

SCIENTIA FRUCTUOSA

Scientific journal

Established: 1998

№ 4⁽¹⁶⁸⁾2026

To October 2000 had been published under the title "Herald of Kyiv State University of Trade and Economics"
To February 2022 had been published under the title "Herald of Kyiv National University of Trade and Economics"
From March 2022 it will be published under the title "Scientia fructuosa"
It is published six times a year

The journal is recognised by the Ministry of Education and Science of Ukraine as a Category "B" specialist publication within the "Economic Reforms, Business and Administration" cluster

EDITORIAL BOARD

MAZARAKI A., Doctor of Sciences (Economics), Professor, Rector, SUTE – Editor in Chief

MELNYK T., Doctor of Sciences (Economics), Professor, Head of the Department of International Management, SUTE – Deputy Editor

GERASYMENKO A., Doctor of Sciences (Economics), Professor, Vice-Rector for Scientific and Pedagogical Work and International Relations, SUTE – Executive Secretary

ADAMYK O., PhD (Economics), Associate Professor,
Loughborough University (*Great Britain*);

BOIKO M., Doctor of Sciences (Economics),
Professor, SUTE;

BONDARENKO O., Doctor of Sciences (Economics),
Professor, SUTE;

BOSOVSKA M., Doctor of Sciences (Economics),
Professor, SUTE;

CHUGUNOV I., Doctor of Sciences (Economics), Professor, SUTE;

CHEBAN Yu., PhD (Economics), Associate Professor,
Mykolaiv National Agrarian University;

FOMINA O., Doctor of Sciences (Economics), Professor,
SUTE;

GDOWSKA K., Doctor of Science Technical, Associate
Professor, AGH University of Krakow (*Poland*);

GONÇALVES J., PhD (Geography and Regional Planning)
Assistant Professor at Instituto Superior Técnico, University of
Lisbon (*Portugal*);

KANEVA T., Doctor of Sciences (Economics), Professor, Dean
of the Faculty of Finance and Accounting, SUTE;

KAPINUS L., Doctor of Sciences (Economics), Professor,
National university of food technologies;

KLAPKIV L., PhD (Economics), Associate Professor, University
of Maria Curie-Skłodowska (*Poland*);

KRAIEVSKYI V., Doctor of Sciences (Economics), Professor,
Dean of the Faculty of Taxation, Accounting and Auditing, State
Tax University;

KUZHELIEV M., Doctor of Sciences (Economics), Professor,
National University of Kyiv-Mohyla Academy;

OBUSHNA N., Doctor of Sciences (Public Administration),
Professor, P.L. Shupyk National University of Healthcare
of Ukraine;

PAVLOVA V., Doctor of Sciences (Economics), Professor,
University of Customs and Finance;

PAWAR A., PhD, Associate Professor, D. Y. Patil Institute
of Management Studies University of Pune (*India*);

PYLYPENKO H., Doctor of Sciences (Economics), Professor,
Dnipro University of Technology;

TRUNINA I., Doctor of Sciences (Economics), Professor,
Mykhailo Ostrohradskyi Kremenchuk National University;

VEDMID N., Doctor of Sciences (Economics), Professor, SUTE;

VLACHOS P., PhD, Professor University of Greenwich

(*Great Britain*);

VYSOCHYN I., Doctor of Sciences (Economics),
Professor, SUTE;

ZALIZNIUK V., Doctor of Sciences (Public Administration),
Professor, Head of the Department of Public Administration,
SUTE

Founder, edition,
publisher and manufacturer
State University of Trade and Economics

Director of periodicals – KRYVYTSKA I.

Editors: KYRYCHENKO E., DUBKO M.

Artistic and Technical Editor

PSHENICHNA T.

Entered into the Register of entities in the field
of print media by decision
of the National Council of Ukraine on Television and Radio
Broadcasting

No. 798 dated August 31, 2023
and assigned the identifier R30-01229

Index of the magazine in Catalogue
of publications in Ukraine in 2026 – 21910

Signed 21.08.2026.
Conventional print. pages. 11
Circulation 250. Order 281

Address of the Editorial board,
publisher, manufacturer:
St. Kyoto, 19, Kyiv-156, Ukraine, 02156.

Contact us at 531-31-16
visnik@knute.edu.ua
http://journals.knute.edu.ua/scientia-fructuosa/pro_journal

Printed on equipment of SUTE.

Certificate of subject of publishing industry
series DK № 7656 of 05.09.2022

Published on the recommendation
of the Academic Council of SUTE
(minutes № 11 of 28.05.2026)

The journal is represented in international scientometric databases, repositories and search engines, such as Index Copernicus,
Register of Scientific Publications of Ukraine, Vernadsky National Library of Ukraine, Crossref, Dimensions, Research Bible

© State University of Trade and Economics, 2026

C O N T E N T

DIGITAL GOVERNANCE AND SOCIAL DEVELOPMENT

TONON B.	Algorithmic urbanism and structural inequality: a critical assessment of artificial intelligence in urban systems	4
ALAMR A.	Conceptualising archival heritage management in Jordan: policy, digitisation, and public access	16
POLOZOVA T., SALIKHOV M.	EU policy on artificial intelligence integration in manufacturing	32

MARKETING

DOBRODUM O.	Digital consumerism in the development of virtual communities	52
KONOPLIANNYKOVA M.	Quantum marketing in E-commerce	67
IANKOVETS T., KOSTENKO A., VYSHNEVSKA M.	Digital eco-branding of FMCG companies	83
ROZHDESTVENSKYY V.	Gamification in digital branding	103
CHUNIKHINA T., CHISTIAKOVA S.	AI-advertising in jewelry retail	116
HUDZENKO O.	The economics of manipulation: digital choice architecture and the rationality of consumer decisions	131

ADAPTIVE MANAGEMENT AND INNOVATION

VZHYTYNSKA K.	Adaptive logistics architecture: the case of Ukraine	143
KRAVTSOV S.	Startup ecosystem of Albergo Diffuso: digital orchestration of value co-creation	162
FEDULOVA I., SBEHAT F. N.	Artificial intelligence in building sustainable competitive advantages in retail	178
STOIANENKO I., KONDRATIUK O.	Adaptive pricing policy in enterprise management	198

З М І С Т

ЦИФРОВЕ ВРЯДУВАННЯ ТА СУСПІЛЬНИЙ РОЗВИТОК

ТОНОН Б.	Алгоритмічний урбанізм та структурна нерівність	4
АЛАМР А.	Концептуалізація управління архівною спадщиною в Йорданії: політика, оцифрування та публічний доступ	16
ПОЛОЗОВА Т., САЛІХОВ М.	Політика ЄС щодо інтеграції штучного інтелекту в промисловість	32

