

DIGITAL ECOSYSTEMS AS A DRIVER OF BUSINESS LANDSCAPE TRANSFORMATION IN THE MODERN ECONOMY

Ganna Kolomiyets¹, Vladyslav Korol², Dmytro Bilianskiy³

Abstract. The article defines the features of the ecosystem business model, reveals the importance and role of digital ecosystems in the evolution of the digital economy and sustainable development. The relevance of the study is due to the deployment of exponential technologies (artificial intelligence, the Internet of Things, cloud computing, etc.), which have caused and enabled the formation of digital ecosystems and will contribute to their spread. *The purpose* of the article is to define the essential features of digital ecosystems as a modern form of business and their role in transforming the business landscape in line with the current challenges of the digital economy. *The methodology* for studying business ecosystems is based on the key theoretical concepts that formed the basis for their formation, namely: the theory of complex systems, the theory of firm behaviour in quasi-competitive markets, and the theory of competitive co-operation. The methodological basis for the study of the ecosystem business model includes the theory of e-network economy, which focuses on horizontal relationships and spillover effects, and platform theory, which considers the interaction of participants in the process of creating common value. *Results.* It has been determined that business ecosystems contribute to the creation of a higher level of shared value than participants can obtain individually. The experience of the world's leading international companies shows that their strengthening and growth is driven by the use of an ecosystem model built on digital platforms, services and solutions. Global leaders of the digital economy (Apple, Amazon, Google, etc.) are examples of large digital ecosystems based on the integration of products, services, platforms and partnerships, which ensures their sustainability and ability to adapt to changes. The presence of communities of software developers, service providers, venture capitalists, startups and other participants in ecosystems is important for creating innovations and maintaining competitiveness in the long term. It has been proven that the implementation of ethical and environmental practices is a means of reducing risks and improving the reputation and viability of companies in the current environment. Business ecosystems can mitigate the negative effects of technological growth. *Practical implications.* It is proved that digital ecosystems play a key role in the development of the circular economy, which is a tool for achieving ESG. The authors identify the imperative directions of influence of digital ecosystems on the expansion of the circular economy. *Value/Originality.* The following has been further developed: the theory of business models through the definition of the essential features of digital ecosystems; the role of business ecosystems in improving the ESG criterion. Future research could be aimed at studying the institutional support for the development of business ecosystems at the international and national levels.

Keywords: digital economy, digital ecosystem, business landscape, circular economy, ESG indicator, sustainable development.

JEL Classification: O10, O44, L86

¹ V.N. Karazin Kharkiv National University, Ukraine (*corresponding author*)

E-mail: gkolomiets@karazin.ua

ORCID: <https://orcid.org/0000-0002-1835-1023>

ResearcherID: rid67543

² V.N. Karazin Kharkiv National University, Ukraine

E-mail: vkorol88@gmail.com

ORCID: <https://orcid.org/0000-0002-3929-0864>

ResearcherID: rid67547

³ V.N. Karazin Kharkiv National University, Ukraine

E-mail: Dimka1977ua@ukr.net

ORCID: <https://orcid.org/0009-0002-3772-1461>

ResearcherID: rid99172



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1. Introduction

Digitalisation of the economy catalyses dynamic business development, changing the institutional structure of the economy and transforming business models. It creates a favourable environment for the emergence of new sectors and industries, and causes changes in the way business is conducted and revenues are generated. "Of all the ways that digitalisation is changing business models and the relationships between companies and their customers, no development has been as significant or potentially lucrative as the emergence of digital ecosystems." (Bhatnagar et al., 2021)

Global digital companies, showing the largest increase in value in recent years, are pushing traditional corporations out of leadership positions (Table 1). For example, the leader in terms of market capitalisation in 2020, the oil company Saudi Arabian Oil Company, has risen in price by only 5% over five years, leaving it behind Apple, Microsoft, Amazon, and Alphabet (Google), which have increased their value by 179%, 132%, 77%, and 126%, respectively. In May 2021, the value of Apple (1,876 billion USD) minimally exceeded the value of Saudi Aranso (1,855 billion USD), and now the difference in capitalisation is more than twice as large (Companies Market Cap, 2021).

The dominance of these companies and their expansion into new markets are the result of their transformation into large digital ecosystems of additional products around their core value proposition (Blagodyr, 2022) and, according to McKinsey (2022), by the end of 2025, could generate a combined revenue of \$60 trillion with a potential increase in their share of the global economy to 30% of global GDP.

