

DIGITAL PLATFORM AS A GLOBAL BUSINESS MODEL OF INDUSTRY 4.0 ЦИФРОВА ПЛАТФОРМА ЯК ГЛОБАЛЬНА БІЗНЕС-МОДЕЛЬ ІНДУСТРІЇ 4.0

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Abstract. *This article explores the evolution and impact of digital platforms (DPs) within the context of global business models and the digital economy. DPs serve as pivotal mechanisms in the transformation of business processes, facilitating network effects and enhancing competitive advantages through the sharing economy and gig economy. The study examines how private and public organizations within digital ecosystems benefit from expanded customer bases, diverse service offerings, and improved digital communications with consumers. Key strategies for DP development are identified, including the creation of diverse services (proposition), personalized client interactions (personalization), innovative pricing models (price), maintaining customer trust and data protection (protection), and strengthening partnerships with app developers and payment service providers (partners). The implementation of this 5P model leverages digital tools and client-oriented strategies within DP ecosystems. As new digital technologies progress towards widespread adoption, the article anticipates active discussions on DP management models, legal compliance, commercial trust, online reputation, and public-private partnerships. This research*

underscores the critical role of DPs in shaping the future economic landscape and driving business model innovation.

Key words: *digitization, digital platform, digital technologies, business model, economic regulation, ecosystem, digital public-private ecosystems, information communication potential.*

Анотація. У статті досліджується еволюція та вплив цифрових платформ (ЦП) в контексті глобальних бізнес-моделей та цифрової економіки. ЦП служать ключовими механізмами в трансформації бізнес-процесів, сприяючи мережевим ефектам і підвищуючи конкурентні переваги через економіку спільного споживання та гіг-економіку. Дослідження аналізує, як приватні та публічні організації в межах цифрових екосистем отримують користь від розширених клієнтських баз, різноманітних пропозицій послуг та покращених цифрових комунікацій з споживачами. Визначено ключові стратегії розвитку ЦП, включаючи створення різноманітних послуг (*proposition*), персоналізовані взаємодії з клієнтами (*personalization*), інноваційні моделі ціноутворення (*price*), підтримання довіри клієнтів та захист даних (*protection*) і зміцнення партнерських відносин з розробниками додатків та постачальниками платіжних послуг (*partners*). Впровадження цієї моделі 5P базується на використанні цифрових інструментів та клієнтоорієнтованих стратегій в межах екосистем ЦП. По мірі широкого впровадження нових цифрових технологій, стаття передбачає активні дискусії щодо моделей управління ЦП, правової відповідності, комерційної довіри, онлайн-репутації та державно-приватних партнерств. Це дослідження підкреслює критичну роль ЦП у формуванні майбутнього економічного ландшафту та стимулюванні інновацій у бізнес-моделях.

Ключові слова: *цифровізація, цифрова платформа, цифрові технології, бізнес-модель, економічне регулювання, екосистема, цифрові державно-приватні екосистеми, інформаційно-комунікаційний потенціал.*

Introduction. Modern digital platforms (DPs) are specific mechanisms that establish a network of connections and information exchange in an online environment, transforming production, trade, and logistics chains, simplifying business processes and operations, and altering management model principles. Their functioning and development are linked to an accelerated trend of shortening investment cycles and the life cycles of digital assets and technological innovations. As complex information systems, DPs provide a specific way of performing certain functions and are used by market participants (clients/companies, partners, application developers, agents) across all sectors of the economy, in the practice of information technology support, and in the implementation of new business models. Importantly, this concerns, firstly, intellectual capital rather than physical capital, evaluated through both monetary and non-monetary metrics. Secondly, it involves a significant transformation of the set of multi-faceted connections between its elements - human capital (access to digital technologies and digital competencies), consumer capital (communication resources of consumers and suppliers), and organizational-process capital (technical/software, IT, and information systems). Furthermore, the processes of platformization create a new type of platform economy due to the scale of access to potential consumers, geographical coverage, market differentiation, systemic changes in capitalization metrics, and new business opportunities in global market competition. This underscores the relevance of this research.

The purpose of the article is to investigate the potential of DPs and the features of business model transformation in the context of digitalization in Industry 4.0, which is associated with the accelerated development of national and global ecosystems and the formation of new business development concepts.

Literature Review. In recent years, the number of studies by both foreign [Cennamo, 2021; Li & Zhu, 2021; Panico & Cennamo, 2022; Meyer et al., 2024] and domestic [Shchehliuk, 2019; Dubel, 2021; Zhukova, 2022; Novikova et al., 2023] economists dedicated to digitalization in general and the implementation of DPs, in particular, has increased. However, the scientific

literature still lacks systematization and unified interpretation of DPs as a tool for digital transformation, and often many studies and attempts at their practical application cannot be reconciled with each other (Kannan & Hongshuang, 2016; Kaabi & Jallouli, 2019; Parasuraman, 2019). Moreover, the one-sided interpretation of the principles of a systematic approach or merely nominal use (without connection to real practice) also leads to the fact that the same tools are used differently in modern digital marketing (Kotler et al., 2020; Norton et al., 2023).

