UDC 330.131.7:658.5:004.738.5
JEL Classification: L21, D22, O33, M21
DOI: 10.20535/2307-5651.33.2025.335920

Mazhara Glib
Doctoral Student, Doctor of Philosophy in Economics, Docent,
Associate Professor at the Department of Economic Cybernetics
(corresponding author)
ORCID ID: 0000-0002-1860-756X

Koryshtenska Yuliia
Postgraduate Student
ORCID ID: 0009-0001-3924-0509
National Technical University of Ukraine
"Igor Sikorsky Kyiv Polytechnic Institute"

Мажара Г. А., Кориштенська Ю. Я.
Національний технічний університет України
«Київський політехнічний інститут імені Ігоря Сікорського»

GENESIS OF ADAPTABILITY OF ECONOMIC BEHAVIOUR OF ENTERPRISES IN THE CONDITIONS OF INDUSTRIES 1.0–8.0

ГЕНЕЗА АДАПТИВНОСТІ ЕКОНОМІЧНОЇ ПОВЕДІНКИ ПІДПРИЄМСТВ В УМОВАХ ІНДУСТРІЙ 1.0–8.0

The article is aimed at generalising the evolution of adaptive economic behaviour of enterprises in the context of Industries 1.0–8.0. The methodological basis is formed by historical and evolutionary analysis; institutional approach (considers adaptability as an adaptation to regulatory, cognitive, legislative, socio-cultural and other requirements of the environment); the concept of dynamic capabilities (the ability of an enterprise to integrate, restructure and renew resources to respond to changes); foresight (a method of forecasting future technological and socio-economic scenarios). As a result, a comparative table of adaptive models, a typology of strategies (reactive, cognitive, strategic, proactive-innovative, symbiotic), and quantitative metrics of adaptability are built, and quantitative metrics of adaptability are systematised. The practical significance is in developing tools for diagnosing and managing the adaptability of enterprises in the context of Industry 4.0.

Keywords: *enterprise adaptability, industrial revolutions, dynamic capabilities, typology of adaptive strategies, digital transformation, cognitive economy, quantitative adaptation metrics.*

У статті розглянуто еволюцію адаптивності підприємств у контексті промислових змін від Індустрії 1.0 до 8.0. Актуальність зумовлена зростанням складності економічного середовища, що вимагає не лише швидкої реакції, а й стратегічного передбачення змін. У процесі переходу від механізованого виробництва до когнітивних екосистем підприємства змінюють поведінку, структуру та логіку управління. Адаптивність перетворюється на ключову здатність до виживання й успіху в умовах технологічних, етичних та інституційних викликів. У дослідженні використано поєднання кількох методологічних підходів. Історико-еволюційний аналіз дає змогу відстежити зміни моделей поведінки в межах індустріальних епох, а інституційний підхід – висвітлити нормативно-когнітивні чинники адаптації. Концепція динамічних здібностей оцінює внутрішню гнучкість підприємств, а форсайт застосовується для аналізу потенціалу випереджального реагування. Такий міждисциплінарний підхід дозволяє сформувати системне уявлення про адаптивність як про змінну, що має як часовий, так і стратегічний характер. У дослідженні здійснено порівняння моделей адаптації у восьми фазах промислового розвитку з урахуванням технологічних, організаційних і поведінкових аспектів. Представлено типологію адаптивної поведінки підприємств, що охоплює реактивні, когнітивні, стратегічні, проактивно-інноваційні та симбіотичні стратегії. Їх систематизовано за рівнем ініціативи та інноваційності, що допомагає зрозуміти позиціонування підприємств у турбулентному середовищі. Також узагальнено кількісні показники адаптивності за технічними, поведінковими й стратегічними критеріями. Практична цінність полягає у можливості визначати тип адаптивної моделі підприємства та формувати ефективні стратегії підвищення його стійкості й конкурентоспроможності. Запропоновані типологія й система показників можуть бути основою для рефлексії, формування політик і створення адаптивних аналітичних інструментів для різних секторів. Дослідження також задає напрям для подальших емпіричних розвідок у сфері регіональних та інституційних чинників адаптивності в умовах цифрової, біологічної та когнітивної конвергенції.