МАРКЕТИНГ

ДОБРОДУМ О.	Цифровий консьюмеризм у формуванні віртуальних спільнот	52
КОНОПЛЯННИКОВА М.	Квантовий маркетинг в електронній комерції	67
ЯНКОВЕЦЬ Т., КОСТЕНКО А., ВИШНЕВСЬКА М.	Цифровий еко-брендинг FMCG підприємств	83
РОЖДЕСТВЕНСЬКИЙ В.	Гейміфікація у цифровому брендингу	103
ЧУНІХІНА Т., ЧІСТЯКОВА С.	ШІ-реклама в ювелірному ритейлі	116
ГУДЗЕНКО О.	Економіка маніпуляції: цифрова архітектура вибору та раціональність споживчих рішень	131

АДАПТИВНЕ УПРАВЛІННЯ ТА ІННОВАЦІЇ

ВЖИТИНСЬКА К.	Адаптивна логістична архітектура: кейс України	143
КРАВЦОВ С.	Стартап-екосистема <i>Albergo Diffuso</i> : цифрова оркестрація співтворення цінності	162
ФЕДУЛОВА І., СБЕХАТ Ф.-Н.	Штучний інтелект у формуванні стійких конкурентних переваг у ритейлі	178
СТОЯНЕНКО І., КОНДРАТЮК О.	Адаптивна цінова політика в управлінні підприємством	198

DIGITAL GOVERNANCE AND SOCIAL DEVELOPMENT

DOI: [http://doi.org/10.31617/1.2026\(168\)01](http://doi.org/10.31617/1.2026(168)01)
UDC 711.4:316.342=111



TONON Beatriz

 <https://orcid.org/0009-0005-7903-2228>

MSc Sustainable Urban Development,
Department for Continuing Education,
University of Oxford
Oxford, United Kingdom
beatriz.tonon@kellogg.ox.ac.uk

ALGORITHMIC URBANISM AND STRUCTURAL INEQUALITY: A CRITICAL ASSESSMENT OF ARTIFICIAL INTELLIGENCE IN URBAN SYSTEMS

Artificial intelligence is increasingly deployed to optimise urban energy systems, transport networks, and housing markets. However, its infrastructure frequently reproduces structural inequalities, imposing environmental and social costs onto marginalised communities whilst concentrating benefits among capital-holding actors. This paper argues hypothesis that AI urbanism, as currently embedded within existing urban political economies, functions as a mechanism of cost externalisation rather than public service optimisation: efficiency gains accrue to capital-holding actors whilst costs are displaced onto marginalised communities and peripheral territories. This study adopts a qualitative, critical analytical approach, combining a systematic literature synthesis with comparative case studies across three urban domains of energy, transport, and housing, drawing on evidence from both the Global North and the Global South. The informational basis combines peer-reviewed scholarship, intergovernmental reports, and investigative journalism. The study relies on secondary sources, which constitutes its principal limitation alongside the

ТОНОН Беатріс

 <https://orcid.org/0009-0005-7903-2228>

магістр сталого міського розвитку,
Оксфорд Лайфлонг Лернінг,
Університет Оксфорду
Оксфорд, Велика Британія
beatriz.tonon@kellogg.ox.ac.uk

АЛГОРИТМІЧНИЙ УРБАНІЗМ ТА СТРУКТУРНА НЕРІВНІСТЬ

Штучний інтелект (ШІ) дедалі активніше впроваджується в міські системи, зокрема в енергетичні мережі, транспортну інфраструктуру та ринок житла. Проте його інфраструктура часто відтворює структурну нерівність, оскільки екологічні та соціальні витрати непропорційно покладаються на маргіналізовані громади, тоді як вигоди концентруються серед тих, хто має капітал та інфраструктурну владу. Висунуто гіпотезу, що ШІ-урбанізм, вбудований у міські політичні економії, функціонує як механізм екстерналізації витрат, а не як оптимізація публічних послуг. Алгоритмічні системи в цьому контексті сприяють концентрації ефективності, ресурсів і прибутків серед капіталомістких акторів, тоді як екологічні та соціальні ризики непропорційно покладаються на маргіналізовані групи населення. Застосовано якісний критично-аналітичний підхід, поєднуючи систематичний синтез літератури з порівняльними кейсами у трьох доменах: енергетиці, транспорті та житловому секторі, з доказами як з країн Глобальної Півночі, так і з країн Глобального Півдня. Інформаційну базу становлять рецензовані наукові праці, міжурядові доповіді та матеріали журналістських розслідувань. Результати аналізу



Copyright © 2026. The Author(s). This is an open access article distributed under the terms of the [Creative Commons Attribution License 4.0. International License \(CC-BY\)](https://creativecommons.org/licenses/by/4.0/)

rapidly evolving nature of AI governance. The analysis revealed that AI data centre infrastructure in Mesa, Arizona, extracted 5.5 million cubic metres of water annually whilst residential construction permits were simultaneously revoked due to aquifer depletion. In Caucaia, Brazil, a proposed data centre would consume electricity equivalent to 2.2 million households, exemplifying computational colonialism in peripheral economies. In transport, the Waze for Cities programme in Joinville, Brazil, created extractive data dependency that undermined municipal governance capacity, whilst Singapore's publicly governed system demonstrated that equitable outcomes are achievable under different governance architectures. In housing, Barcelona's Sant Marti district experienced algorithmic amplification of gentrification, displacing low-income residents despite environmental improvements. The paradox of AI urbanism is sustained not by technical failure but by the political economy in which these systems operate. The study provides recommendations for municipal authorities to implement public data trusts, participatory governance mechanisms, and wellbeing-oriented optimisation metrics, ensuring that AI-driven urban systems serve collective wellbeing over capital accumulation.

Keywords: AI urbanism, urban sustainability, algorithmic inequality, computational colonialism, data sovereignty, political economy.

показали, що інфраструктура центрів обробки даних у м. Месі (штат Арізона) споживала щорічно 5.5 млн м³ води, тоді як дозволи на нове житлове будівництво одночасно скасовувалися через виснаження водоносних горизонтів. У Каукаїї (Бразилія) запропонований центр обробки даних споживав би електроенергію, еквівалентну потребам 2.2 млн домогосподарств. У сфері транспорту програма Waze for Cities у Жуанвілі (Бразилія) створила залежність від приватної платформи, що підірвала муніципальний суверенітет даних, тоді як публічно керована система Сингапуру продемонструвала досяжність справедливих результатів за інших умов управління. У сфері житла район Сант-Марті у Барселоні зазнав алгоритмічного посилення джентрифікації, що призвело до витіснення малозабезпечених мешканців попри екологічні покращення. Встановлено, що парадокс ШІ-урбанізму зумовлений не технічними збоями, а політичною економією, в якій функціонують ці системи. Сформовано рекомендації для муніципальних органів влади щодо впровадження публічних довірчих фондів даних, механізмів партисипативного управління та метрик оптимізації, орієнтованих на добробут, з метою забезпечити функціонування міських систем на основі ШІ в інтересах добробуту, а не для накопичення капіталу.

Ключові слова: ШІ-урбанізм, міська сталість, алгоритмічна нерівність, обчислювальний колоніалізм, суверенітет даних, політична економія.

JEL Classification: R10, R58, O33, L86, Q50.