Cennamo (2021) explores how digital markets create competitive advantages through platform-based perspectives, emphasizing the role of network effects. Li and Zhu (2021) highlight the importance of information transparency in the competition among platforms, using the daily deals market as a natural experiment. Panico and Cennamo (2022) discuss user preferences and strategic interactions within platform ecosystems, providing insights into how these dynamics shape the market. Meyer et al. (2024) analyze the competition for attention on digital platforms, particularly in the news industry, and the implications for strategy.

Domestically, Shchehliuk (2019) provides a comprehensive analysis of the digital economy's morphology, focusing on the development and regulation of digital technological platforms. Dubel (2021) examines the growth of digital platforms and their impact on the global economy, while Zhukova (2022) discusses the development of the digital economy through platformization. Novikova et al. (2023) highlight digital platforms as a driver for economic development, emphasizing their transformative potential.

The practical application of digital marketing frameworks has been extensively reviewed by Kannan and Hongshuang (2016), who propose a comprehensive framework for digital marketing research. Kaabi and Jallouli (2019) provide an overview of e-commerce technologies and their implications for data analysis and marketing knowledge. Parasuraman (2019) presents a conceptual model of service quality and its future research implications, which are crucial for understanding digital platforms' impact on service industries.

Kotler et al. (2020) and Norton et al. (2023) address the evolving strategies in digital marketing, highlighting the integration of sustainability and purpose in modern marketing practices. These works underscore the necessity of adapting traditional marketing strategies to the digital age, reflecting the dynamic and multifaceted nature of digital platforms.

The dynamism, multifaceted nature, and global development of modern DPs necessitate further research in this area in the context of the transformation of business models and the challenges associated with this process. An analysis is required of the formation of modern hybrid client-centric DP business models, DP modeling based on a multi-agent approach and platform thinking, and the structure of algorithmic DP management.

Main Results of the Research.

1. Positioning and Activities of Digital Platforms in the Context of the Fourth Technological Revolution

In the era of digitalization, the technological capabilities of interpersonal and business communications are rapidly evolving, impacting all existing business models and processes among key market participants. There is an increasing demand for high service levels and prompt delivery of necessary services (efficient communication between economic agents), and the elimination of temporal, territorial, and linguistic barriers necessitates radical changes to the "classical" approaches to business process construction, market positioning, and competitiveness. Consequently, DPs and digital ecosystems are altering traditional business practices and market power dynamics, with their owners strengthening their influence through price control, challenging the proprietors of conventional businesses. It is widely recognized that companies actively leveraging platform solutions are among the largest globally by market capitalization (Migol, 2018). The rapid expansion of the range of services provided by DPs, supported by a substantial and stable consumer base, enables the integration of both proprietary and third-party (complementary) digital resources to implement specific targeted initiatives and profitable innovation-investment projects. This maximizes the effective realization of new business models, enhances competency levels through reusable structures and systems, elements, and templates. Essentially, value and price

proposition creation, as well as business conduct in the platform economy, are no longer linear as in traditional business models (including pricing models); instead, DPs with user and client self-organization serve as tools for managing consumer behavior.

According to recent studies, physical product sales in the global e-commerce market are expected to grow from \$6.3 trillion in 2023 to \$7.5 trillion by 2025, with 60-70% of the new value created in industrialized countries in the next decade anticipated to be based on DPs (Nova Global, 2023). Currently, digital business transformation through technological digital and network platforms based on a new consumption paradigm is forming, on one hand, a sharing economy (Bergh et al., 2021), which relies on the open and prompt collection and processing of data on customer needs and supplier capabilities, employee potential, and company intellectual capital, as well as utilized business processes. On the other hand, a gig economy (Schwahn & Curtis, 2023) emerges as a specifically new form of relationship between employees and employers, driven by technological advancements and the emergence of new types of economic activities (where the employer is not the owner of production means but an acquirer of intellectual property). Therefore, the development of the technological and infrastructural business environment and DPs is under the close attention of modern companies' digital marketing departments.

Currently, amidst the wide range of interpretations of the essence of DPs, the most accurate definition is provided by experts at the Massachusetts Institute of Technology. Firstly, it is a system of algorithmized mutually beneficial relationships among a significant number of independent participants in an industry (or activity sector), conducted in a unified information environment. Secondly, it is a high-tech business model that creates value by facilitating exchanges between two or more interdependent groups of participants (Bonnet & Westerman, 2020). Hence, it serves as a resource portfolio for a company's digital marketing, allowing the incorporation of digital technologies as a resource tool for structuring information to communicate with external environment subjects (consumer audience). Moreover, it offers the potential for significant savings in material and financial resources and reduces transaction costs for companies through the use of a package of digital technologies, data management, and business process changes.