Ключові слова: *адаптивність підприємств, індустріальні революції, динамічні здібності, типологія адаптивних стратегій, цифрова трансформація, когнітивна економіка, кількісні метрики адаптації.*

Problem statement. In the context of a transformational economy shaped by technological revolutions and geopolitical shifts, enterprises must not only react quickly to change but also proactively shape adaptive strategies. Each industrial revolution - from mechanization in Industry 1.0 to the data-driven and digitally integrated systems of Industry 4.0 - has redefined value creation, competition, and market interaction.

As industrial paradigms develop, business requirements are also changing from standardization and automation to digital interaction and flexible production. Emerging concepts such as Industry 5.0–8.0 are raising the standard even further, introducing human–AI symbiosis, sustainability goals, and interdisciplinary business models.

In this landscape, adaptability becomes a strategic competence rather than just an operational trait. It covers not only structural flexibility or innovation capacity, but also the cognitive ability to anticipate and respond to latent risks and opportunities – what can be called cognitively driven adaptability.

Considering the ongoing discourse on dynamic capabilities, digital transformation and innovation, adaptability must be understood as an evolving construct shaped by each industrial phase. This requires an interdisciplinary, future-oriented perspective that integrates both retrospective analysis and foresight into enterprise transformation.

So, this study develops a comparative table of adaptability models across industrial stages, introduces a typology of adaptive strategies, and systematizes key quantitative metrics to assess adaptability under technological turbulence.

Analysis of recent research and publications. In recent years, interest in enterprise adaptive behaviour has significantly increased, driven by accelerated digital transformation and new industrial paradigms. A landmark document in this context is the European Commission's Industry 5.0: Towards a sustainable, human-centric and resilient European industry [1], which expands the concept of adaptability to include environmental sustainability, social responsibility, and value transformation alongside technological flexibility.

The international discourse has shifted towards future industrial phases. Based on bibliometric analysis [2], the concept of Industry 6.0 seen as a convergence of quantum computing, bioengineering, and autonomous technologies, defining adaptability as rapid innovation implementation under ethical and regulatory uncertainty. A more radical vision [3] presents Industry 7.0 as a human–AI symbiosis, requiring new cognitive models of adaptation, moral reasoning, and risk governance.

Practically, adaptability is increasingly viewed in terms of digital infrastructure and management competencies. In [4] is highlighted the digital infrastructure as a foundation for organizational agility, while [5] emphasized that human-centred production demands enhanced adaptive skills both organizationally and in HR. In this regard, psychological capital – hope, optimism, flexibility, and self-confidence – is recognized as a key factor in adaptive employee behaviour [6].

Despite the expanding literature, most studies focus on particular sectors (e.g., manufacturing, IT, HR) or isolated aspects of adaptability. A comprehensive, phase-by-phase analysis of how adaptive models evolve through successive industrial revolutions – from mechanization to cognitive singularity – is still lacking. This historical, institutional, and futurological gap forms the methodological foundation of the present study.

Formulating the purposes of the article. The article aims to systematically study the evolution of adaptive economic behaviour of enterprises in the context of industrial revolutions from Industry 1.0 to 8.0, analyze the relevant challenges and business response models, as well as to form a typology of adaptive strategies and systematize quantitative metrics that allow assessing the level of adaptability in the context of technological turbulence.

Presentation of the main research material. The evolution of industrial development – from 18th-century mechanization to 21st-century AI and cognitive symbiosis – illustrates how each industrial wave reshaped the economic logic of enterprise functioning. Industries 1.0–4.0 transformed production, management, and markets: from factories and assembly lines to digital ecosystems and smart manufacturing. As noted by Schwab [7], a distinctive feature of Industry 4.0 is the fusion of physical, digital, and biological systems, which redefines not only production but the very interaction between people, business, and technology. The ongoing shift toward Industry 5.0 introduces deeper digital integration, human-centricity, and ethical sustainability [1].

In this context, adaptability becomes a core enterprise capability – enabling continuous restructuring of behaviour, systems, and decision-making in response to technological, market, or institutional shifts [6, 8].

The study is based on a combination of methodologies: historical-evolutionary analysis (to track changes in enterprise behaviour across industrial stages); institutional theory (emphasizing regulatory and cognitive environments); the concept of dynamic capabilities (focused on resource flexibility under uncertainty); and foresight (used to anticipate future scenarios). This integrative framework enables a comprehensive understanding of the genesis of adaptive enterprise behaviour – across both historical trajectories and forecasts for the future.