Introduction

Algorithmic systems have become foundational instruments for governing urban infrastructure, enabling cities to coordinate energy consumption, regulate traffic flows, and administer housing allocation at unprecedented scales. Yet the widespread enthusiasm for AI's problem-solving capacity coexists with a structural paradox: the very systems designed to optimise urban life frequently reinforce the material and political inequalities they claim to address. The proposed data centre in Caucaia, Brazil, illustrates this tension concretely: community protests exposed how the facility's environmental burdens on a water-stressed region were systematically disregarded, revealing how optimisation logics operate in ways that override local ecological and social thresholds (Martins & Amorim, 2025).

The hypothesis underlying this study is that AI urbanism, as embedded within existing urban political economies, functions as a mechanism of cost externalisation rather than public service optimisation: efficiency gains are

systematically captured by capital-holding actors whilst environmental, governance, and social costs are displaced onto marginalised communities and peripheral territories. This analysis builds upon and expands the theoretical framework initially proposed in the author's preliminary study on algorithmic systems in urban contexts (Tonon, 2025). The hypothesis is tested through a critical synthesis of urban studies, political ecology, and technology governance literature, structured around comparative case studies across three domains, with cases drawn from both the Global North and the Global South.

Within urban contexts, AI urbanism describes the growing influence of algorithmic systems on spatial planning, infrastructure management, resource distribution, and governance structures (Cugurullo et al., 2024). Central to this paradigm is optimisation: a logic that seeks to improve outcomes through data-driven prediction and control. Yet aligning AI with the Sustainable Development Goals remains structurally ambiguous. Whilst AI can facilitate the achievement of 134, or 79%, of SDG targets across several dimensions, it simultaneously risks hindering 59, or 35%, of targets across social, economic, and environmental dimensions (Vinuesa et al., 2020). These tensions confirm that optimisation is never a neutral technical operation, but one shaped by the political economies and governance architectures in which AI systems are embedded (Vinuesa et al., 2020; Cugurullo et al., 2024).

This study adopts a qualitative, critical analytical approach, combining a systematic literature synthesis with comparative case analysis across three urban domains. Cases were selected from both the Global North and the Global South, following a logic of maximum variation to assess whether identified patterns are geographically contingent or structurally determined. The reliance on secondary sources constitutes the study's principal methodological limitation; however, this is consistent with its theoretical objectives, which seek to identify structural patterns rather than generate primary empirical data. The analysis builds upon the preliminary framework developed in Tonon (2025) and extends it through an explicit economic dimension.

The article is structured as follows. Section 1 surveys the measurable advances in urban sustainability that AI enables across energy, transport, and housing, establishing that the critique targets AI's current political-economic embedding rather than its technical potential. Section 2 examines material contradictions and structural inequalities produced across the same three domains through paired case studies from the Global North and Global South. Section 3 analyses the economic mechanisms that explain why these patterns persist. Section 4 considers the institutional conditions necessary for more equitable AI governance. The conclusions synthesise the findings and position the study's contribution to the critical AI urbanism literature.

1. Advances in sustainability

Proponents of AI urbanism argue that algorithmic optimisation delivers measurable improvements in resource efficiency, pollution reduction, and infrastructure management across energy, transport, and housing sectors (OECD, 2019). This section examines three domains where AI evidently advances sustainability metrics, whilst maintaining critical awareness that efficiency gains do not automatically translate into equitable or ecologically sustainable outcomes.

1.1. Energy: smart grids and renewable integration

AI-driven smart grids revolutionise urban energy systems by dynamically balancing supply and demand, integrating variable renewable sources, and reducing overall consumption. Machine learning algorithms predict consumption patterns and coordinate renewable energy sources, utilising satellite imagery to create emissions predictions essential for power system optimisation and disaster management (UN-Habitat, 2022). This capacity is particularly valuable in smart cities, where energy consumption fluctuates with weather conditions, time of day, and population density. Barcelona exemplifies this implementation, applying AI-powered solutions in smart lighting and waste management to measurably reduce energy consumption and carbon footprints (Singh & Shah, 2024).

1.2. Transport: route optimisation and emission reduction

Algorithmic transport optimisation targets congestion reduction, emission minimisation, and mobility efficiency through interconnected systems aligned with SDGs 11.2, 11.3, and 11.6 (UN-Habitat, 2022). AI systems manage traffic flow by analysing real-time sensor and camera data, enabling dynamic signal adjustments and vehicle rerouting that significantly reduce congestion (UN-Habitat, 2022). Singapore's traffic management system demonstrates this potential at scale, substantially reducing congestion and travel times whilst anticipating potential incidents (Singh & Shah, 2024). This case is instructive precisely because, as Section 2 will show, such outcomes depend fundamentally on governance architecture rather than technology alone.

1.3. Housing: building management and resource efficiency

Smart building technologies apply AI to optimise energy, water, and occupant comfort simultaneously, addressing SDGs 11, 9, 12, 7, and 3 (UN-Habitat, 2022). Integrated with IoT sensors, these systems enable continuous monitoring, proactive maintenance, and automated temperature control (Singh & Shah, 2024). Mehdi (2018) documents 25 to 35% reductions in energy consumption through such automated systems.

These applications demonstrate AI's technical capacity for measurable efficiency improvements. The following section examines the critical questions they raise: efficiency for whom, at what hidden costs, and through what governance structures?

2. Material contradictions and structural inequalities

The material infrastructure sustaining AI-driven urbanism, comprising data centres, computational networks, and digital platforms, places enormous demands on water and energy systems already under pressure from climate change (Lee, 2025). These burdens fall disproportionately on vulnerable communities across the Global North and South (Sharma et al., 2023). Rather than redistributing resources equitably, AI systems operationalise a logic of capital accumulation, embedding patterns of extraction characteristic of colonial resource regimes within the governance structures of ostensibly progressive smart cities (Cugurullo, 2021). The following case studies demonstrate how this logic generates economic asymmetry across energy, transport, and housing, producing systematic cost externalisation onto marginalised populations whilst concentrating benefits among technology corporations and high-income urban residents (Sharma et al., 2023).

2.1. *Energy: water extraction and computational colonialism*

AI-driven energy optimisation masks significant material contradictions: computational infrastructure consumes water at scales that threaten community access in water-stressed regions (Barratt et al., 2025). Data centres are frequently sited in arid regions to minimise corrosion, paradoxically concentrating consumption precisely where water is scarcest. One study projects AI-driven facilities could consume up to 1.7 trillion gallons globally by 2027 (Fleury & Jimenez, 2025).

Mesa, Arizona. In Mesa, Arizona, a region experiencing extreme drought, authorities permitted Google's data centre to extract 5.5 million cubic metres of water annually, equivalent to the annual consumption of 23,000 residents. This occurred whilst residential construction permits were revoked due to aquifer depletion. The decision reveals a political-economic hierarchy in which corporate infrastructure investment takes precedence over community need: the same resource whose scarcity was being used to deny housing permits was simultaneously being allocated to a private data centre. Recent investigations identified 632 existing data centres, including 38 already located in water-stressed areas and another 24 under development, collectively representing a 78% increase in planned capacity, placing Mesa within a systematic pattern (Barratt et al., 2025).