The technical and organizational aspects of DP functionality depend on their type, creation principles, and specialization directions. According to the typology proposed by Evans and Gawer (2016), DPs are classified based on the specifics of their architecture usage:

- **Transactional:** Technology acting as a channel to facilitate exchanges/operations between different users, buyers, or suppliers.
- **Innovation:** Technology serving as a foundation for developing additional technologies, goods/products/services for other companies, organized into an innovation ecosystem.
- **Integrated:** Technology functioning both as a transactional and innovation platform.
- **Investment:** A platform consisting of companies developing portfolio platform strategies and active investors.

The basis of DPs is a software-hardware complex designed to create electronic or digital solutions for applied purposes and service provision algorithms for users/consumers: a) access to sources and data management; b) digitalization tools for their activities (IT services) utilizing pervasive digital technologies; c) interaction capabilities in a unified information environment and resource/value exchange through labor division logic changes. Depending on the field of activity, four types of DPs are distinguished (Evans & Gawer, 2016):

- **Advertising platforms** (targeted advertising campaigns with personal data accumulation and storage based on confidentiality).
- **E-commerce platforms** (product and IoT online markets with low operational costs for buyers and sellers).
- **Industrial platforms** (specialized in specific economic sectors).
- **Cloud platforms** (large databases and AI, creating simple, secure, flexible, and cheap services compared to intra-corporate information and communication technologies).

Based on the method of creating additional value through combining existing advantages of disparate goods/services into a new comprehensive product/service that maximally satisfies consumer needs, DPs are classified as:

- **Application platforms** (ensuring the digitalization of specific markets – Alibaba, Uber, Facebook, Airbnb, etc.).
- **Instrumental platforms** (technological foundation of application platforms – Amazon Web Services, Java, Android OS, iOS, Bitrix, etc.).
- **Infrastructure platforms** (various IT services – General Electric Predix, ESRI ArcGIS, EIA, etc.).

There is a wide range of DP types: general and specialized (by exchange subject), open (available to all market participants) and corporate (focused on internal interaction efficiency), free access (with free registration) and monetized platforms (earning from providing access to participants). Additionally, economic entities may use DP subtypes: peer-to-peer (equal participants) and hierarchical (by user and consumer hierarchy), by ownership (private and public), and by region (global, national, local), platforms whose profitability is determined by activities unrelated to the exchange subject, and platforms independent of non-core revenues (including charitable). Multilateral platforms, significantly more complex, offer multifunctionality, enabling a wide range of services ("network effect"), and modular architecture, determining business models based on digital innovations (Mariani et al., 2023).

On the modern global market, the top 10 DP producers are: Magento, Cloudcraze Software, IBM, Accenture, PHILIPS, NetSuite, SAP, Oracle, Adobe Systems, and Apttus (LinkedIn, 2024). The main principles of their DP operation are:

a) Equal responsibility of all market participants for all possible outcomes (self-regulation) and trust (capitalized into financial capital through participant reputation). b) Ensuring operational safety (environmental friendliness of solutions). c) Complete information availability to participants for mutual maximum benefit (rationality). d) Information transparency (openness). e) Social utility (principle of "win-win," not just commercial profit).

A significant role in implementing these principles is played by the concept of behavioral economics, gaining importance with the transformation of capital from passive to active (reconfiguration of cash flows) through the extensive use of participation mechanisms in the information-communication infrastructure. Analysis of current Western sources (Bonnet & Westerman, 2020; Spagnoletti et al., 2015; Yablonsky, 2018) allowed grouping the main advantages of DP operation in Industry 4.0:

- Convenience of consumer choice of goods/services, resource, and financial asset allocation efficiency (consumer value formation).
- Market transparency and access possibilities for all business environment subjects (market participant interaction and ability to regulate target relationships).
- Transformation of intermediary institutions through the integration and unification of interaction processes in the value creation chain (building a new integrated cooperation environment).
- Efficient technology use and generation of quality information data, converting into additional value (allocation efficiency and standardization).
- Reduction of information-communication and logistics transaction costs (additional reserves for productivity growth and entrepreneurial activity efficiency).
- Flexible organizational structures and innovative business models (stimulating innovation processes).

A distinctive feature of DPs (at the organizational decision level) is not only the virtually unlimited accumulation of users and constant additions in the form of new IT solutions but also obtaining specific income – "communication" (resulting from digital platform relationships). Economically, DPs become a production factor characterized by, on one hand, resource data scaling and capitalization, functioning simultaneously in two economic formats (digital twin – virtual and analog). On the other, a network structure (resource formation effect), motivating decision-making

based on the "4win" principle, benefiting all process participants – producer, seller, buyer, and DP owner.

Digitalization has stimulated the rise of many fast-growing companies with varying value proposition/customer interaction structures, leading to the emergence of new business models as high-level schemes integrating primary and auxiliary DP business processes. In recent decades, there has been a shift from visualization and analysis schemes – "business model canvas" (infrastructure – value proposition – customer interaction – finance) to creating comprehensive ("overarching") taxonomy of platform business models. The number of attributes considered in this taxonomy (at least 20) makes it a convenient tool for in-depth analysis of specific company business models (Yablonsky, 2018). This is related to the growing needs of specific industries and markets, primarily high-tech ones.