1. Evolution of industrial revolutions and the scientific concept of adaptive behaviour of enterprises.

Each wave of the industrial revolution not only changed the technological landscape but also put forward new requirements for business adaptability. This chapter explores how enterprises restructure their economic behaviour in response to new challenges, and which adaptive strategies become crucial for survival and competitive success in each historical era.

Industry 1.0 (late 18th century – early 19th century) marked the beginning of mechanization powered by steam energy, transforming craft production into factory-based systems. Enterprises restructured around hierarchical management, capital-intensive equipment, and vertically integrated supply chains. The emergence of public limited companies enabled large-scale infrastructure projects, such as railways, redefining logistics and accelerating urbanization. Business adaptability at this stage relied on mechanized labor, centralized planning, and financial innovation. Thus, mechanization of labor, growth of production capacity and new forms of financing became the main elements of the Industry 1.0 adaptation model. This led to the rapid development of factory production, the birth of large industrial giants and rapid urban growth with the construction of railways and steamships.

Industry 2.0 (late 19th century – early 20th century) introduced electrification, assembly lines, and mass production. Productivity dramatically increased due to innovations like Ford's flow production, while firms adopted Taylorism principles to manage growing workforces. Enterprises scaled operations, standardized outputs, and competed in national markets. Adaptive responses centred on corporate centralization, procedural control, and brand-driven consumer engagement – setting the stage for automation and global expansion.

Industry 3.0 (mid – late 20th century) marked the digitalization of production through electronics, computers, and automation technologies. The adoption of PLCs, ERP systems, and industrial robots enabled lean production and real-time monitoring. Businesses responded to global competition by investing in research and development (R&D), outsourcing non-core tasks, and shifting to service-based models. Adaptation required flexibility, innovation partnerships, and the ability to operate in technologically volatile environments.

One example of strategic adaptation at the 3.0–4.0 boundary is the pharmaceutical sector's transition to digital clinical trials and real-time supply chain monitoring. Companies such as Pfizer and Roche integrated ERP and digital quality management systems to accelerate regulatory compliance and patient engagement. This case illustrates how structured innovation and regulatory forecasting became key to surviving in a highly regulated and innovation dependent environment.

Industry 4.0 (early 21st century) introduced a paradigm shift through the integration of cyber-physical systems, the Internet of Things (IoT), artificial intelligence (AI), big data, and cloud computing. Enterprises transformed into smart factories where real-time data flows enabled predictive maintenance, mass customization, and networked coordination of supply chains. This phase marked a deep convergence of the physical, digital, and biological spheres, radically altering how firms interact with technologies and stakeholders [1, 7].

Key challenges include digital transformation costs, cybersecurity threats, data management complexity, and workforce reskilling. Adaptive responses involve deploying flexible management methods (e.g., Agile, Scrum), integrating predictive analytics, and fostering human-machine collaboration (e.g., cobots, AR interfaces). According to [9], firms adopting Industry 4.0 practices demonstrate higher resilience and self-organization due to next-generation analytics and real-time feedback loops.

Industry 5.0 (2020s–2030s) shifts the focus from full automation to human-centric innovation, ethical technology, and sustainability. This phase assumes a cooperative model between humans and intelligent systems aimed at enhancing both operational performance and human well-being [1, 10].

The main adaptive challenge is to integrate ethical considerations, circular economic principles, and workforce retraining into enterprise strategies. Businesses are transitioning toward digital ecosystems and inclusive value networks, while investing in lifelong learning systems using VR/AR and AI-powered content. Industry 5.0, therefore, redefines adaptability as not only a technical capacity but also a cultural and organizational competence centred on creativity, empathy, and systemic responsibility [9].

A good example of cognitive adaptation in Industry 5.0 is the case of agritech platforms such as John Deere's Operations Center, which uses AI and satellite data to advise farmers in real time. The system learns from past decisions and environmental patterns, creating adaptive knowledge feedback loops. This demonstrates the role of cognitive technologies in transforming decision-making logic in traditional industries.

Industry 6.0 (2030s–2050s, conceptual) builds upon Industry 5.0 by aiming for full technological autonomy, hyper-automation, and sustainable intelligence. It integrates quantum computing, green energy, nano- and bio-engineering, and advanced AI into decentralized, self-learning production ecosystems. The platform promotes disruption-ready and regulation-sensitive enterprises.