Caucaia, Brazil. The proposed TikTok data centre in Caucaia, Brazil, exemplifies computational colonialism: resource extraction from peripheral regions sustaining centralised digital infrastructure (Cugurullo, 2021).

The facility would consume electricity equivalent to 2.2 million homes, exceeding 99.9% of Brazilian municipalities' per-capita use, and would rank as Brazil's seventh-largest electricity consumer as a single entity (Martins & Amorim, 2025). The asymmetry is stark: the data centre would generate digital value for global platforms whilst imposing energy and water burdens on a water-stressed region with limited capacity for legal or political contestation. Community protests against the facility reveal that the affected population recognised this asymmetry clearly, even when regulatory frameworks did not (Martins & Amorim, 2025).

Together, Mesa and Caucaia reveal that the logic of externalisation operates consistently across distinct regulatory and geographic contexts: costs are imposed on communities selected precisely because their capacity to resist is weakest. This is a structural feature of how AI infrastructure is deployed, not an incidental failure (Cugurullo, 2021; Sharma et al., 2023).

2.2. Transport: data extraction and municipal sovereignty

The political economy of AI transport optimisation is characterised by structural economic asymmetry: platform corporations extract commercially valuable municipal datasets whilst providing minimal reciprocal benefit, systematically diminishing local governance capacity and concentrating analytical power within private technology corporations (UN-Habitat, 2022). Smart mobility systems thus function less as instruments of public service than as mechanisms of data extraction and capital accumulation. Through network effects and proprietary data architectures, platform corporations position themselves as indispensable intermediaries, generating a form of cost externalisation whereby the public investment required to produce valuable urban data is borne by municipalities, whilst the economic returns accrue entirely to private platforms (Hiroki, 2021; Sharma et al., 2023; UN-Habitat, 2023).

Singapore. Singapore's AI-assisted traffic management demonstrates what is technically achievable when algorithmic systems are deployed within strong public governance frameworks. The city-state retains public ownership of its transport data infrastructure, enabling AI optimisation to serve collective mobility goals rather than platform profit. The result is a system that genuinely reduces congestion and travel times whilst maintaining public accountability, instructive as evidence that AI outcomes depend fundamentally on governance architecture: who owns the data, who sets the targets, and to whom the system is accountable (Singh & Shah, 2024).

Joinville, Brazil. The contrast with Joinville, Santa Catarina, is instructive. The city's participation in the Waze for Cities programme created a dependency in which the platform retained software ownership and patents whilst providing only filtered, partial information insufficient for medium- or large-scale traffic planning (Hiroki, 2021). Although municipal officials recognised the imbalance, Waze's market dominance left few alternatives.

This dynamic reproduces colonial extraction patterns: data flows from the periphery to the core, whilst analytical capacity concentrates in Global North corporate headquarters, weakening municipal data sovereignty and limiting autonomous policymaking aligned with community needs (Hiroki, 2021; Sharma et al., 2023). This vulnerability is particularly acute in Global South cities, where limited budgets and expertise create greater exposure to exploitative data arrangements (Hiroki, 2021; Sharma et al., 2023).

Singapore and Joinville demonstrate that the AI paradox in transport is not technical but political: the same algorithmic tools produce radically different outcomes depending on who controls the data and what governance frameworks protect public interests.

2.3. Housing: algorithmic discrimination and access barriers

AI housing systems reproduce and amplify existing discrimination, creating algorithmic barriers that restrict access for marginalised communities whilst optimising markets for investor profit rather than residential need (Rosen & Garboden, 2024; Sharma et al., 2023). Research on the US housing market demonstrates that AI-driven systems reproduce racial discrimination, systematically restricting access for racialised minorities in ways that mirror historical patterns of exclusion (Rosen & Garboden, 2024). Machine learning models treat discrimination as a signal rather than a bias to be corrected, thereby reinforcing racist market structures (Cugurullo & Xu, 2025). Algorithmic opacity obscures these dynamics, limiting accountability and enabling corporations to maintain plausible deniability (Cugurullo & Xu, 2025; Lee, 2025; Sharma et al., 2023).

Barcelona. Barcelona's Sant Marti district illustrates how environmental improvements, mediated by algorithmic housing systems, can accelerate displacement of the very communities they were ostensibly designed to benefit. Between 1992 and 2006, the creation of 18 parks attracted higher-income residents: adults with university degrees rose by 27.92% and household income by 26.7%, far above district-wide trends (Anguelovski et al., 2018). Market algorithms classified the area as a high-return zone whilst labelling vulnerable residents as high risk, channelling investment and driving up costs. Low-income populations were consequently displaced to Nou Barris, where algorithmic systems continued to rate the neighbourhood negatively despite the presence of green amenities, reinforcing structural inequalities (Anguelovski et al., 2018; Sharma et al., 2023; UN-Habitat, 2022).

Sant Marti reveals a deeper contradiction: AI does not cause gentrification but amplifies and accelerates it, identifying investment opportunities whilst simultaneously flagging existing residents as financial risks (Othengrafen et al., 2025). This transforms environmental improvement into a mechanism of displacement, making the process harder to contest and easier to conceal behind ostensibly neutral data-driven decision-making.

These contradictions reveal AI urbanism's fundamental tension with genuine sustainability (Cugurullo, 2021; Sharma et al., 2023): energy systems extract water from drought-stressed communities, transport platforms extract data from municipalities, and housing algorithms extract access from marginalised residents, all whilst claiming optimisation. What unites these three domains is a shared economic logic: the externalisation of costs onto those least able to contest them, and the internalisation of gains by those who control infrastructure and capital. The following section examines the mechanisms through which this logic is reproduced.

3. Economic dimension: the political economy of AI urbanism

The contradictions documented across the three domains are not incidental outcomes of imperfect implementation. They reflect the political economy within which AI urbanism operates: a structure that systematically generates economic efficiency for those who hold capital and infrastructure power, whilst producing systematic cost externalisation onto communities and municipalities that do not. Three interconnected mechanisms of economic asymmetry sustain this pattern (Cugurullo, 2021; Sharma et al., 2023).

First, the concentration of AI infrastructure investment among a small number of global platform corporations enables these actors to extract favourable terms from host governments, including tax incentives, subsidised energy tariffs, and loosened environmental permitting (IEA, 2024). Corporations thus capture the economic value of urban data and AI services whilst externalising infrastructure costs such as water depletion onto local communities and public budgets. Mesa and Caucaia exemplify this: in both cases, scarce public resources were allocated to private digital infrastructure through governance frameworks that prioritised corporate investment over community need (Barratt et al., 2025; Martins and Amorim, 2025).

Second, the commodification of urban data creates persistent asymmetries between platform corporations and municipalities. As the Joinville case illustrates, proprietary platforms extract commercially valuable datasets from public infrastructure investment, monetising traffic patterns, mobility behaviour, and spatial demand signals through advertising and logistics optimisation, whilst municipalities receive only partial, filtered information in return (Hiroki, 2021). This redistribution of urban surplus from public institutions towards technology corporations weakens the fiscal and institutional base from which municipalities might otherwise develop autonomous, equity-oriented policies.