2. Development of Platform Technologies and Interaction Mechanisms of DP Entities

Platform technologies are not only "open" to development opportunities through network partnerships and set "standards" for influencing the overall architecture of solutions when acquiring goods/services, but they also perform critically important functions in the "producer-consumer" communication sphere, including complementary companies (suppliers of complementary goods/services) and competitors. On DPs, there is standardization of services, differentiation of services, and implementation of innovations to benefit participants and increase transaction efficiency by reducing operating costs. This involves creating a "network effect" (search engines, social networks, e-commerce platforms, app stores, websites, etc.), new strategic dependencies, interaction algorithms, and forms of participation (or business conduct) based on the collection, analysis, processing, and use of large volumes of information. The success of implementing platform technologies depends on the level of providing all interacting entities within the DP with individualized solutions. Depending on the ownership form of the DP (asset ownership) and the subjectivity in setting prices and usage conditions of resources, the following models are distinguished for ensuring the profitability of corresponding reference groups (Ruggieri et al., 2018):

- **Decentralized:** The asset owner sets conditions and offers them to users, the DP facilitates communication between economic agents and eases transaction completion for commission rewards.

- **Centralized:** The DP owns the asset and sets prices, controls quality and work standards, earning a percentage of transaction value.

- **Hybrid:** Asset owners offer services at prices and standards set by the DP, ownership and risks are decentralized, while standards and service levels are centralized.

DP owners provide, based on platform standards, opportunities for online interactions, electronic transactions, collection, processing, and exchange of relevant information, digital marketing tools, and business concepts that allow the realization of the network effect of interaction. They do not monopolize app production, as doing so would decrease app quality and ecosystem value for its members, raise service prices, and negate competition. DP business agents collectively use the platform's infocommunication capabilities to develop innovative products/services, apps, and IT services, while DP clients execute transactions using online tools and interact discretely (no need for simultaneous availability of different users) (Ritter & Pedersen, 2020). Moreover, both DP owners, business agents, and clients must possess digital competencies, not only the participants/employees providing goods/services but also the consumers/recipients. Hence, digitalization fundamentally changes the factors determining competitiveness, transforming information and personnel with digital competencies into key assets.

DP app developers interact among themselves (not with the platform owner), as their product must meet the standard (API, SDK) and offer clients value that exceeds other similar products. In dynamic markets, the mass participation in DPs determines subjectivity and competition levels, the number and quality of apps, and thus the ecosystem's value. For example, the 30-year phenomenon of Windows software market stability for personal computers is not due to its perfection (well-known flaws noted by experts) or its developers' competencies but due to the continuously

developing DP ecosystem. Another example: Apple's iPhone (controlling 12% of the global smartphone market and earning over 60% of profits from sales) is not just a product but a DP that created the "app developers-app users" market through the App Store and network effect usage. Hence, the growth of DP iPhone Apple participants (users) increases the ecosystem's value for developers. Eight years ago (2016), direct investment markets valued Uber (founded in 2009, with almost no material assets, a permanent staff of about 200 people) higher than the diversified company General Motors (founded in 1908, owning vast material assets, producing millions of cars annually) due to the value of the DP service network connecting taxis and potential passengers (Gawer, 2021). Thus, the ecosystem effect of DPs defines its value, which grows without the platform owner's effort, through the value of apps created by third-party developers.

Platform connections "client-company" involve interaction between the consumer and producer in a "single economic network," where the producer can sense the market (market sensing) – perceive and understand the consumer, develop partnerships and brand loyalty (market relating), and the client (through CRM technologies) becomes a management object. DP users experience "seamlessness" – providing information about themselves once (data, payment, address) and using it across different services, transitioning between services (e.g., in NightNote mode) without additional authorizations, payments, or other attributes via a loyalty program. Since the platform strategy is an interactive product generating network effects, the DP value generally increases. Using the Win-Win strategy, DPs implement personalized online scenarios in e-commerce (supporting courier delivery, car rental, selling voice assistants, etc.), simplifying payment methods, increasing the sales funnel conversion, and opening new directions for value proposition development and attracting new users.

Companies using DP services employ the principle of infrastructure development as a platform, realized through open API applications, flexible integration of software applications with partner services, and AI integration into business processes, linking email, messengers, and social networks. They grow and spread quickly across various economic sectors and sub-sectors. For example, the total capitalization of companies using platform business models already exceeds \$4 trillion, and 6 of the top 10 global companies by capitalization are platform-based or actively use DPs in their business. Their activities include e-commerce sales (Alibaba – B2B, Amazon – B2C), telecommunications (Google, Apple), banking (Bank of New York Mellon), "smart" cities/buildings/apartments using IoT (Schneider Electric), healthcare (Kaiser Permanente), transportation (Uber), and others (Andreassen et al., 2018). Platform link maps created and modified by the company for platform design tasks reflect the goals and opportunities of stakeholders (consumers, producers, partners, and DP owners), containing current and potential values, rare characteristics, and product imitation possibilities. The potential and motivation matrix includes all current and potential value flows to determine what each DP participant can offer another, analyzing mechanisms for role changes (transforming a user into a producer or partner). This reduces customer acquisition costs (CAC) and increases their profitability (customer lifetime value, CLTV), enhancing profitability in the "cost-benefit" link through client expense dynamics.