Key challenges include ethical compliance in human–machine integration, quantum-secure data protection, and managing interdisciplinary innovation. Adaptive strategies involve experimental prototyping in future-oriented testbeds ("factories of the future"), blockchain-based economic models, and workforce upskilling in bioinformatics and quantum technologies [2, 9].

Industry 7.0 (~ 2050s, conceptual) envisions the emergence of organic AI and eco-integrated networks. Businesses operate in hybrid systems combining biological and digital intelligence (NOAI – Neuro-Organic Artificial Intelligence). Adaptive demands now include mastering biomaterial technologies, managing organic-cyber interactions, and navigating evolving ethical norms around AI rights and ecological equity.

Enterprise models evolve into intelligent mega-ecosystems based on real-time adaptability, bio-integrated expertise, and circular innovation. This phase shifts adaptability from structural flexibility to co-evolutionary reflexivity across digital and living systems [3].

Industry 8.0 (futuristic) represents the synthesis of physical, digital, cognitive, and biotechnological spheres. Businesses operate as nodes in continuously adaptive, intelligent networks enabled by AI, quantum computing, 5D printing, synthetic biology, and digital twins.

Challenges include algorithmic ethics, perpetual reskilling (e.g., systems thinking, emotional intelligence), and balancing innovation with sustainability. Firms adapt through lifelong learning systems (VR/AR simulations, corporate academies), cross-organization alliances, and mission-driven models focused on transparency, ecological responsibility, and social value creation [9].

Thus, the evolution of the Industries demonstrates a gradual transition from instrumental to cognitive adaptation, from reactive response to proactive advancement, from linear management to network synergy. The identified challenges and corresponding models of adaptation provide the basis for building an analytical comparative table that allows systematizing the patterns of changes in the economic behaviour of enterprises during the eight phases of industrial development.

2. Analytical comparative table of adaptive models of enterprises

To analyze the evolution of enterprise adaptability, a phase-based approach is used: each stage of industrial development (from Industry 1.0 to 8.0) introduced distinct technologies and socio-economic conditions. These industrial revolutions differed in timelines, technological breakthroughs, and organizational consequences, shaping business behaviour in response to new challenges.

This analysis is systemic and interdisciplinary. Technological shifts, especially in Industry 4.0 and beyond, are studied across management, economics, psychology, education, and computer science, as they affect multiple dimensions of enterprise activity and have multidisciplinary impacts. A holistic approach helps to understand the interconnected dynamics of transformation.

The study applies a historical-economic methodology to trace long-term changes in business models driven by innovations – from steam power to artificial intelligence. Each wave of transformation redefined production, organization, and strategic logic. Enterprise adaptability is examined as a response mechanism to ongoing disruptions, with emphasis on forward-looking models such as Industry 5.0 that highlight sustainability, human-centricity, and planetary limits.

The table below compares the key technological drivers, main challenges and adaptive models of enterprises at each stage of industrial evolution.

The comparative table provides a structured understanding of how enterprises have adapted across eight industrial stages. Each phase is defined not only by technological breakthroughs but also by distinct adaptive pressures – ranging from mechanization and mass production to ethical AI and planetary sustainability. This format links technological context with behavioral and organizational models, reflecting the interdisciplinary nature of modern adaptation.

Table 1

Comparative characteristics of adaptive models of enterprises in the context of Industries 1.0–8.0