The study of business ecosystems is based on the notion that companies are integrated parts of a larger system that evolves through their interaction (Bertalanffy, 1934); on the analysis of various types of so-called "quasi-integration" (Williamson, 1971); and on the theory of competitive co-operation (Brandenburger and Nalebuff, 1996), according to which companies in a business ecosystem co-operate to obtain common benefits while maintaining their own competitive advantage. The methodological framework for studying business ecosystems is also

based on the recently developed e-network economy theory (Castells, 2011), which focuses on horizontal interconnections and spillover effects, and platform theory (Kenney and Zysman, 2016), where different parties (suppliers, users, partners) interact to create shared value.

Despite active discussions related to the characterisation of digital ecosystems (Koch, 2022; Moore, 1993; Hong, 2019; Joshi, 2022; Sarafin, 2021), and possibly because of this, their conventional definition has not yet been developed, in particular due to the heterogeneity of objects that are united by this concept, as well as the fact that it is used for different purposes, but the mechanisms of functioning of these objects are not always obvious to researchers (sometimes even to the participants of the digital ecosystem themselves) (Koch, 2022). Therefore, the functioning of business ecosystems, including digital ones, requires further research in view of the changing business environment caused by technological, socio-cultural, and geopolitical shifts.

2. Essential Features of the Digital Ecosystem

One of the first attempts to conceptualise an ecosystem in the economic context was made by J. Moore (1993), who proposed to consider a company not as a member of one industry, but as part of a business ecosystem that spans different industries. The newest business ecosystems are much more complex, multifaceted, and large-scale. According to BCG (2024), many companies collaborate in digital ecosystems with dozens or even hundreds of partners across multiple industries to bring their offerings to market.

The main features of digital ecosystems include: the presence of at least one digital platform among the company's services; network effects; global nature; integration of participants' services; presence in more than two markets and/or industries. Network effects generate a high concentration of participants in the ecosystems' areas of activity, and the number of complementarities that interact with the leader, the end user and each other is very high.

Experts from Gartner Research define a digital ecosystem as "an interdependent group of actors that

Table 1
Changes in the value of the world's most valuable companies

Company name	Market capitalisation, 2020, trillion USD	Market capitalisation, December 2024, trillion USD	Change, %
Apple	1,286	3,587	+179
Microsoft	1,359	3,148	+132
Amazon	1,233	2,185	+77
Alphabet (Google)	0,919	2,080	+126
Saudi Arabian Oil Company	1,685	1,778	+5%
Meta Platforms (Facebook)	0,584	1,436	+146%

Source: authors' calculations on the basis of data (Companies Market Cap, 2020, 2024)

jointly use standardised digital platforms to interact with each other to achieve common goals, such as commercial gain, innovation, or a shared interest" (Hong, 2019). Business ecosystems exist to create a higher level of value than participants can create individually. Companies that have managed to build a digital ecosystem experience exponential growth and profits 27-32% higher than the industry average (Joshi, 2022).

The absence of a universally accepted definition of digital ecosystems gives rise to divergent perspectives on their prevalence in the contemporary economy. Pursuant to the initial approach, it is possible to identify approximately 10-15 digital ecosystems on a global scale, which encompass the world's most prominent IT companies, such as Google (Alphabet), Amazon, Facebook, Apple, Microsoft, Alibaba and Tencent. The digital ecosystems of leading international technology companies are distinguished by their global scale, complementarity, dynamism, flexibility, multi-products, multi-actors, complexity, multi-platforms, etc. According to statistics, the average ecosystem has 27 partners, the most successful digital ecosystems have about 40 partners; 83% of digital ecosystems include partners from more than three industries and 53% from more than five; 90% of ecosystems include participants from more than five countries (Jacobides et al., 2019).

On the other hand, this phenomenon is considered to be not so unique and includes a much larger number of companies built on an ecosystem approach to working with their infrastructure, employees, partners, customers, etc., which, through this model, are trying to find new opportunities to implement their growth strategy on a global scale. Through ecosystem integration, firms can get the technology they need without resorting to labour- and capital-intensive software development projects. For companies, it is much easier and faster to work with ecosystem integrators than to try to develop ecosystems on their own. Integration into ecosystems offers a shorter path to optimise the entire value chain, rather than making additional or partial improvements (Sarafin, 2021).

