledger's (Everledger, 2024) use of blockchain technology to track and verify diamonds' origins significantly benefits e-commerce consumers. This innovative approach ensures that the diamonds they purchase are conflict-free and ethically sourced, providing peace of mind and fostering trust in the brands. Consumers are increasingly concerned with the ethical implications of their purchases, and this transparency allows them to make informed decisions aligned with their values. Additionally, the immutable nature of blockchain records offers an added layer of security and authenticity, reducing the risk of counterfeit products in the market. By prioritizing ethical sourcing and transparency, these platforms enhance consumer confidence in their products and contribute to a more responsible and sustainable global diamond industry.

The emergence of decentralized blockchain platforms for video (Dtube, 2024), audio (Audius, 2024), and advertising represents a significant shift in how e-commerce consumers interact with content and advertisements. These platforms decentralize content control, shifting power from traditional centralized entities to the creators and consumers. For e-commerce consumers, this means access to a broader range of unfiltered and diverse content and more direct engagement with creators without intermediaries.

Decentralized advertising platforms disrupt conventional advertising

models by offering more transparency in transactions. Consumers benefit from enhanced privacy, as blockchain technology provides more control over personal data and reduces unsolicited advertisements. Some decentralized platforms reward consumers for viewing ads or participating in content curation, fostering a more interactive and rewarding online experience. For example, The Brave (Brave, 2024) web browser, launched in 2016, stands out for its emphasis on privacy, ad-blocking capabilities, and fast browsing experience, serving over 25 million global users. Utilizing Chromium's source code minus Google's privacy-compromising software, Brave offers a Chrome-like experience with enhanced privacy. It's distinguished by not profiting from user data sales, integrating blockchain technology, supporting crypto wallets, and being notably faster than other browsers. Its Web 3.0 features include the Ethereum-based Basic Attention Token (BAT) for rewarding ad viewing and an integrated, secure crypto wallet, making it less prone to security threats.

Researcher Yun proposes that open innovation can motivate individualism by increasing individual creativity (Yun et al., 2017). In Fig. 6 can see the dynamic relation between individualism and collectivism in open innovation. Successful innovation increasingly depends on the effective recombination of knowledge inputs across firm boundaries (Mina et al., 2014).

Open innovation within Decentralized Autonomous Organizations (DAOs) represents a transformative approach to collaboration and problem-solving. In DAOs, open innovation facilitates the pooling of collective intelligence and resources from a broad network of participants, not confined by organizational boundaries. This model allows for the rapid iteration of ideas, solutions, and projects, leveraging the strengths of blockchain technology for transparency, security, and trust. For example, DAO Kambria.io (Kambria, 2024) is an open innovation platform for deep tech (AI, robotics, blockchain, VR/AR, IoT, etc.). Via the platform, especially with Kambria DAOs, anyone can collaborate in researching, developing, and commercializing deep tech solutions and get rewarded fairly for their contributions. In a DAO, open innovation can manifest through various mechanisms, such as crowd-sourced funding for new projects, community-driven decision-making processes, and transparent collaboration on development tasks. This approach accelerates innovation and democratizes the process, giving every participant a voice and stake in the organization's direction and success. By integrating open innovation principles, DAOs can efficiently harness their communities' collective creativity and capabilities, leading to more resilient, adaptable, and innovative outcomes aligned with the decentralized ethos of blockchain technology.

Society 5.0 envisions a human-centric society that leverages advanced technologies, such as blockchain, to solve societal challenges, enabling new, sustainable, and innovative business models. Fig. 7 shows the impact of decentralization on technologies related to society 5.0. The authors conducted targeted searches for practical e-commerce solutions using the Google search engine, focusing specifically on Google.com. Their aim was to identify e-commerce solutions that are relevant to Society 5.0, particularly those that exemplify decentralized autonomous organizations. They used keywords such as "decentralized autonomous organization" and "WEB3," and sorted the results by relevance to ensure the most pertinent solutions were identified.

3.2.1. Human-centric society

Society 5.0 aims to solve societal challenges and achieve economic growth by leveraging advanced technologies and fostering the development of new, sustainable, and inclusive business models.