Third, in housing markets, AI amplifies existing capital advantages by enabling institutional investors to act on investment signals at a speed and scale unavailable to individual households or municipal governments (Othengrafen et al., 2025). Barcelona demonstrates this amplification: algorithmic systems did not introduce gentrification to Sant Marti, but accelerated and deepened it in ways that manual market analysis could not

match. These three mechanisms interact and reinforce one another, which is why piecemeal technical reforms consistently produce limited results: the AI paradox is sustained not by flawed algorithms, but by the political economy in which they operate (Cugurullo, 2021; Sharma et al., 2023).

4. Conditions of possibility

If the paradox of AI urbanism is structural rather than incidental, as the preceding analysis demonstrates, then addressing it requires structural responses: not better algorithms, but different ownership arrangements, different governance architectures, and different definitions of what optimisation is for. Three transformations emerge as essential: public data sovereignty (UN-Habitat, 2022), democratic participation in design processes (Othengrafen et al., 2025), and optimisation metrics prioritising justice alongside efficiency (Sharma et al., 2023). These are not independent recommendations but interconnected conditions, and none is sufficient without the others.

4.1. *Public data sovereignty and municipal ownership*

Municipal and cooperative data ownership enables alternative outcomes prioritising equity alongside efficiency. Barcelona's Decidim platform demonstrates this possibility: a free, open data commons infrastructure for participatory democracy that achieves high implementation rates for citizen proposals (Bernardi, 2019). However, Caucaia's resistance against data centre infrastructure reveals that public ownership alone proves insufficient without robust accountability mechanisms and capacity to contest corporate power (Martins & Amorim, 2025). Data sovereignty must combine legal ownership with institutional capacity-building and community technical expertise, as the contrast between Decidim and the Joinville arrangement illustrates: the difference is not technical but political (Bernardi, 2019; Hiroki, 2021; UN-Habitat, 2022).

4.2. *Participatory governance*

Democratic participation in AI system design challenges technocratic decision-making that excludes affected communities. Effective participation requires more than consultation; it demands redistributing decision-making power over algorithmic systems, including community oversight of data practices, transparent audits, and mechanisms to contest automated decisions (Sharma et al., 2023; UN-Habitat, 2022). The resistance to Caucaia's proposed data centre demonstrates how organised communities can oppose corporate infrastructure even when regulatory frameworks fail them, though their capacity to participate remains limited when state decisions override local mobilisation (Martins & Amorim, 2025). Genuine participatory governance therefore requires legal frameworks protecting community veto

power, binding consultation requirements, and resources for communities to develop the technical capacity necessary for meaningful engagement (Cugurullo, 2021).

4.3. Alternative metrics

Reconceptualising optimisation metrics challenges the growth-oriented logic embedded in AI urbanism. Doughnut Economics offers an alternative framework prioritising ecological sustainability and social equity over GDP expansion (Raworth, 2017; DEAL, 2024). More than 70 cities worldwide are exploring adoption through DEAL's Data Portrait of Place, a tool generating holistic assessments of local social and ecological performance (DEAL, 2024). By establishing legitimate wellbeing metrics, the framework helps municipalities resist profit-maximising optimisation logics (Raworth, 2017). Yet implementation faces major barriers: the computational colonialism documented in Caucaia shows the consequences of leaving profit-driven optimisation unchallenged, whilst Barcelona's green goods polarisation demonstrates how environmental improvements produce inequitable outcomes when distributional concerns are sidelined (Anguelovski et al., 2018; Martins & Amorim, 2025). Alternative metrics must therefore be paired with governance reforms ensuring algorithmic systems advance collective welfare, constrained as they are by corporate resistance and structural power asymmetries favouring capital over communities (Sharma et al., 2023).

Conclusions

AI generates measurable gains in renewable integration (Vinuesa et al., 2020), mobility optimisation (Singh & Shah, 2024), and building performance (UN-Habitat, 2022). Yet its infrastructures frequently externalise socioecological harms, from water extraction in drought-stressed regions (Barratt et al., 2025) to the erosion of municipal data sovereignty (Hiroki, 2021) and discriminatory housing outcomes (Anguelovski et al., 2018; Rosen & Garboden, 2024). Its impact, therefore, turns not on technical capacity but on governance structures shaped by corporate control and uneven resource flows, which reproduce forms of computational colonialism (Cugurullo, 2021; Sharma et al., 2023).

The case studies demonstrate that these patterns are not geographically confined or sectorally specific. In energy, Mesa and Caucaia reveal how infrastructure costs are imposed on communities selected for their limited capacity to resist. In transport, Singapore and Joinville show that the same tools produce radically different outcomes depending on who owns the data. In housing, Barcelona's Sant Marti illustrates how AI transforms environmental improvement into a mechanism of displacement.

These patterns persist because they are sustained by a political economy that concentrates AI's benefits among capital-holding actors whilst externalising its costs. Achieving genuine sustainability, therefore, requires

moving beyond tech-centric approaches towards transforming ownership structures, governance models, and optimisation logics themselves (Cugurullo, 2021; Sharma et al., 2023). Public ownership of data infrastructures, participatory institutions with enforceable community rights, and optimisation metrics aligned with collective wellbeing rather than profit are not supplementary considerations; they are the conditions under which AI urbanism could begin to deliver on its sustainability promise.

This paper contributes to the critical AI urbanism literature by demonstrating that the paradox of algorithmic urban governance is not a technical malfunction but a structural feature of the political economies in which these systems operate. It advances the debate by proposing that genuine urban sustainability requires institutional transformations in data ownership, governance participation, and optimisation metrics, rather than incremental adjustments to existing algorithmic systems. For scholars of urban economics, the findings suggest that AI infrastructure investment follows the same logic of rent extraction and cost socialisation that characterises urban development more broadly: the question is not whether AI is good or bad for cities, but who captures the value it creates and who absorbs the costs it generates. Answering that question is both an analytical and a political task.