Industry stage	Characteristic technologies/ drivers	Main challenges for enterprises	Adaptation Model
Industry 1.0 (late 18th century – early 19th century)	Steam engine, mechanization, water power.	Transition from craft to factory production; resource supply; high investment in industrial machinery.	Massive introduction of machine building and factory production; concentration of production; rigid labor organization (emergence of the factory model).
Industry 2.0 (late 19th century – early 20th century)	Electrification, conveyor production, oil and gas energy, steel construction, telegraph.	Large-scale production lines; mass standardization; training of a large industrial workforce; logistics and transport networks.	Mass production on conveyors (Fordism); scientific management (Taylorism); vertical integration of companies; formalization of organizations.
Industry 3.0 (mid – late 20th century)	Electronics, computing, programmable logic, robotics, process automation.	IT integration; global market competition; quality regulation; need for IT staff training; production flexibility.	ERP systems; computerization of processes; flexible production systems; industrial robots; outsourcing and lean approaches.
Industry 4.0 (early 21st century).	Cyber-physical systems, Internet of Things (IoT), cloud technologies, big data, artificial intelligence (AI), smart robots.	Digital infrastructure; cybersecurity and data privacy; the need for analytics and data management; digital literacy of employees.	Smart factories with flexible production chains; networked business models (cyber-physical systems, digital twins, industrial platforms); decentralized production networks; online analytics.
Industry 5.0 (2020s–2030s)	Collaborative robots (co-bots), additive manufacturing (3D printing), biotechnology, VR/ AR, green energy.	Sustainability and green transition: environmental responsibility and regulation; balance between automation and social good; personalization of products; human factor in a high-tech environment.	Human-centric production: human-machine collaborations; adaptive and flexible production models (e.g., sustainable circular economy); creative collaboration.
Industry 6.0 (2030s–2050s, conceptual)	Hyper-automation, artificial general intelligence, quantum computing, advanced robotics, digital twins.	Ethical and legal issues of AI; large-scale retraining of workers; transparency and trust in autonomous systems; energy sustainability and social responsibility in hyperintelligent production.	Autonomous learning systems; digital twin, predictive maintenance, adaptive supply chains; network platforms; continuous learning.
Industry 7.0 (~2050s, conceptual)	Integration of artificial general intelligence into all industries, bionic interfaces (fusion of human and machine intelligence), global intelligent networks, sustainable ecosystem.	Redistribution of human roles in the knowledge economy, regulation of conscious AI, holistic integration of technologies into life, cybersecurity at the level of biological systems.	Production focused on the "symbiosis of man and machine": co-creation platforms; new business models with radical automation and full personalized service.
Industry 8.0 (futuristic)	Fully self-learning and self-organizing systems; nanotechnology in manufacturing; synergistic integration of biological, physical and digital systems, global intelligence.	Unpredictable complexity: the need to manage supersystems; system self-evolution, global resource use and even interplanetary production; ensuring harmony between humans, nature and technology.	Fully self-organized production ecosystems: enterprises become part of cyber-physical-social networks that adapt without centralized control; focus on the sustainable self-evolution of production systems; mission-driven innovation.

Source: compiled by the authors

The column "Adaptation Model" synthesizes how firms restructured their operations in response to evolving demands. Early stages focused on mechanistic control and efficiency; later stages prioritize flexibility, cognitive foresight, and ecosystem-based cooperation.

This evolution reveals three major trends. First, adaptive models have shifted from reactive responses to proactive, innovation-led strategies. Second, the importance of intangible assets – data, values, relationships – has grown exponentially. Third, adaptability now works as a strategic capability, enabling firms not only to survive disruption but to shape it. In this context, adaptability emerges as the core logic of organizational resilience and competitiveness in the era of exponential change.

3. Model Matrix of Adaptive Strategies for Enterprise Behaviour

Following the historical and comparative analysis, this section synthesizes a general classification of enterprise adaptability types – each reflecting a distinct approach to environmental change.

The proposed matrix integrates fragmented perspectives on adaptability (e.g., reactive vs. proactive management, innovation capability, institutional plasticity) by using a dual-axis framework based on "initiative" and "innovation." This structure offers a systematic typology of adaptive strategies relevant to industrial transformation, enriching interdisciplinary analysis in turbulent business environments.

Traditionally, literature has distinguished between passive (reactive) adaptation – where firms respond to change, and active (proactive) adaptation – where firms shape their environments. This article extends that binary by proposing a more granular typology aligned with the dynamics of Industries 1.0 – 8.0.

Innovation and initiative are key drivers of adaptability at all levels. Their combination enhances organizational resilience, but imbalance poses risks: over-adaptation without innovation leads to inertia; rapid innovation without adaptation can cause instability.

In accordance with the scientific logic of classification, the typology is based on two key dimensions: the level of initiative (proactivity) in adopting changes and the degree of innovation in responding to changes. This approach allows us to identify several basic types of adaptive behaviour:

• **Reactive adaptation** is marked by low initiative and minimal innovation. Enterprises respond only after changes occur, relying on stable procedures and mechanistic structures (hierarchy, rigid rules), which limit their ability to proactively face external challenges.

• **Strategic adaptation** focuses on trend forecasting and long-term planning. Companies act with high initiative but adopt innovations cautiously, prioritizing stability and optimization over transformation. This model is typical for large, process-heavy corporations.