3.2.2. Blockchain technology

Enables the creation of decentralized platforms that transform traditional operations, providing enhanced transparency, security, and user autonomy, facilitating direct peer-to-peer transactions without intermediaries, simplifying processes, and reducing transaction costs and speeds.

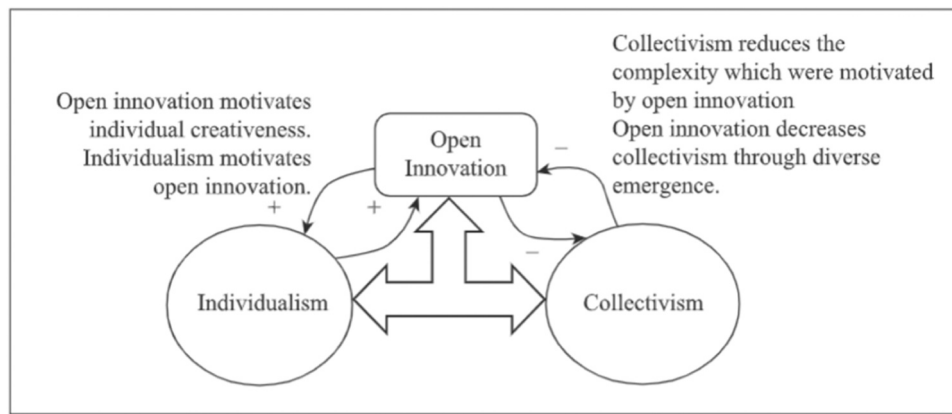


Fig. 6. The Dynamic Relation between Individualism and Collectivism in Open Innovation (Yun et.al, 2017).

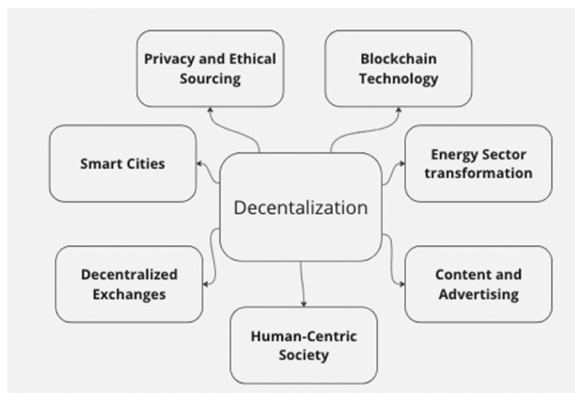


Fig. 7. Decentralization impact on Society 5.0 related e-commerce technologies. (Authors created).

3.2.3. Smart cities

Advocates for smart city models based on cost/benefit perspectives aligned with the 4th Industrial Revolution, emphasizing the need for national strategies to construct self-organizing Smart City 4.0, highlighting the value of DAOs in building these cities.

3.2.4. Decentralized exchanges (DEXs),

Such as Uniswap and SushiSwap, allow for cryptocurrency trading without centralized intermediaries, offering users greater financial freedom and control, enhanced security, access to a broader range of cryptocurrencies, and innovative financial products.

3.2.5. Energy sector transformation

Platforms like Power Ledger enable peer-to-peer transactions of renewable energy within communities, promoting energy independence, sustainability, and environmental responsibility.

3.2.6. Ethical sourcing

Blockchain technology, as utilized by Everledger, tracks and verifies the origins of diamonds, ensuring they are conflict-free and ethically sourced, enhancing consumer trust and contributing to responsible and sustainable industry practices.

3.2.7. Content and advertising

The rise of decentralized blockchain platforms for video, audio, and advertising shifts control from centralized entities to creators and consumers, offering unfiltered and diverse content, direct engagement, and enhanced privacy in advertising transactions.

For e-commerce, this environment cultivates a more trustful and

engaged community. Consumers can make more informed purchasing decisions based on reliable reviews and endorsements directly from trusted content creators without worrying about biased promotions. Moreover, the transparency and security inherent in blockchain technology ensure that transactions, whether they're content purchases or product sales linked to content, are secure and verifiable.