Modern demand for DP usage increases due to reducing companies' primary production cost indicators while mastering innovations. This includes, firstly, increasing labor productivity in production up to 55% (through automation and AI use) and reducing quality assurance costs by 20% (through digital quality management implementation). Secondly, unforeseen cost reduction by decreasing equipment downtime by 30-50% (through remote monitoring and control of production equipment and VR in maintenance). Thirdly, reducing storage costs for production stocks and products by 20-50% (by optimizing batch sizes and organizing real-time supply chains) and after-sales service costs by 10-40% (through remote service technology application) (Hein et al., 2020).

DPs provide open and prompt data collection and processing on personnel potential, customer needs, supplier capabilities, company intellectual capital, and business processes. Regarding cloud technologies implemented as DPs, they ensure the creation of an infocommunication infrastructure through tools like PaaS (platform as a service), SaaS (software as a service), IaaS (infrastructure as a service), DRaaS (disaster recovery as a service), SecaaS (security as a service), BaaS (backup as a

service), and others. Their use aligns with the trend of increasing intellectual resources' contribution to business value, motivating a shift "from a product and service-based business model to a network and platform-based business model" (Hadi & Lawey, 2018). For example, according to data on companies whose shares are included in the Standard & Poor's 500 index, the contribution of tangible assets to their value averaged up to 62% in the 1980s, decreased to 38% in the 1990s, and to 16% in the 2010s (Schwab, 2017).

3. Genesis of DPs and Modification of "Classical" Business Models

Today, companies are undergoing an intensive process of forming a new model of integrated marketing communications (IMC) within the e-commerce system. This model integrates into a single block: a) resources/tools; b) means of classical marketing communications in various proportions; and c) communications with consumers, which serve as the key link between the elements of the internal production-economic system and the external environment. The further genesis of DPs and their information channels in the context of a client-oriented approach has led companies to utilize the HADI (Hypothesis, Action, Data, Insights) auxiliary tool in building their business models (Kretschmer et al., 2022). This methodology, associated with startup management technology, involves: starting with a hypothesis (launching a minimum viable product or hypothesis), proceeding through actions, and analyzing data and insights (evaluating results, feedback, etc.), which then leads to hypothesis adjustment and the next cycle iteration. This optimization chain in the business model looks as follows: "goal – analysis – hypothesis – experiment – testing – reporting – implementation of changes – further optimization," effectively optimizing the company's conversion rate.

According to forecasts, utilizing the potential of DPs will remain a key factor in transforming business models in the medium term. Over 85% of surveyed companies have identified the expansion of digital access to DP services and the widespread implementation of new and advanced technologies (BigData, cloud technologies, AI, VR, etc.) as trends that will drive their organizational transformation. By 2027, 75% of companies plan to implement e-commerce and digital trade based on DPs into their practices (with 42% of business decision-making tasks and 65% of data processing information being automated) (Gawer, 2021). These digital advantages allow companies to become independent digital leaders, fundamentally changing the ways they interact with consumers, where digitalization represents a rethinking and revolutionizing of mutual interactions.

Today, a multilateral DP is a complex partnership network structure that develops through the sharing of assets, competencies, and efforts of all participants (Verhoef et al., 2019). Unlike aggregator platforms (connecting buyers and sellers), maintaining multilateral (or industry) platforms requires addressing issues related to defining DP participant groups, their functions, interaction management systems, the development of platform thinking among participants, and monetization methods. On a successfully developing multifunctional platform, a business ecosystem as a community of other platforms, partners, and competitors forms over time. Simultaneously, the chain of market power growth for successful DPs and business ecosystems transforms the competitive landscape and modifies traditional business models.

The emergence of a new type of digital consumer is associated with the development of the on-demand economy and the experience economy, applying DPs as innovative interaction technologies between producers (suppliers) of goods/services and their consumers. The DP ecosystem is a group of interconnected digital applications that create shared value for participants (Hein et al., 2020). This expands online access capabilities within a unified information space, minimizes intermediary involvement, and significantly reduces indirect costs and production expenses. Essentially, DPs, through the effect of complementarity, create a unique service product with enhanced consumer value, while also radically changing end-user behavior, which imposes specific requirements on the infocommunication component of services and goods to meet the end needs of clients. Therefore, DPs as a client-centric business model implemented in modern digital ecosystems aim to maximize client satisfaction through a "one-stop-shop" approach (consumers can access a wide variety of goods/services through a single access point).