According to statistics, no more than 15% of companies are capable of creating an effective digital ecosystem (Joshi, 2022), so the rest often turn into participants in digital ecosystems coordinated by first-tier companies whose leadership position is sustainable. In general, the development of digital ecosystems can be described in terms of the life cycle logic (Figure 1).

At the nascent stage, the ecosystem is trying to gain a significant market share (approximately 50%). According to BCG's research, almost half of the analysed ecosystems did not move to the next stage after reaching 15% of the market. In the emerging stage, the ecosystem gains a significant share of the market (approximately 80%), but then may lose some ground. Almost 25% of ecosystems analysed by BCG halved their market share within seven years (Reeves et al., 2019). This indicates the need for constant action to maintain market share. At the maturity stage, if a company has a dominant position for a long period of time, the ecosystem becomes sustainable.

Most of the world's leading digital economy companies are examples of large digital ecosystems based on the integration of products, services, platforms and partnerships, which ensures their sustainability, ability to adapt to changes and create innovations. At the same time, digital ecosystems differ depending on the type of platform on which shared value is formed (transactional, innovative, hybrid), the approach to its construction (multi-product, multi-actor), the direction of scaling of the key product (horizontal, vertical, hybrid), the degree of openness (closed, open), and so forth (Korablinova, Ganzha, 2023). For example, Apple, which is one of the most successful and integrated companies in the world, has created a closed ecosystem where devices, services and software are integrated to provide a seamless user experience. Alibaba and Amazon are examples of open ecosystems, as third-party participants can sell their products on the ecosystem's marketplace. Amazon combines e-commerce, cloud technologies, streaming services and home automation. Alibaba combines e-commerce, logistics, financial technology and cloud computing. Google integrates digital services with physical products (e.g., Google Pixel, Nest).

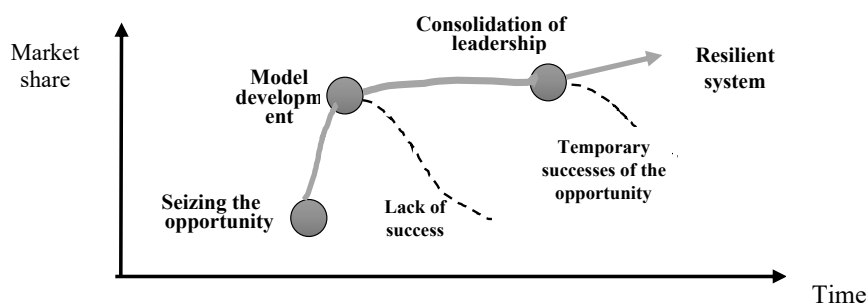


Figure 1. Life cycle of digital ecosystems

Source: developed by the authors on the basis of (Reeves et al., 2019)

Such ecosystems include communities of software developers, service providers, venture capitalists, startups and other participants, which is important for maintaining competitiveness in the long term.

The deployment of exponential technologies (artificial intelligence, machine learning, the Internet of Things, cloud computing, etc.) is driving the proliferation of platform and ecosystem companies in the business landscape of the digital economy. Generative artificial intelligence has evolved from a niche research topic to a core technology that will radically change business and society in the near future. It is predicted that by 2026, more than 80% of enterprises will be using AI APIs and models or deploying AI applications in production environments, compared to five percent in early 2023 (Gartner, 2023). At the same time, experts note the growing risks of widespread AI adoption, which is reflected in the decline in people's trust in technology products from 90% in 2016 to 50% in 2023 (Kolomiyets, 2024).

3. Digital Ecosystems in Achieving the Sustainable Development Goals

The development of digital ecosystems allows for the effective realisation of consumer values in terms of the Environmental, Social and Governance (ESG) criterion (Eastgate, 2024). Each component of ESG has separate but often interrelated components (Figure 2), which makes it difficult to classify an ESG issue as environmental, social or governance and can only be addressed in a comprehensive manner.

In the early 2000s, there were only 20 companies with an ESG rating in the United States, and by 2020, their number had grown to almost 800 (Fintech Insider, 2022). According to KPMG's 2024 Transition to Mandatory Reporting study, 96% of the world's top 250 companies and 79% of the top 100 companies in each country report on sustainability and ESG, 64% recognise climate change as a risk to their business, and 49% recognise social components as a risk to their business (KPMG, 2024).