3.3. The current level of societal understanding regarding Web3 technology

Global retail e-commerce sales were expected to reach \$6.3 trillion by the end of 2024 (insiderintelligence, 2024). Projections suggest a 39 percent increase in these figures to reach eight trillion dollars by 2027 (Statista, 2024), Fig. 8. Marketplaces are a significant driver of e-commerce growth: Forrester estimates that two-thirds of all e-commerce occurs through marketplaces. Half of the brands we surveyed said that their sales on marketplaces were growing faster than sales through traditional wholesale (Forrester, 2024). The Web 3.0 sector is on the brink of substantial expansion, propelled by a growing demand for data privacy, the decentralized nature of Web 3.0, and advancements in Internet technology. The burgeoning adoption of digital assets like cryptocurrencies and the rollout of 5 G technologies are also expected to fuel its growth significantly (grandviewresearch, 2024).

Web 3.0 represents the next evolution of the Internet, focusing on a decentralized, intelligent, and interconnected web. Building on Web 2.0's social media and user content, Web 3.0 integrates blockchain, AI, and decentralized applications, aiming for a "Semantic Web" where machines can understand data more effectively. Its decentralization aspect, powered by blockchain, could revolutionize industries by enabling secure, transparent transactions. Growth drivers include the adoption of blockchain and decentralized finance (DeFi) applications, offering financial services without traditional intermediaries, and potentially disrupting and creating new market opportunities (acumenresearchandconsulting, 2024).

Blockchain technology has reached a stage where it supports various business applications, yet it still lacks widespread enterprise adoption due to the absence of transformative applications. While consumer adoption progresses more rapidly, enterprise integration typically follows at a slower pace, reflecting the usual trajectory for emerging technologies. Innovations like blockchain wallets and smart contracts are nearing maturity, expected within five years. However, other areas, such as decentralized identity and non-fungible tokens (NFTs), need to improve on technical issues, regulatory concerns, and interoperability barriers, which need to be improved in business settings. Gartner predicts (Fig. 9) that most blockchain innovations will mature in two to ten years (Gartner, 2024).

The financial services industry has been at the vanguard of emerging Web3 technologies and assets. At one point, the daily volume of

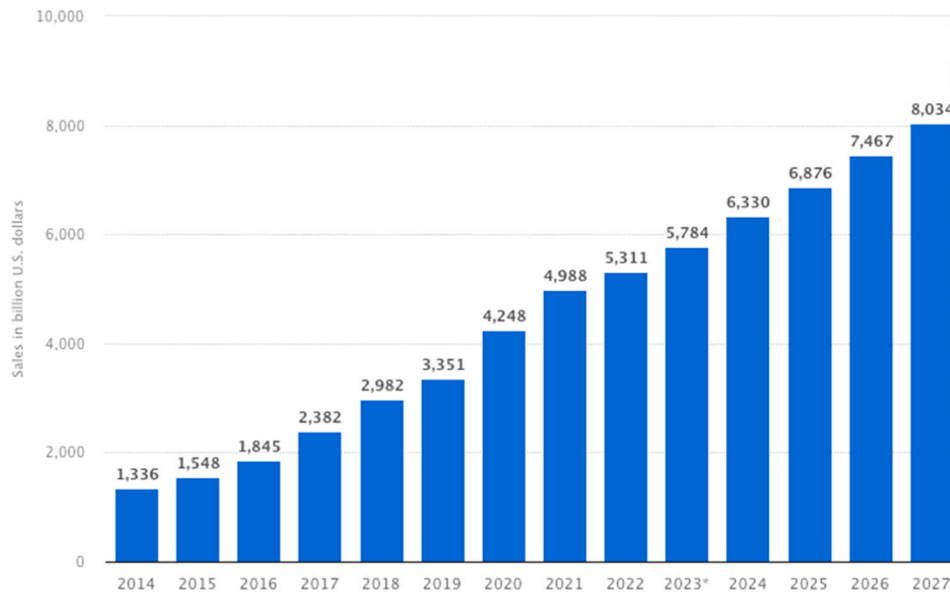


Fig. 8. Forecast of worldwide retail e-commerce sales (Statista, 2024).