REFERENCES / СПИСОК ВИКОРИСТАНИХ ДЖЕРЕЛ

- Anguelovski, I., Connolly, J. J. T., Masip, L. & Pearsall, H. (2018). "Assessing green gentrification in historically disenfranchised neighborhoods: a longitudinal and spatial analysis of Barcelona", *Urban Geography*, 39(3), 458–491. <https://doi.org/10.1080/02723638.2017.1349987>
- Barratt, L., Gambarini, C., Witherspoon, A., & Uteuova, A. (2025). 'Data centre expansion: water extraction and drought conflicts in Aragon and Arizona', *The Guardian*, 9 April. <https://www.theguardian.com/environment/2025/apr/09/big-tech-datacentres-water>
- Bernardi, M. (2019). "Digital Democracy and Data Commons (DDDC): a participatory platform to build a more open, transparent and collaborative society", *The Urban Media Lab*, 21 February. <https://labgov.city/theurbanmedialab/digital-democracy-and-data-commons-dddc-a-participatory-platform-to-build-a-more-open-transparent-and-collaborative-society/>
- Cugurullo, F. (2021). *Frankenstein Urbanism: Eco, Smart and Autonomous Cities, Artificial Intelligence and the End of the City*. London: Routledge. ISBN 978-1-138-10178-4.
- Cugurullo, F., Caprotti, F., Cook, M., Karvonen, A., McGuirk, P., & Marvin, S. (2024). "The Rise of AI Urbanism in Post-smart Cities: A Critical Commentary on Urban Artificial Intelligence", *Urban Studies*, 61(6), 1168–1182. <https://journals.sagepub.com/doi/10.1177/00420980231203386>
- Cugurullo, F., & Xu, Y. (2025). "When AIs become oracles: generative artificial intelligence, anticipatory urban governance, and the future of cities", *Policy and Society*, 44(1), 98–115. <https://doi.org/10.1093/polsoc/puae025>
- DEAL. (Doughnut Economics Action Lab). (2024). Cities and Regions: Let's Get Started. Pathways for local and regional governments to engage with Doughnut Economics as a tool for transformative action (Version 2). *Doughnut Economics Action Lab*, UK. <https://doughnuteconomics.org/themes/cities-regions>
- Fleury, M., & Jimenez, N. (2025). "I cannot drink the water: life next to a US data centre", *BBC News*, 10 July. <https://www.bbc.com/news/articles/cy8gy7lv4480>
- | | |
|--|---|
| Hiroki, S. M. Y. (2021). Mobility, participation, and data: The case of the application of Waze for Cities Data in the city of Joinville (SC). <i>Urbe. Revista Brasileira de Gestão Urbana</i> , 13, e20200030. https://doi.org/10.1590/2175-3369.013.e20200030 . | Hiroki, S. M. Y. (2021). "Mobilidade, participação e dados: o caso da aplicação do Waze for Cities Data na cidade de Joinville (SC)", <i>Urbe. Revista Brasileira de Gestão Urbana</i> , 13(e20200030). https://doi.org/10.1590/2175-3369.013.e20200030 . |
|--|---|

-
- IEA. (International Energy Agency). (2024). *Electricity 2024: Analysis and Forecast to 2026*. Paris: IEA. Available at: <https://www.iea.org/reports/electricity-2024>
-
- Lee, H. J. (2025). 'Seeing like AI? AI urbanism reconsidered through a critical posthumanist perspective', *Urban Studies*, pp. 1-22. <https://doi.org/10.1177/00420980251344914>
-
- | | |
|---|---|
| <p>Martins, L., & Amorim, F. (2025, May 22). Protests and algorithmic pollution: The case of Casa dos Ventos em Caucaia. <i>The Intercept Brasil</i>. https://www.intercept.com.br/2025/05/22/tiktok-data-center-cidade-seca-no-ceara/</p> | <p>Martins, L. & Amorim, F. (2025) "Protestos e a poluição algorítmica: o caso da Casa dos Ventos em Caucaia", <i>Intercept Brasil</i>, 22 May. https://www.intercept.com.br/2025/05/22/tiktok-data-center-cidade-seca-no-ceara/</p> |
|---|---|
-
- Mehdi, N. (2018). *Big data, smart cities, intelligent buildings: surveying in a digital world*. London: Royal Institution of Chartered Surveyors (RICS). <https://www.rics.org/profession-standards/rics-standards-and-guidance/sector-standards/built-environment>
-
- OECD (Organisation for Economic Co-operation and Development). (2019). *Artificial Intelligence in Society*. Paris: *OECD Publishing*. <https://doi.org/10.1787/eedfee77-en>
-
- Othengrafen, F., Sievers, L., & Reinecke, E. (2025). 'From Vision to Reality: The Use of Artificial Intelligence in Different Urban Planning Phases', *Urban Planning*, 10 (Article 8576). <https://doi.org/10.17645/up.8576>
-
- Raworth, K. (2017). *Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist*. London: Random House. ISBN 978-1-847-94137-4.
-
- Tonon, B. (2025) Optimised for Whom? AI in Urban Energy, Transport, and Housing Between Efficiency and Structural Inequality (Working Paper). Zenodo. <https://doi.org/10.5281/zenodo.18793700>
-
- Rosen, E., & Garboden, P. (2024). "Algorithms and racial discrimination in the US housing market", in Cugurullo, F. et al. (eds.) *Artificial intelligence and the city: Urbanistic perspectives on AI*. London: Routledge, 322–338. <https://doi.org/10.4324/9781003365877>
-
- Sharma, N. K., Hargreaves, T., & Pallett, H. (2023). "Social justice implications of smart urban technologies: an intersectional approach", *Buildings and Cities*, 4(1), 315–333. <https://doi.org/10.5334/bc.290>
-
- Singh, R. K. & Shah, M. S. (2024). "AI-Driven Smart Cities: Improving Urban Infrastructure and Services", *International Journal of Advanced Research in Science, Communication and Technology*, 5(2), 22–31. <https://ijarsct.co.in/Paper23304.pdf>
-
- UN-Habitat. (United Nations Human Settlements Programme). (2022). *AI and Cities: Risks, Applications and Governance*. Nairobi: UN-Habitat. Available at: <https://unhabitat.org/ai-cities-risks-applications-and-governance>
-
- UN-Habitat (United Nations Human Settlements Programme). (2023). *Annual Report 2022*. Nairobi: *UN-Habitat*. <https://unhabitat.org/annual-report-2022>
-
- Vinuesa, R. et al. (2020). "The role of artificial intelligence in achieving the Sustainable Development Goals", *Nature Communications*, 11(1), 1–10. <https://doi.org/10.1038/s41467-019-14108-y>
-

Conflict of interest. The author certifies that she doesn't have financial or non-financial interest in the subject matter or materials discussed in this manuscript; the authors have no association with state bodies, any organisations, or commercial entities having a financial interest in or financial conflict with the subject matter or research presented in the manuscript. Given that the author is affiliated with the institution that publishes this journal, which may cause potential conflict or suspicion of bias and therefore the final decision to publish this article (including the reviewers and editors) is made by the members of the Editorial Board who are not the employees of this institution.

The author received no direct funding for this study.

Tonon B. (2026). Algorithmic urbanism and structural inequality: a critical assessment of artificial intelligence in urban systems. *Scientia Fructuosa*, 4(168), 4–15. [http://doi.org/10.31617/1.2026\(168\)01](http://doi.org/10.31617/1.2026(168)01)

Received by the editorial office 20.03.2026.

Sent for revision 22.04.2026.

Accepted for printing 30.05.2026.

Published online 07.09.2026.