Thus, low fixed costs associated primarily with their maintenance and almost zero marginal cost of servicing one additional client, linear optimization of internal business processes, and high-quality matching of heterogeneous supply and demand ensure DP liquidity. This is confirmed by the experience of DP giants like Alibaba, Facebook, Amazon, and Google. Established value orientations of DPs, the accumulation of a critical mass of users essential for DP success among advertisers, seeking potential partners in independent companies contributing to platform development, creating a community of consumers, suppliers, and partners (platform interaction) are key elements of a structured approach to creating a platform business model. Its operation is based on unlimited DP asset capacity, dynamic pricing, accelerated transaction execution, and data and analytics creating value by reducing information asymmetry among equal groups and lowering information search costs (Mostaghel et al., 2022; Wang et al., 2023). In modern conditions, additional value in DP business models does not form automatically but is the result of building communications and a thoughtfully managed system based on platform thinking. It combines traditional business approaches with platform strategies, collaboration with partners and even competitors, a unique approach to creating and perceiving value, resources, and key competencies, and shared use of all participants' assets. Platform thinking algorithms include (Vial, 2019):

- a) A new perception of the created DP value by all participants and an understanding of the consumer value of the product for specific clients;
- b) Transitioning from a linear value creation process (within a sequence of stages) to value creation within a network community of DP participants;
- c) Opportunities to use other participants' competencies within the DP and form new key competencies related to DP creation and development;
- d) Shifting from the concept of resource ownership and control within a company to shared use of DP participants' resources (sharing economy).

For example, Amazon's multilateral DP, which has almost monopolized the US retail market, operates an open access policy – over 12,000 independent companies and about 140,000 software developers work on it, enhancing its value for consumers and attracting new partners and clients (Digital Commerce 360, 2023). It is a platform of voluntary partnership (without property and legal status unification), providing high-tech services partially materialized as software products and lacking dependence on payments to the owner or landlord for using their material assets. It fundamentally involves innovative shared resource use without ownership, network value creation for consumers and all DP participants, implying a new management and personnel thinking paradigm. Monetization methods used on Amazon's DP do not undermine the DP's network effect and the collective nature of value creation through implemented models: 1) Advertising model (free use of platform services and resources by consumers and developers, with payment based on the volume of downloaded information); 2) Service commission (payment is received for platform transactions and service subscriptions); 3) Paid API connection for developers and franchise providers; 4) Partner programs with paid access to the platform's consumer community or data it generates (Gelato, 2024).

Key features of the hybrid platform business model (ILO, 2021) include the following (Andreassen et al., 2018): First, direct and indirect network effects are created by attracting an increasing number of users, and the expansion of the market through one group of them increases the added value for the other (a level unattainable for traditional businesses). This depends on the transformation of data into digital intelligence and their monetization through commercial use, hence the success and rapid growth of the platform. In other words, value creation occurs through the continuous collection, processing, and analysis of large amounts of data, enabling valuable information (value generation) for decision-making by both individual managers and companies as a whole.

Second, the algorithmization of the activities of the economic entity from hiring employees, determining their qualification levels, tracking and evaluating work, to organizing and controlling business processes, staff ratings, and the matrix of effective communication between employees and clients. Algorithmic management adapts to the principles of platform management (platform

services, user coverage or exclusivity, contact opportunities with clients, account deactivation conditions, dispute resolution procedures, and data usage and confidentiality).

Third, the minimization of investments in the core capital of companies (production, storage facilities, personnel, etc.) and the ability to rapidly grow the business at low costs. Essentially, it involves: a) creating a cloud infrastructure based on the ideas, qualifications, and material resources of users (clients and employees); b) changing pricing strategies (dynamic pricing, subscription subscriptions, bonuses, prizes, rewards, providing additional benefits); c) using venture capital funds (venture financing is an important source of investment in the platform).

The multi-agent approach, proposed by Darling-Wolf and Steinberg (2018, 2019), describes agent interactions within the platform for DP modeling. Agents include the DP owner, the service consumer as both customer and executor, used applications, and their targeted behavior in a dynamically changing environment. Today, multi-agent DP systems are designed at four methodology levels: a) Object-oriented programming (OOP) methods; b) Traditional knowledge engineering methods (observation, process visualization, scientific information research); c) Methods based on organizational-oriented representations; d) Combination of OOP, knowledge engineering, and organizational-oriented representations. USE-CASE models are used for functional process descriptions, including activity diagram analysis to identify agents, define their responsibilities, and specify each agent's tasks, class diagrams for agent architecture descriptions, and sequence diagrams for interaction protocol descriptions. This enables creating interaction scenarios within the DP and helps model the behavior of the platform owner and its participants as customers and executors.