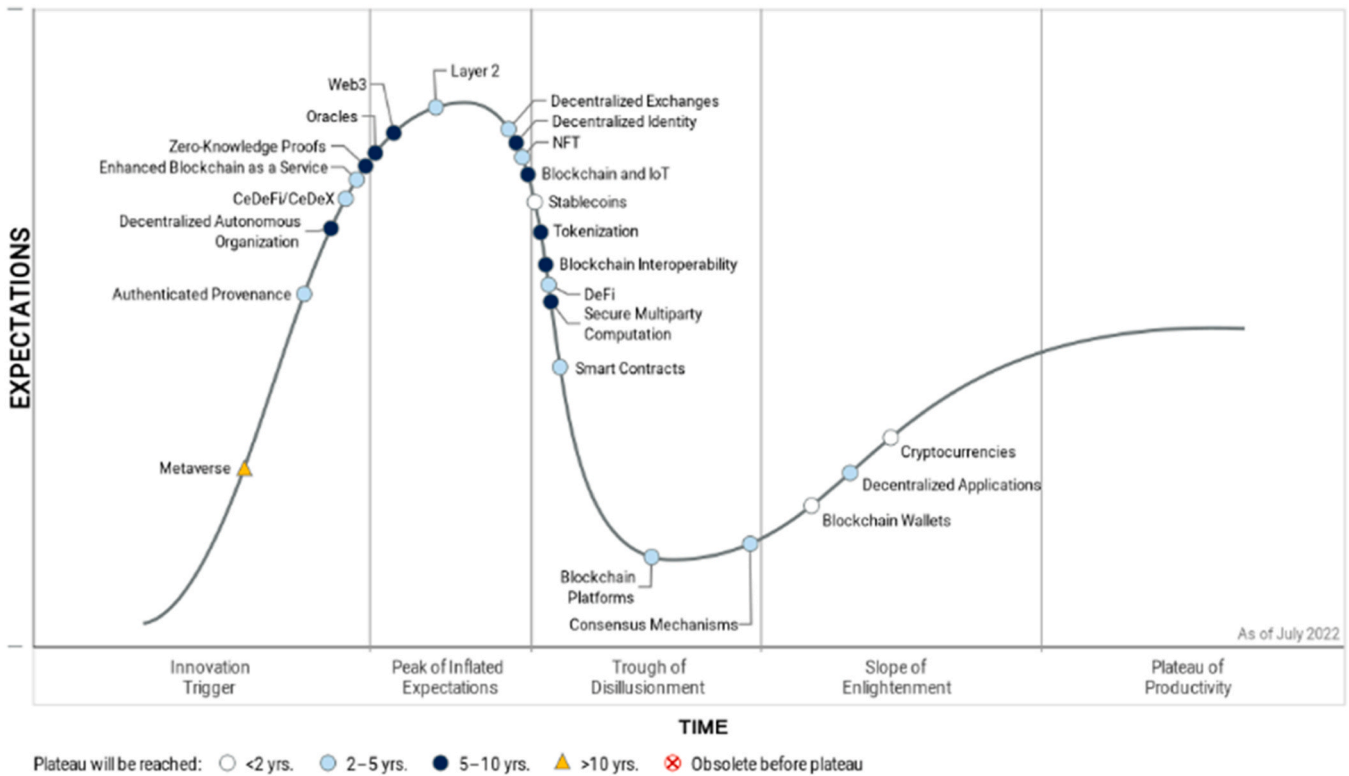


Fig. 9. Hype Cycle for Blockchain and Web3 (Gartner, 2024).

transactions processed on so-called decentralized finance exchanges exceeded \$10 billion (McKinsey, 2024). Web 3.0 aims to enhance the web’s functionality through extensive user data utilization, allowing for more streamlined and rapid information access. This evolution benefits web users and digital marketers by enabling them to stay updated with B2B marketing trends. Key features include decentralization, removing a single controlling authority for a distributed network model, integrating blockchain for secure and transparent transactions, and heightened privacy and security, offering users control over their data and safeguarding against centralized vulnerabilities (gartner, 2024). Gartner

forecasts (Fig. 7) that, in the coming years, the technology landscape will see blockchain wallets, cryptocurrencies, and stablecoins reaching maturity. Highlighting decentralization as a critical component of Web 3.0 and Society 5.0, the prediction extends to decentralized applications, identities, exchanges, and DeFi platforms, achieving their development peak within the next five years. GlobalData estimates that the blockchain market will grow from US\$18.42 billion in 2023 to US\$508.1 billion in 2030 at a CAGR of 62.4 % over the forecast period. Blockchain as a service, acceptance of cryptocurrency, cost and timesaving, and acceptance in retail are the major blockchain market drivers