ALAMR Ayman <https://orcid.org/0000-0002-1100-6702>

PhD (Antiquities),
Professor of the Department of Services Courses
Aqaba University of Technology
Airport Road, P.O. Box 1199,
Aqaba, 77110, Jordan
aamr@aut.edu.jo

CONCEPTUALISING ARCHIVAL HERITAGE MANAGEMENT IN JORDAN: POLICY, DIGITISATION, AND PUBLIC ACCESS

This study examines the transformation of archival governance from a traditional protection-oriented paradigm to an integrated management framework, with a specific focus on the Jordanian context. While archival institutions have historically prioritised the safeguarding and preservation of documentary materials, contemporary developments in digital technology, governance models, and public expectations necessitate a broader and more strategic approach. A hypothesis is proposed that leads to an integrated model for managing the efficiency, accessibility, and public value of archival institutions. Adopting a qualitative analytical methodology, the research draws on international legal frameworks, heritage management guidelines, and archival theory to assess the conceptual and structural evolution of documentary heritage governance. A comparative analytical framework is employed to identify the key differences between protection-based and management-oriented models, particularly in relation to policy coherence, digitisation strategies, and public accessibility. The findings reveal that archival governance in Jordan remains largely influenced by custodial practices, with emerging yet fragmented digitisation initiatives and limited structured public engagement mechanisms. The study highlights the absence of comprehensive management plans and coordinated national digitisation policies as critical gaps. The paper argues that effective archival heritage management in Jordan requires the integration of three interdependent pillars:

АЛАМР Айман <https://orcid.org/0000-0002-1100-6702>

доктор філософії з антикознавства, асистент-професор кафедри загальноосвітніх дисциплін
Технологічного університету Акаби
Аеропорт-Роуд, а/с 1199,
Акаба, 77110, Йорданія
aamr@aut.edu.jo

КОНЦЕПТУАЛІЗАЦІЯ УПРАВЛІННЯ АРХІВНОЮ СПАДЩИНОЮ В ЙОРДАНІЇ: ПОЛІТИКА, ОЦИФРУВАННЯ ТА ПУБЛІЧНИЙ ДОСТУП

Розглянуто трансформацію управління архівною справою від традиційної парадигми, орієнтованої на охорону, до інтегрованої моделі управління, з акцентом на Йорданії. Якщо історично для архівних установ у пріоритеті були захист і збереження документальних матеріалів, то сучасні тенденції у сфері цифрових технологій, моделей управління та суспільних очікувань зумовлюють необхідність ширшого та більш стратегічного підходу. Висунуто гіпотезу, яка передбачає створення інтегрованої моделі управління ефективністю, доступністю та суспільною цінністю архівних установ. Застосовуючи якісну аналітичну методологію, дослідження спирається на міжнародно-правові рамки, рекомендації у сфері управління культурною спадщиною та архівну теорію для оцінювання концептуальної й структурної еволюції управління документальною спадщиною. Для визначення ключових відмінностей між моделями, заснованими на охороні, та моделями, орієнтованими на управління, використано порівняльно-аналітичний підхід зокрема щодо узгодженості політики, стратегій цифровізації та доступності архівних матеріалів для громадськості. Результати дослідження свідчать, що управління архівною справою в Йорданії значною мірою залишається під впливом традиційних практик зберігання документів. Водночас спостерігаються нові, проте фрагментарні ініціативи з цифровізації та обмежені механізми системної взаємодії з громадськістю. Наголошено на відсутності комплексних планів управління та скоординованої національної



strategic policy development, structured digitisation frameworks, and inclusive access mechanisms. By aligning national practices with international standards—particularly UNESCO's Memory of the World Programme—Jordan can reposition its archives as dynamic cultural assets that contribute to transparency, knowledge production, and national identity formation in the digital age (UNESCO, 2015).

Keywords: heritage management, World Programme, digital technology, governance models, Archival, Conceptualising.

політики цифровізації, що є критичними прогалинами у цій сфері. Обґрунтовано, що ефективне управління архівною спадщиною в Йорданії потребує інтеграції трьох взаємозалежних складових: стратегічного формування політики, структурованих механізмів цифровізації та інклюзивних механізмів доступу. Узгоджуючи національні практики з міжнародними стандартами, зокрема з програмою ЮНЕСКО "Пам'ять світу" (Memory of the World Programme), Йорданія може перетворити свої архіви на динамічні культурні ресурси, що сприятимуть прозорості, продукуванню знань та формуванню національної ідентичності в цифрову епоху (UNESCO, 2015).

Ключові слова: управління культурною спадщиною, програма "Пам'ять світу", цифрові технології, моделі управління, архівна справа, концептуалізація.

JEL Classification: Z11, Z18, O38, D83, L86.

Introduction

This study adopts a qualitative and analytical perspective to reconceptualise archival heritage management in Jordan within the broader framework of policy development, digitisation strategies, and public access mechanisms. Given the conceptual and governance-oriented nature of the research problem, the study relies on doctrinal analysis, comparative review, and policy evaluation rather than quantitative measurement.

The research is grounded in a theoretical–analytical approach that examines the transition from a protection-oriented paradigm to an integrated management model in archival governance. This shift reflects global developments in archival science, where preservation is increasingly linked to accessibility, digital transformation, and public engagement. The analytical framework presented in Table is used as a conceptual tool to assess the dimensions of this transformation.

To ensure a comprehensive analysis, the study draws on multiple categories of sources, including international legal and policy frameworks (such as UNESCO conventions and Memory of the World Programme guidelines), national legislative and institutional regulations in Jordan, relevant scholarly literature on archival theory and digital transformation, and selected comparative international experiences that illustrate best practices in archival management.

The analysis is structured around key dimensions of archival governance, including philosophical foundations, policy orientation, institutional roles, digitisation strategies, access mechanisms, public engagement, and governance evaluation. These dimensions are examined through a comparative lens, contrasting the traditional protection-based model with the proposed integrated management model in the Jordanian context (Conway, 2010).

The study proceeds through three main stages: conceptual analysis, policy assessment, and synthesis for model development. Rather than

producing statistical generalisations, the research aims to provide a normative and strategic contribution to archival heritage governance. It is limited to publicly available documents and does not include empirical data collection. Ethical standards are fully maintained, as no personal or confidential data are used (Department of Antiquities of Jordan, n. d.).

Objective

- To examine the transformation of archival governance from a traditional protection-oriented model to an integrated management framework.
- To analyse the current state of archival governance in the Jordanian context.
- To evaluate policy coherence, digitisation strategies, and public access mechanisms within archival institutions.
- To identify structural and conceptual gaps in national archival management practices.
- To propose an integrated framework based on policy development, digitisation, and inclusive access.

A hypothesis is proposed that leads to an integrated model for managing the efficiency, accessibility, and public value of archival institutions.

Methodology

The study adopts a qualitative analytical approach. It relies on documentary analysis of international legal frameworks, heritage management guidelines, and archival theories.

A comparative analytical framework is used to distinguish between protection-based archival models and management-oriented archival governance models.

The analysis focuses on three dimensions: Policy structure, Digitisation strategies; Public accessibility mechanisms

Results

Archival governance in Jordan remains predominantly custodial and protection-focused.