Digital Public-Private Ecosystems represent a collaborative framework where governments and private sector entities synergize to leverage digital technologies for public service enhancement and economic development. These ecosystems foster innovation by combining the agility and technological prowess of private companies with the public sector's regulatory support and reach. In these partnerships, digital platforms play a crucial role in streamlining operations, enhancing transparency, and improving service accessibility for citizens. For instance, in healthcare, platforms like e-Health Record in Estonia or Helsi in Ukraine have unified patient data across the nation, allowing for seamless access to medical histories by authorized healthcare providers, thereby improving patient care and reducing administrative overhead. In Ukraine, the Diia platform has emerged as a groundbreaking example, offering over 50 digital government services, from business registrations to social assistance applications, making public services more accessible and transparent for millions of citizens. In education, the partnership between the Indian government and private tech firms through the DIKSHA platform has provided teachers and students with accessible, quality educational resources, even in remote areas. Similarly, Ukraine's integration of digital platforms in education, particularly through the implementation of the "New Ukrainian School" initiative, has enhanced digital literacy and provided online resources to students and teachers nationwide. Transportation has seen significant advancements with the integration of smart traffic management systems in cities like Barcelona, improving traffic flow and reducing congestion through data-driven insights. In Ukraine, the digital transformation of public transportation in cities like Kyiv, with electronic ticketing and real-time tracking systems, has streamlined operations and improved user experience. Governance has also benefited, as illustrated by the GovTech initiatives in Singapore, where digital platforms facilitate citizen engagement and streamline government services, enhancing public trust and participation. These case studies underscore the transformative potential of public-private partnerships leveraging digital platforms to create more responsive and inclusive public services. The integration of digital platforms into public services has revolutionized how governments interact with citizens, enhancing efficiency, transparency, and accessibility.

4. Globalization of DP Ecosystem Models and New Business Development Concepts

Today, DPs serve as experimental platforms for monitoring the "digital journey" of clients (personalized and targeted communication with them), analyzing their search history and past purchases, activity on social networks, and archives of inquiries, studying comments about products/services (including desired purchases), and the dynamics of monetizing operations. These

are essential conditions for companies in building their business models. It is necessary to continually adapt and change the business model in response to: a) the emergence of new technologies and digital services, and transformation of business processes (involving large-scale, strategic changes as opposed to ongoing improvements); b) changes in operational processes and development of partnerships; and c) the search for fundamental and applied innovations, and reengineering (Schwab, 2017). Comprehensive organizational change programs related to transforming the company's product/service/brand and client experience into added value are crucial for the success of the new business model.

The modern Jobs-To-Be-Done (JTBD) methodology based on DPs includes methods and algorithms from Lean Startup, Customer Development (CustDev), and Design Thinking. It allows the design of a Business Model Canvas based on studying consumer motivation in product selection, key consumer needs (understanding how they are satisfied), competitor product capabilities, and conditions for offering new products/services to consumers. The JTBD approach, combined with CustDev and Design Thinking techniques, is implemented as follows (Andreassen et al., 2018; Kretschmer et al., 2022):

- Understanding the context and motivation of consumers (CustDev approach: interviews, field research, observations, data analysis, and defining consumer profiles);
- Evaluating market potential (TAM, SAM, SOM indicators) and direct/indirect/secondary competitors;
- Completing the JTBD Canvas: "choice evaluation – rethinking – compromise evaluation – shopping" (desires/future experience, catalysts/events influencing desires, constraints/barriers to achieving desires, set of solutions/possible options);
- Analyzing the forces of progress: push of the situation, magnetism of the new solution, habit of the present, and anxiety about the new solution;
- Designing a minimum viable product (MVP) – A/B testing to mitigate economic risks when entering the market with a product that has unique qualities, guaranteed demand, minimal functions, simplified design, and low-cost packaging;
- Conducting startup metric analysis based on unit economics: interpreting consumer information using Design Thinking frameworks (empathy maps, HMW, CJM, PEDPL) and creating Job Stories;
- Formulating the value proposition – building the Value Proposition Canvas;
- Choosing a monetization model and building the Lean Canvas business model with the structure: "problem and competitor alternatives," "key solution opportunities," "key metrics," "unique advantage." Metrics used to measure goal achievement include engagement, activation, retention, referrals, and revenue.

Analysis shows that in traditional manufacturing industries, the dominant approach in developing business models still involves analyzing resources within the traditional configuration of global value chains that provide competitive advantages (RBV analysis). Companies in these industries have limited customer bases, relatively low information and data share in added value, and continue using vertical integration strategies and growth opportunities through market differentiation. Therefore, strategic management specialists rarely use RBV principles and its differentiated versions applied in DPs, using new partners and services for high-quality customer service (Ritter & Pedersen, 2020). Business model changes due to incorrect risk responses can lead to both unexpectedly positive and predictably negative outcomes, while supplementing the traditional platform business model faces the challenge of creating an ecosystem, complicating tasks both conceptually and technically.