• **Cognitive adaptation** relies on learning and experience. Firms invest in analytics, knowledge management, and routines that encode successful practices. Adaptation is driven by intellectual processes and internal research rather than reactive changes.

• **Proactive-innovative adaptation** merges foresight with active innovation. Firms anticipate challenges, use predictive tools, and invest in R&D and open innovation to create new markets. They don't just adapt but lead transformation. Symbiotic adaptation: the highest degree of proactive-innovative adaptation. Enterprises collaborate closely with ecosystem partners (e.g., via platforms and co-creation), leveraging shared resources and network effects to strengthen resilience and joint development.

A clear example of symbiotic adaptation is demonstrated by SaaS companies like Atlassian or GitLab. These firms integrate constant deployment pipelines with community-based co-creation and open innovation ecosystems. Their strategic use of Agile and DevOps is not only internal but also collaborative – enabling customers, developers, and partners to shape product evolution through feedback loops, API integrations, and platform-based interactions. Such firms demonstrate how adaptability emerges from network effects and shared value generation across the business ecosystem.

The proposed typology of adaptive strategies has a theoretical basis and resonates with classical concepts of organizational development. For example, a study by Burns and Stalker [11] showed that organic structures with flexible management are better adapted to the conditions of change, while mechanistic structures are effective in a stable environment. This corresponds to the reactive type of adaptation in our typology (mechanistic approach) and the proactive-innovative type (organic/adhocratic approach). Mintzberg [12] identified so-called "adhocracies" – dynamic structures that can quickly form to solve non-standard problems, which is in line with our proactive and symbiotic types. The concept of dynamic capabilities [13] focuses on the ability of organizations to recognize changes in the environment (sensing), seize opportunities (seizing) and transform internal resources (transforming), which directly corresponds to the strategic and proactive approaches in the proposed classification. In turn, Pavitt's taxonomy of innovation [14] explains why knowledge-intensive and specialized enterprises demonstrate a higher tendency towards innovative adaptation. The evolutionary theory of the firm by Nelson and Winter [15] emphasizes the role of routines and learning as the main mechanisms of adaptation under conditions of limited rationality, which

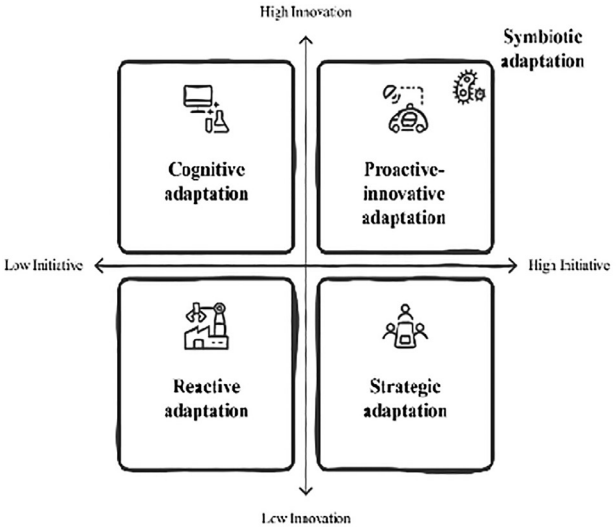

Figure 1. Typological matrix of adaptive behavioral strategies of enterprises by the level of initiative and innovation

Source: compiled by the authors

is the conceptual basis for the cognitive type. Finally, the concept of business ecosystems [16] emphasizes that symbiotic interactions between organizations contribute to long-term sustainability and joint development. Thus, our typology integrates leading scientific approaches and provides an interdisciplinary framework for understanding the adaptive behaviour of enterprises in the context of industrial transformation.

The scientific and applied value of the typology of adaptability. This typology systematizes enterprise adaptive strategies by linking them to both industrial context and managerial logic. Scientifically, it consolidates key theories of organizational development and maps them to the challenges of Industries 1.0 –8.0. It also provides a foundation for empirical research on adaptability types and their transitions.

Practically, the model helps managers identify their firm's dominant adaptation style and align strategic tools accordingly – whether it be investment in R&D, employee training, or ecosystem partnerships. In this way, it provides a basis for developing effective adaptation strategies in times of rapid change.