Developments in technology have an ambivalent impact on ESG. On the one hand, they play an important role in promoting sustainable development and reducing environmental impact. For example, the emergence of smart technologies, such as IoT devices, allows companies to optimise energy use in real time; software platforms, such as the Salesforce Sustainability Cloud, help organisations track their emissions, manage energy consumption and set goals to reduce their environmental impact.

But at the same time, the growth of technological sophistication is increasingly harmful to the environment, as the digital economy is resource-intensive: a 2 kg computer requires 800 kg of raw materials, a smartphone – 70 kg; greenhouse gas emissions from the ICT sector account for up to 3% of global GHG emissions. Between 2018 and 2022, electricity consumption by the 13 largest data centres (DC), including leading digital ecosystems, more than doubled (Figure 3). According to the International Energy Agency, in 2026, energy consumption by DCs will approach 1000 TWh (UNCTAD, 2024).

Amidst the boom in the digital economy, the production of digital devices is growing steadily: in 2010-2023, annual shipments of smartphones more than doubled to 1.2 billion USD. This is leading to an increase in digital waste (waste from screens and small IT equipment increased by 30% from 2010 to 2022, reaching 10.5 million tonnes), which, if not properly disposed of, leads to pollution and other health and environmental hazards. As of the end of 2022, only 24% of digital waste was officially collected worldwide (UNCTAD, 2024). The problem is difficult to solve quickly, as the production of digital devices is projected to continue to increase – for example, the number of Internet of Things (IoT) devices will more than double from 2023 to 2029 (Figure 4).

The digital economy is currently responsible for a significant amount of waste, which is exacerbated by the inherent age-related decline in functionality that is a consequence of the production methods employed. This decline can be attributed to technical, functional or psychological factors. Consequently, experts in



Figure 2. Classification of ESG indicator components

Source: developed by the authors on the basis of (Eastgate, 2024)

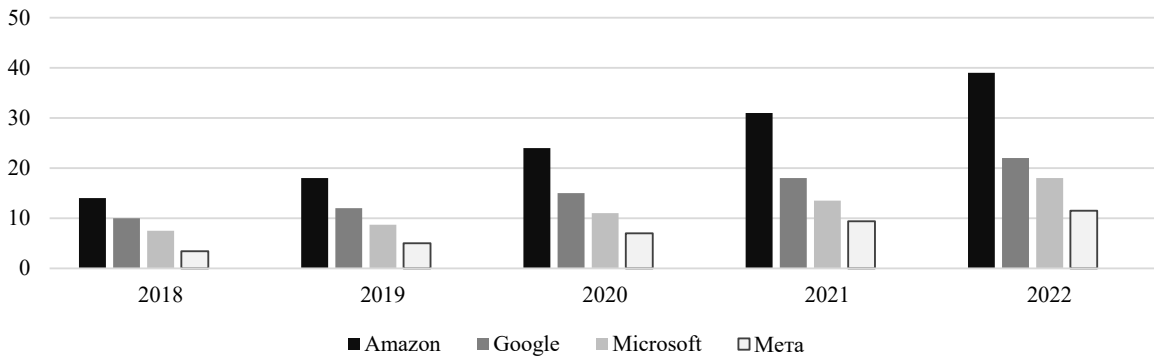


Figure 3. Annual electricity consumption by some digital ecosystems in 2018-2022, terawatt-hours

Source: compiled by the authors on the basis of (UNCTAD, 2024)

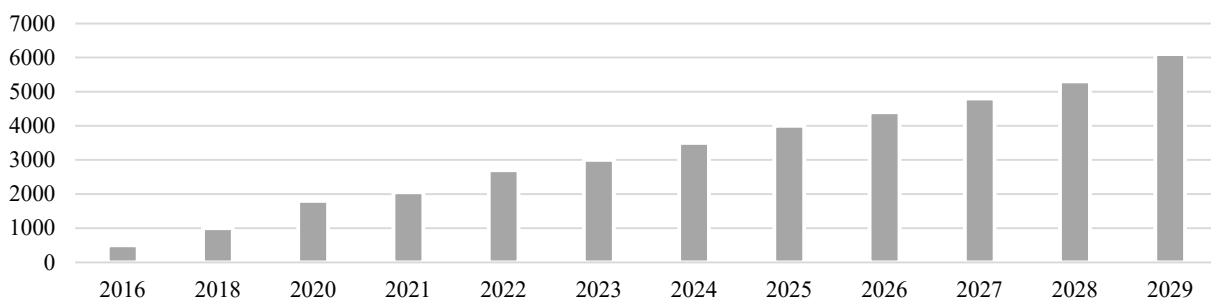


Figure 4. Dynamics of the number of IoT devices with cellular connectivity in 2016-2029 (2025-2029 – forecast), million connections