(globaldata, 2024), and the global Web 3.0 market is anticipated to reach approximately \$2,3 trillion by 2032, growing at a compound annual growth rate (CAGR) of 85.7 % (precedenceresearch, 2024).

A Harvard Business Review (HBR, 2024) survey in 2022 found that nearly 69 % of over 50,000 respondents confessed to not understanding what Web3 is. A study conducted by Consensys (Consensys, 2024) on Crypto and Web3 revealed that out of 15,158 participants globally, only 24 % are familiar with the concept of Web3. A Coinbase Institute (Coinbase, 2024) international survey of Web3 adoption involving 32,788 respondents found that 42.5 % had never heard of the term "blockchain technology." By aggregating data from three surveys focused on understanding Web 3.0, the authors reveal that out of 97,946 respondents, 55.17 % need to be more informed about blockchain and Web 3.0 technologies. According to a survey conducted by Consensys, 79 % of participants have expressed a desire for greater control over their online identity.

In comparison, 67 % feel they should own the content they create online. Interestingly, attitudes towards these concepts vary significantly globally across countries and age groups. For instance, only half of respondents aged 18–24 in the United States, India, and Nigeria are familiar with Web3. Additionally, findings from a Coinbase survey reveal that 27 % of respondents are unsure how to begin participating in Web3. As Gen Z will significantly influence the workforce and consumer base by 2030 (Edelman, 2024), their preference for brands contributing to societal and political solutions underscores the changing landscape of business-consumer relationships. Despite the increasing popularity of Web3 technology and decentralization among researchers and business owners, less than half of the population possesses knowledge or information about the true essence of Web3 and blockchain technology and its benefits to e-commerce customers.

This data demonstrates that most of the population lacks a basic understanding of Web3 and blockchain technologies despite the significant interest and investment from financial sectors and tech communities. The surveys also highlight a desire among individuals for greater control over their online identities and content, suggesting a potential openness to embracing Web3 concepts if their benefits and functionalities were better understood. However, the knowledge gap remains a critical barrier, underscoring the need for enhanced educational efforts and clearer communication about the implications and opportunities of Web3 technology.

4. Discussion

The blockchain market faces regulatory uncertainty, hindering adoption across various sectors due to a need for more standardization and transparent regulatory frameworks. Additionally, a significant gap in skilled professional's adept in blockchain technology complicates its integration and use (EC 2021). Despite these challenges, the rapid embrace of new technologies promises growth, mainly through data decentralization, which offers enhanced control and security of data usage. However, Web3's emergence highlights user experience issues and unclear benefits of products like NFTs, contrasting with the more refined Web2 products.

On 11 July 2023, the European Commission presented its new Web 4.0 and virtual worlds strategy. The European Council has called for the European Union to stay at the forefront of Web 4.0 development. Web 3.0 is the third generation of the World Wide Web. Its main features are openness, decentralization, and users' full empowerment, enabling them to control and realize the economic value of their data, manage their online identities, and participate in governing the web. Decentralized technologies and digital twins enable peer-to-peer transactions, transparency, data democracy, and innovation along entire value chains. Web 4.0 is the expected fourth generation of the World Wide Web. Using advanced artificial and ambient intelligence, the internet of things, trusted blockchain transactions, virtual worlds, and XR capabilities, digital and natural objects and environments are fully integrated

and communicate, enabling truly intuitive, immersive experiences, seamlessly blending the physical and digital worlds (Europe, 2023). In an environment where information authenticity is challenging, centralized platforms emerge as trusted intermediaries. (Fig. 10).