4. Quantitative metrics of business adaptability: systematization and sectoral analysis

Along with typologies of adaptive behaviour, the practical need to assess the adaptability of an enterprise leads to the use of quantitative metrics. Such metrics allow not only to record the fact of adaptation, but also to compare its effectiveness over time and across sectors. However, these metrics are not always standardized and often vary across disciplines (HR, strategic management, change management), which makes them difficult to apply in practice and therefore require systematization.

Below is a systematization of the most used key quantitative metrics used to measure the adaptability of enterprises. They cover both technical and economic aspects (speed of response, innovation) and behavioral (operational) and cognitive aspects (psychological capital, implementation of changes).

The analysis of adaptability metrics reveals several insights:

– Techno-economic indicators (e.g., response time, R&D intensity) are prevalent in manufacturing due to their precision and ERP integration.

– Behavioral metrics (like I-ADAPT-M, PsyCap) are useful for HR but limited in cross-company comparisons.

– Organizational indexes (e.g., Adaptive Capacity Index) offer a broad view but require sector-specific adjustment.

– Dynamic capability metrics show potential for evaluating strategic flexibility, though they remain underformalized.

Combining metrics from operational, behavioral, and strategic domains enables the creation of adaptive dashboards – tools for real-time monitoring and timely decision-making.

For instance, IT firms often track "time to market change" using platforms like Jira. One SaaS company halved this metric – from six to three weeks – after incorporating adaptability tracking, accelerating innovation and improving responsiveness.

Such cases illustrate that quantitative metrics support not only theoretical understanding but also practical assessment of strategic performance across industries.

Conclusions. The study demonstrates that enterprise adaptability evolves in parallel with industrial revolutions, with each

Table 2

Key quantitative metrics for assessing the adaptability of enterprises: description, areas of application, strengths and limitations

Metric	Description and measurement	Areas of application	Strengths	Limitations
Change Response Time	Number of days/weeks between detection of changes and response; recorded in ERP or BI systems	IT, telecom, manufacturing	Objectivity, accuracy	Depends on the availability of digital systems
Product renewal rate / R&D intensity	Number of new products, share of innovation costs (% of revenue)	IT, pharmaceuticals, mechanical engineering	Innovation orientation, strategic relevance	Does not take into account the quality of changes, has time lags
Adaptive performance indicator (I-ADAPT-M)	Assessment of personnel by 8 dimensions (flexibility, stress resistance, etc.); scale 1–5	HR, consulting, banks, service	High validity, complexity	Subjective, requires surveys
Dynamic Capabilities	Indicators of knowledge integration, resource transformation, new initiatives	High-tech sectors, corporate R&D	Focus on strategic flexibility	High complexity of collection and interpretation
Metrics of change implementation (according to Prosci and AIHR)	Level of change implementation, staff acceptance, effectiveness of implementations	All areas (especially change management)	Relationship to change, applicability	Subjectivity, dependence on culture
Adaptive Capacity Index	Index of adaptation measures implemented (%); scored on an environmental/organizational scale	Energy, agriculture, green economy	Comprehensive assessment	Unclear for business, complexity of the methodology
Psychological capital (PsyCap)	Luthans scale (hope, optimism, resilience); 24 questions × 6-point scale	HR, finance, service	Research on individual adaptability	Does not cover the organizational level
Organizational Resilience Index	5 dimensions (strategy, capital, culture, etc.); 20-question survey	Manufacturing, retail, large corporations	Multidimensionality	Resource intensity, complexity of application

Source: compiled by the authors

phase (1.0–8.0) introducing greater complexity and demanding new forms of response. Industry 4.0, for instance, triggered the widespread use of digital tools, pushing companies toward ecosystem thinking and integration. The future belongs to those able to anticipate change and treat flexibility as a competitive asset. In this light, the concept of a "continuously adaptive enterprise" becomes critical – it not only endures uncertainty but grows through innovation and learning.

The article presents several analytical tools. It summarizes the transformation of adaptive behaviour across eight industrial stages and highlights key mechanisms at each. A comparative table illustrates technological drivers, challenges, and response models. A typology of adaptive strategies has been developed, classifying firms by their technological and organizational flexibility. In addition, a system of quantitative adaptability metrics has been structured.