Source: compiled by the authors on the basis of (Ericsson, 2023)

the field advocate for the transition to a circular and inclusive digital economy as a means of addressing the environmental challenges posed by digitalisation. This transition necessitates the implementation of sustainable development practices throughout the entire product life cycle, encompassing the stages of design, production, use and disposal. The circular economy is a tool for achieving sustainable development goals. However, today only 7.2% of the global economy is considered circular, and this share is decreasing due to the increase in the extraction and use of materials (Ericsson, 2023).

Digital ecosystems can play a key role in the development of the circular economy, contributing to its efficiency, scalability and innovation. They create an environment for different actors to interact, share resources, data and knowledge, which facilitates the transition from a linear to a circular economy model. The main areas where digital ecosystems can support society's movement towards a circular economy include resource optimisation; reuse of goods and materials; data exchange; product life cycle tracking; creating a platform for innovation; stimulating consumer awareness; expanding the sharing economy; and stimulating closed loops.

On the other hand, the transition to a circular economy requires modernisation and introduction of

innovative approaches and solutions, as well as active implementation of eco-innovations. It is the ecosystem model of business organisation that can ensure productive coordination of the process of interaction between business entities in the digital economy.

4. Conclusions

Thus, digital business ecosystems as a phenomenon of the modern economy have a significant impact on the transformation of the business landscape. Effective focus on modern consumer values is a prerequisite for the development of business ecosystems and their consequence. Digital ecosystems are a community of organisations that interact with each other using digital technologies based on the principle of modularity, aimed at achieving higher consumer values than the participants can achieve individually, which generates a synergistic effect and allows for a sustainable competitive advantage. They are characterised by multi-product, multi-actor, complementarity, dynamism, and flexibility. Digital ecosystems typically include communities of software developers, service providers, venture capitalists, startups, and other participants, which is important for creating innovations.

Exponential technologies (artificial intelligence, machine learning, the Internet of Things, cloud

computing, etc.) are driving the development of business ecosystems. The progress of digital technologies has a contradictory impact on the functioning of society and the achievement of ESG goals. Business ecosystems have the potential to achieve them in a controlled manner. Simultaneously,

their intensive spread requires a scientific understanding and generalisation of the practice of business ecosystems. Changes in their institutional support at both the international and national levels are becoming an increasingly urgent requirement.

References:

- Bertalanffy, L. (1934). Untersuchungen über die Gesetzlichkeit des Wachstums. *W. Roux' Archiv f. Entwicklungsmechanik*, Vol. 131, p. 613–652. DOI: <https://doi.org/10.1007/BF00650112>
- Bhatnagar, A., Modi, S., Powers, B., Szczepanski, K., & Tang, T. (2021). BCG's Digital Ecosystem Accelerator Kick-Starts Platform Strategies. Available at: <https://www.bcg.com/capabilities/digital-technology-data/digital-ecosystems/accelerator>
- Blagodyr, L. (2022). Digital business ecosystems as a specific form for economic activities coordination in the digital economy. *Economy and Society*, Vol. 46. DOI: <https://doi.org/10.32782/2524-0072/2022-46-55>
- Boston Consulting Group (2024). *Digital Ecosystems*. Available at: <https://www.bcg.com/capabilities/digital-technology-data/digital-ecosystems>
- Brandenburger, A., & Nalebuff, B. (1996). *Coopetition*. New York: Currency Doubleday.
- Castells, M. (2011). *The Rise of the Network Society: The Information Age: Economy, Society and Culture*. Cambridge, MA; Oxford, UK: Wiley Blackwell.
- Companies by Marketcap. (2024). Available at: <https://companiesmarketcap.com/>
- Gartner (2023) Top strategic technology trends for 2024. Available at: <https://www.networkworld.com/article/957390/gartner-top-strategic-technology-trends-for-2024.html>
- Eastgate SOFTWARE (2024). Digital Business Transformation Trends to Watch in 2025. Available at: <https://eastgate-software.com/digital-business-transformation-trends-to-watch-in-2025/>
- Ericsson (2023). Ericsson Mobility Visualizer. Report 2023. Available at: <https://www.ericsson.com/en/reports-and-papers/mobility-report/mobility-visualizer?f=1&ft=2&α=2,3,4,5,6,7,8,9&t=1,2,3,4,5,6,7&s=4&u=1&sy=2024,2030&c=3>
- Fintech Insider (2022). Shcho take ESG-pryntsyppy i chomu kompaniiam vazhlyvo iih dotrymuvatysia. Available at: <https://fintechinsider.com.ua/shho-take-esg-prynczypy-i-chomu-kompaniyam-vazhlyvo-yih-dotrymuvatysya/>
- Hong, H. (2019). How Ecosystems Will Dominate Our Digital Future. *Gartner IT Symposium Xpo 2019, Barcelona*. Available at: <https://kpc-group.cz/blog/gartner-it-symposium-xpo-2019-barcelona-pondelni-shrnuti>
- Jacobides, M. (2019). In the Ecosystem Economy, What's Your Strategy? *Harvard Business Review*, Vol. 97(5), p. 128–137. Available at: <https://hbr.org/2019/09/in-the-ecosystem-economy-whats-your-strategy>
- Joshi, M. (2022). 4 Lessons From Land O'Lakes on Building a Digital Ecosystem. *Gartner*. Available at: <https://www.gartner.com/en/articles/4-lessons-from-land-o-lakes-on-building-a-digital-ecosystem>
- Kenney, M., Zysman, J. (2016). The rise of the platform economy. *Issues in Science and Technology*, Vol. 32 (3), p. 61–69. Available at: <https://issues.org/rise-platform-economy-big-data-work/>
- Koch, M., Krohmer, D., Naab, M., Rost, D., Trapp, M. (2022). A matter of definition: criteria for digital ecosystems. *Digital Business*, Vol. 2(2). DOI: <https://doi.org/10.1016/j.digbus.2022.100027>
- Kolomiyets, G., Melentsova, O., Moskalenko, M. Gen-All – imperatyv udoskonalennia instytutysinogo pidgruntia upravlinnia ryzkamy. *Biznes Inform*, Vol. 5, p. 118–124. DOI: <https://doi.org/10.32983/2222-4459-2024-5-118-124>
- Korablinova, I., Ganzha, K. (2023). Tsyfrovii ekosystemy u mizhnarodnomu tehnologichnomu biznesi. *Ekonomika. Finansy. Pravo*. 12, 38–43. DOI: <https://doi.org/10.37634/efp.2023.12.8>
- KPMG (2024). Themove to mandatory reporting: Survey of Sustainability Reporting 2024. Available at: <https://assets.kpmg.com/content/dam/kpmg/xx/pdf/2024/11/the-move-to-mandatory-reporting-web-copy.pdf>
- McKinsey & Company (2022). Tech highlights from 2022 – in eight charts. Available at: <https://www.mckinsey.com/capabilities/mckinsey-digital/ourinsights/tech-highlights-from-2022-in-eight-charts>
- Moore, J. (1993). Predators and prey: a new ecology of competition. *Harvard business review*, Vol. 71(3), p. 75–86. Available at: <https://hbr.org/1993/predators-and-prey-a-new-ecology-of-competition>
- Reeves, M., Lotan, H., Legrand, J., Jacobides, M. (2019). How Business Ecosystems Rise (and Often Fall). Available at: <https://sloanreview.mit.edu/article/how-business-ecosystems-rise-and-often-fall/>
- Sarafin, G. (2021). How organizations can create value through ecosystem integration. Available at: https://www.ey.com/en_ua/alliances/how-organizations-can-create-value-through-ecosystem-integration
- UNCTAD (2024) Digital Economy Report 2024. Available at: https://unctad.org/system/files/official-document/der2024_en.pdf
- Williamson, O. (1971). The Vertical Integration of Production: Market Failure Considerations. *American Economic Review*, Vol. 61(2), p. 112–123. DOI: <https://doi.org/10.1179/102452907X166845>

Received on: 14th of January, 2025
 Accepted on: 25th of February, 2025
 Published on: 13th of March, 2025