Web3 and decentralization have the potential to transform traditional e-commerce platforms by introducing new paradigms of ownership, security, and user control. Decentralized marketplaces powered by blockchain technology enable peer-to-peer transactions without intermediaries, fostering trust and transparency in online transactions. Smart contracts facilitate automated and secure transactions, reducing the risk of fraud and dispute resolution. Decentralization empowers users with greater control over their data and digital assets. Through self-sovereign identity solutions and decentralized authentication mechanisms, users can manage their online identities and protect their privacy more effectively. Ownership of digital assets, such as cryptocurrencies and non-fungible tokens (NFTs), allows users to monetize their digital creations and participate in new forms of value exchange.

Different generations may perceive and interact with Web3 and decentralized e-commerce platforms differently. Millennials and Gen Z, who are digital natives and value authenticity and transparency, may embrace decentralized platforms that offer greater control and ownership. They are more likely to adopt cryptocurrencies and NFTs for online transactions and digital asset management. While Web3 and decentralization provide numerous benefits for e-commerce, they pose challenges such as scalability, regulatory uncertainty, and user adoption. E-commerce platforms must address these challenges while capitalizing on the opportunities presented by decentralized technologies. Educating users about the benefits and functionalities of Web3 platforms is essential for widespread adoption and acceptance. The future of e-commerce lies in embracing Web3 technologies and decentralized principles to create more inclusive, transparent, and efficient online marketplaces. Collaborations between traditional e-commerce players and blockchain startups can drive innovation and unlock new business models. Moreover, integrating Web3 features such as decentralized finance (DeFi) and decentralized autonomous organizations (DAOs) into e-commerce platforms can further enhance user experiences and foster community engagement.

Web3 and decentralization have the potential to revolutionize e-commerce practices and reshape the digital economy. By prioritizing user control, security, and transparency, decentralized e-commerce platforms can cater to the evolving needs and preferences of different generations of internet users, paving the way for a more equitable and accessible online marketplace. While significant strides have been made in understanding the impact of Web3 and decentralization on e-commerce and generational behavior, several areas warrant further investigation to unlock the full potential of these technologies and address emerging challenges. Future research endeavors could focus on understanding the factors influencing user adoption and behavior on decentralized e-commerce platforms, which remains crucial. Future studies could explore the motivations, preferences, and barriers different demographic groups face when interacting with Web3 technologies.

The decentralization of digital technologies significantly influences the evolution of e-commerce technologies within Society 5.0 by promoting enhanced security, greater transparency, and increased consumer trust. In a Society 5.0 context, which emphasizes human-centric technological advancements, decentralization supports the shift from traditional centralized platforms to distributed systems that empower users and increase data sovereignty. This shift is facilitated by technologies such as blockchain, which allows for secure peer-to-peer transactions without intermediaries, reducing costs and increasing efficiency. Decentralization also enables new forms of e-commerce that are more responsive to consumer needs. For example, decentralized marketplaces can offer personalized shopping experiences based on transparent data usage and consumer preferences, managed securely on distributed ledgers. Embedding IoT with blockchain in e-commerce logistics can lead to more efficient supply chains, providing real-time tracking and the