The findings are useful for managers, policymakers, and strategists. The typology can help enterprises evaluate their adaptability and plan improvements. For instance, understanding that Industry 5.0 prioritizes huma-AI collaboration may guide investments in workforce reskilling. Reactive firms may benefit from digital transformation and cultural shifts. Policymakers may apply these insights to develop policies to support innovation - from infrastructure to education.

The main scientific contribution of this study comes from constructing an integrative framework that links the evolution of industrial paradigms with adaptive enterprise behaviour. At its core stands the concept of the continuously adaptive enterprise – an organization capable not only of absorbing change but of co-evolving with it through strategic foresight, ecosystem integration, and reflexive learning. The typology and metrics proposed form a basis for both theoretical modelling and practical diagnostics. However, the study is limited by its mainly conceptual scope and requires further empirical testing across sectors and institutional contexts.

As prospects for further research, this conceptual framework requires empirical validation. Future studies should account for sectoral and regional specifics. Cross-national comparisons (e.g., EU, Ukraine, Southeast Asia) and industry-specific analyses (e.g., pharma, agriculture, energy) can clarify the influence of socio-cultural and institutional factors. Both quantitative (e.g., clustering, econometrics) and qualitative (e.g., case studies, expert panels) methods are recommended. Future work should also focus on modelling adaptability metrics and foresight for Industries 6.0–8.0, which involve deep human–machine integration – an area that calls for interdisciplinary studies.

References:

1. Breque M., De Nul L. & Petridis A. (2021). *Industry 5.0: Towards a sustainable, human-centric and resilient European industry.* European Commission. Available at: https://ec.europa.eu/info/publications/industry-50_en

2. Roshid M., Khan S. & Ali S. (2025). Conceptualising Industry 6.0. *Journal of Advanced Industrial Systems*.

3. Estrada M. (2023). Industry 7.0 and human-AI symbiosis: A cognitive turn. *Futurism and Policy*.

4. Oliveira T., Thomas M. & Espadanal M. (2020). Assessing the determinants of cloud computing adoption: An analysis of the manufacturing sector in the USA. *Information & Management*, 57(3), 103–119.

5. Brauner P. & Ziefle M. (2022). Human factors in Industry 5.0: Adaptive skills for digital futures. *Human-Centric Computing and Information Sciences*.

6. Luthans F., Avolio B. J., Avey J. B. & Norman S. M. (2007). Positive psychological capital: Measurement and relationship with performance and satisfaction. *Personnel Psychology*, 60(3), 541–572. DOI: https://doi.org/10.1111/j.1744-6570.2007.00083.x

7. Schwab K. (2016). *The fourth industrial revolution*. Geneva: World Economic Forum.

8. Korobka O. (2025). Adaptivnist′ yak stratehichna zdibnist′ pidpryyemstva [Adaptability as a strategic capability of an enterprise]. *Ekonomika i derzhava*. (in Ukrainian)

9. Rijwani K., Tripathi R. & Singh R. (2024). Adaptive enterprise in the era of Industry 4.0. *Journal of Digital Innovation*.

10. Saniuk S., Grabowska S. & Gajdzik B. (2023). Industry 5.0 – An evolution or a revolution? *Procedia Manufacturing*.

11. Burns Tom and G. M. Stalker, *The Management of Innovation* (Oxford, 1994; online edn, Oxford Academic, 3 Oct. 2011). DOI: https://doi.org/10.1093/acprof:oso/9780198288787.001.0001

12. Mintzberg H. (1983). *Structure in fives: Designing effective organizations.* Englewood Cliffs, NJ: Prentice-Hall.

13. Teece D. J., Pisano G. and Shuen A. (1997), Dynamic capabilities and strategic management. *Strat. Mgmt. J.*, 18: 509–533. DOI: https://doi.org/10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z

14. Pavitt K. (1984). Sectoral patterns of technical change: Towards a taxonomy and a theory. *Research Policy*, 13(6), 343–373. DOI: https://doi.org/10.1016/0048-7333(84)90018-0

15. Nelson R. R. & Winter S. G. (1982). *An evolutionary theory of economic change*. Cambridge, MA: Belknap Press of Harvard University Press.

16. Moore J. F. (1993). Predators and prey: A new ecology of competition. *Harvard Business Review*, 71(3), 75–86. Available at: https://www.researchgate.net/publication/13172133_Predators_and_Prey_A_New_Ecology_of_Competition

Стаття надійшла до редакції 07.06.2025
Стаття опублікована 30.06.2025