Today, DPs are transforming standard business concepts both locally and internationally, creating new markets, forming new audiences and user segments, and providing effective communication methods with them. Traditional business models are modified under the influence of DPs, offering inexpensive and attractive alternatives to clients. Since the key principle of DPs is not ownership of the good but access to it, the network effect-based inversion factor defines a new organizational form of management and business models with predictable and manageable

mechanisms. The deep penetration of digital technologies into consumer virtual environments leads most "unicorns" (private startups with a capitalization over \$1 billion) to effectively become platform companies. This new trend accelerates the entry of DPs into the multilateral global market, allowing for "accelerated internationalization" and transforming "young" companies into transnational corporations (TNCs) by applying new business models oriented towards market niches in foreign markets. Unlike international strategic alliances, global DPs allow more participants to collaborate more openly and flexibly without worrying about distances and borders amid ultra-dynamic changes in international competition. For example, there are now stable partnerships like Audi and Volvo with Google on the Android Automotive platform, General Electric with Microsoft for using its Azure cloud services, Walmart with Google, and Daimler and Ford with Baidu on its Apollo platform, considered the "Android of autonomous driving" (Kretschmer et al., 2022).

Such universal determinants and competitive advantages of DPs as the ability to overcome trade barriers, ensuring liquidity through transaction execution, low marginal costs, efficient asset utilization, and attracting investments differentiate traditional business models into "platform" type models based on centralized value exchange and avoiding "classical" linear optimization of internal business processes. Among the two types of business models (traditional and platform), international investors value the multilevel platform business significantly higher than the traditional one. This is because DPs not only minimize the costs of using external resources (ideas, information, clients, labor, etc.) but also generate a new dimension of business openness, competition, and company business strategy. Adding a platform model to the traditional business model through original, conceptually and technically complex tasks, implementing DPs into their business, or using them in partnerships with other firms is now practiced by almost all "classic" Fortune-100 companies (e.g., Walmart, Nike, John Deere, Bosch, GE, etc.). It is important to note that DPs offer opportunities acceptable for both hierarchical management and distributed interaction within a company. However, DP potential is best realized using a distributed management system, as it implies competitive advantage strategies built on functional-product and regional criteria, as well as decisions related to creating opportunities for network interaction (Hein et al., 2020).

Changes in company efficiency approaches are associated with using cross-financing schemes for clients on DPs – virtual payments through Internet wallets or online bank platforms, participation in bonus programs, credit options, etc. The user's value for the DP is determined by their ability to form information databases, whose value depends on whether the information is considered a public or private good, and by the external visibility of the "zero" price of information through the natural exchange of "user information" for "information for the user." It is essential to note that the structured system of "company-DP" interaction efficiency indicators is still under development (Verhoef et al., 2019; Vial, 2019; Wang et al., 2023). Reasons for this include: a) constant modification of existing theories to new "platformization" economic conditions, requiring continuous analysis and hypothesis testing; b) insufficient evidence of DP impact on company functionality; c) lack of specific, scientifically recognized concepts for implementing technological changes in integrated marketing communication systems.

This is further complicated by the absence of tools for assessing the dependency of company capitalization on brand value, e.g., in 2023, Apple was the largest capitalized corporation, while the most valuable brand was Google (World Economic Forum, 2023). The well-known K. Arrow dilemma – "uncertainty-information" – leaves three questions open: first, how to calculate economic added digital value considering investment adjustments, with returns distributed over time; second, what share of intangible assets (including digital) in the capital structure determines company value management efficiency (Value-Based Management, VBM); third, whether such a tool will be proprietary know-how for each company with solution implementation scenarios or a universal model for business entities, markets, industries, etc. These questions require further theoretical analysis and applied developments in the context of Industry 4.0 digital technology development and DP ecosystem globalization.

Conclusion. The development of DP ecosystems occurs alongside the transformation of business models of their entities, simplifying business processes and operations, which determines the advantages of operating based on the sharing economy and gig economy. Companies within digital ecosystems gain significant competitive advantages through the expansion of their customer base, the ability to use various services, and convenient digital communications with consumers. The further development of DPs within the new economic landscape of the digital economy will depend on the algorithms for using new technologies to form macro-markets for clients and service providers. In this context, the most promising paths are: a) creating various services on DPs to enhance transaction opportunities between buyers and service providers (proposition); b) targeted interaction with clients across all channels to understand their needs and create personalized offers (personalization); c) applying new pricing models to meet demand (price); d) maintaining customer trust, protecting data, and differentiating platform activities (protection); and e) strengthening connections with digital partners – app developers and payment service providers (partners). Implementing this 5P model involves effectively using digital tools in developing a business strategy based on DP ecosystems, rooted in a client-oriented approach and the competencies of a corporate design-thinking portfolio.

In the near future, most new digital technologies supporting DP development will approach the expansion phase in the technology life cycle, as major technical barriers will be overcome. Consequently, in the coming years, we can expect active discussions in both foreign and domestic economic sciences regarding the selection of business models for DP management. This is particularly relevant in the context of DP participants adhering to legal algorithms and "non-platform" rules, the increasing importance of concepts such as "commercial trust" and "online image" concerning reputational risks, and the implementation of public-private partnership projects.

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