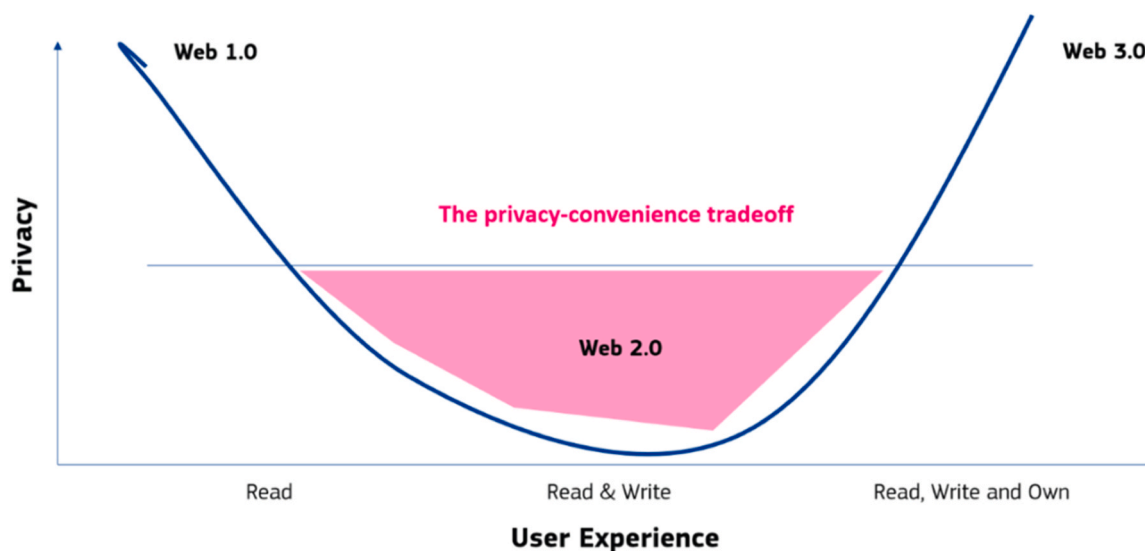


Fig. 10. The privacy-convenience trade-off in Web (EBSI, 2023).

authenticity of goods and enhancing consumer confidence in e-commerce platforms. Moreover, as digital identities become more common in Society 5.0, decentralization ensures that these identities are controlled by individuals rather than by central authorities, thereby enhancing privacy and security in online transactions. This transformation underpins the development of more resilient e-commerce ecosystems that can adapt to the changing needs of society while ensuring that technology serves a supportive and augmentative role in improving everyday life. These findings collectively demonstrate a significant shift towards more integrated, secure, and user-centric digital environments underpinned by decentralization and blockchain technology, embodying the principles and goals of Society 5.0. This shift is not only technological but also cultural, requiring adjustments in consumer behavior and business practices to fully realize the potential of these emerging technologies.

5. Conclusion

Society 5.0 represents a paradigm shift towards integrating advanced technologies into every facet of life to enhance human well-being and economic growth and address societal challenges.

This progression, from the initial stages of e-commerce to the advent of Society 5.0, showcases a transformative journey where digital technologies like AI, IoT, and blockchain play pivotal roles in personalizing, streamlining, and securing online shopping experiences.

The evolution from Web 1.0 through to the anticipation of Web 4.0 underlines a transition towards decentralized, intelligent web platforms, promising more efficient, inclusive, and smart living environments. Amidst this digital transformation, the emergence of blockchain technology facilitates the development of decentralized platforms, significantly impacting e-commerce by fostering transparency, enhancing security, and promoting peer-to-peer transactions.

The rise of DAOs and DEXs exemplifies the shift towards democratizing economic activities and empowering consumers. The paper underscores the need for regulatory clarity and skilled professionals in blockchain technology to overcome current adoption barriers. It also highlights the potential of Web 3.0 and the challenges of integrating these new technologies into existing systems for a more decentralized and user-empowered digital future. Exploring original research articles and reviews on these topics is recommended for further insights into the impact of Society 5.0 on e-commerce and the evolving digital landscape. The global e-commerce market is expanding, with blockchain and Web 3.0 technologies experiencing rapid growth, poised to become integral

to Society 5.0 within the next decade.

Decentralization is a crucial factor in shaping Society 5.0. Research, including surveys from Harvard Business School, highlights a need for widespread understanding of Web 3.0 among the public. Web 3.0 aims to revolutionize the internet by leveraging extensive user data utilization, enhancing information access for users and digital marketers, and facilitating B2B marketing trends. Key features such as decentralization, blockchain integration, and heightened privacy offer users' greater control over their data and transactions. Forecasts from Gartner and GlobalData project significant growth in blockchain and Web 3.0 markets. Despite this promising outlook, surveys highlight a widespread need to understand Web3 and blockchain technologies among the general population, underscoring the need for increased education and awareness efforts.

As Gen Z becomes a dominant force in the workforce and consumer landscape, businesses must adapt to their preference for brands, contributing to societal and political solutions and emphasizing the importance of embracing Web3 technology to meet evolving consumer expectations.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRediT authorship contribution statement

Deniss Sceulovs: Writing – review & editing, Methodology. **Agnis Stibe:** Writing – review & editing, Methodology. **Arturs Bernovskis:** Writing – original draft, Visualization, Methodology, Data curation, Conceptualization.

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