- Digitisation initiatives exist but are fragmented and lack national coordination.
- There is an absence of comprehensive strategic management plans for archival heritage.
- Public engagement and structured access mechanisms are limited.
- Current practices do not fully align with integrated international archival governance standards.

Scientific contribution

- The study introduces a conceptual shift from traditional archival preservation to integrated archival heritage management within the Jordanian context.
- It proposes a three-pillar model consisting of:
 - Strategic policy development.
 - Structured digitisation frameworks.

- Inclusive public access mechanisms.
- The research bridges a gap between archival theory, heritage management, and digital governance.
- It provides a policy-oriented framework that aligns national archival practices with international standards, particularly UNESCO-related initiatives.
- The study contributes to repositioning archives as dynamic cultural and knowledge assets rather than static repositories.

The changing role of archives in society

The transformation of the archive's role in society has long been a subject of scholarly reflection. Early historiographical analyses – most notably those presented by the French archivist Robert-Henri Bautier – outlined the historical evolution of archives across several stages, from palace repositories in antiquity to "arsenals of power" in the early modern period, and later to "laboratories of history" in the nineteenth and twentieth centuries. While this classification effectively captures the pre-digital phases of archival development, it does not fully account for the profound transformations brought about by digital technologies and new models of governance.

In the twenty-first century, archives have entered a new era characterised by digitisation, networked information systems, and expanding public engagement. No longer confined to administrative or purely scholarly functions, archives increasingly serve educational, communicative, and cultural roles. International academic debates have emphasised that archival science is undergoing a paradigm shift—moving beyond custodial preservation toward participatory, policy-driven, and access-oriented frameworks.

This reconceptualisation is particularly relevant to Jordan. As digital transformation reshapes public institutions, archives are no longer perceived merely as repositories of legal or historical records. Instead, they function as dynamic institutions that contribute to transparency, research innovation, civic education, and the strengthening of national identity. The emergence of digitisation initiatives, electronic records management systems, and open-access platforms has expanded the archive's communicative capacity, connecting past and present while facilitating broader societal interaction with documentary heritage.

Contemporary archival discourse highlights several core functions of modern archives: administrative accountability, scientific research support, public education, and cultural communication. In Jordan, these functions increasingly intersect within a policy environment that recognises archives as strategic cultural assets. The educational function enhances historical awareness and civic engagement; the communicative function fosters intergenerational dialogue; and the cultural function positions archives as pillars of collective memory within national development strategies.

Furthermore, modern philosophical and cultural theories have reinforced the understanding of archives as cultural phenomena rather than merely technical repositories. The "archival turn" in the humanities has

underscored the archive's influence on identity formation, memory politics, and historical reconstruction. Within this framework, archival documents are not only evidentiary instruments but also cultural artefacts whose value often extends beyond individual records to entire fonds and collections.

In light of these transformations, archival heritage management in Jordan requires a comprehensive policy framework that integrates preservation, digitisation, and public accessibility. The shift from protection to management reflects a broader recognition that sustainable heritage governance must balance safeguarding documentary integrity with ensuring inclusive access and societal relevance.

The structure of this article is organised as follows. The next section examines the theoretical foundations of archival governance and the transition from protection to management models. This is followed by an analysis of the current state of archival practices in Jordan, including institutional frameworks and digitisation initiatives. The subsequent section presents a comparative evaluation of traditional and integrated archival management approaches. Finally, the article concludes with a proposed conceptual model and policy recommendations for enhancing archival heritage management in Jordan.

1. Theoretical framework: the transformation of the archive and the emergence of a new management paradigm

The role of archives has undergone profound transformation throughout history, reflecting broader political, social, and epistemological shifts. Traditionally, archives were closely associated with authority and governance. In ancient and medieval contexts, archival repositories primarily functioned as instruments of political control and legal authentication. During the early modern period, archives increasingly became administrative tools – often described as "arsenals of power – serving state institutions and reinforcing centralised authority. By the nineteenth and early twentieth centuries, archives evolved into what scholars termed "laboratories of history," supporting academic research and historical reconstruction.

This historical trajectory, however, largely reflects the pre-digital era. The emergence of digital technologies in the late twentieth and early twenty-first centuries has fundamentally altered both the structure and the societal function of archives. Digitisation, electronic records management, big data environments, and online platforms have transformed archives from relatively closed custodial institutions into open, interactive, and networked knowledge systems. Consequently, archival science is no longer confined to preservation techniques; it increasingly engages with governance models, digital policy, information ethics, and public communication strategies.

This transformation has generated what many scholars describe as a paradigmatic shift – from a protection-oriented model to a management-oriented model of archival heritage. The traditional paradigm emphasised safeguarding physical documents, maintaining provenance, and ensuring legal authenticity. While these principles remain foundational, contemporary

archival governance demands broader responsibilities: strategic planning, digital infrastructure development, user-centred services, and institutional transparency. Archives are now expected not only to preserve memory but also to facilitate access, foster civic engagement, and contribute to knowledge economies (Harrison, 2013).

The theoretical "archival turn" in the humanities further reinforces this shift. Philosophical and cultural studies have reconceptualised archives as sites of power, identity construction, and collective memory formation. Within this framework, archival documents are not merely neutral historical traces; they are cultural artefacts embedded in political, social, and interpretative contexts. The archive thus emerges as a dynamic cultural institution whose influence extends beyond historiography into education, public discourse, and nation-building processes.

In the Jordanian context, this theoretical evolution is particularly significant. Jordan's documentary heritage reflects diverse historical layers – administrative, political, cultural, and social – that collectively shape national identity. As digital transformation accelerates across public institutions, archival governance must respond with comprehensive management strategies that integrate preservation, digitisation, and public accessibility. The growing demand for open information, academic research support, and digital services underscores the necessity of aligning archival practice with contemporary governance standards.

Moreover, international frameworks – such as UNESCO's Memory of the World Programme – highlight the importance of documentary heritage as a global cultural asset. These frameworks encourage member states to adopt structured management plans, digitisation policies, and public engagement initiatives. For Jordan, aligning national archival strategies with such international standards strengthens institutional credibility and enhances the visibility of its documentary heritage on the global stage (Jordan National Library, n. d.).

The reconceptualisation of archival heritage management in Jordan, therefore, requires a multidimensional approach. First, it demands policy innovation that clearly defines the archive's cultural, educational, and administrative functions. Second, it necessitates investment in digital infrastructure capable of ensuring long-term preservation and secure public access. Third, it calls for participatory strategies that position archives as communicative institutions serving scholars, policymakers, students, and the broader public.

In this light, archives in Jordan should no longer be perceived solely as custodians of historical records. Rather, they must be understood as strategic cultural institutions operating at the intersection of governance, technology, and society. By adopting an integrated management paradigm, Jordan can transform its archival system into a sustainable, accessible, and policy-driven framework that balances preservation with innovation.

This theoretical foundation supports the central argument of this study: that effective archival heritage governance in Jordan depends on

redefining archives as dynamic cultural assets managed through coherent policies, advanced digitisation strategies, and inclusive public access mechanisms (Consultative Committee for Space Data Systems, 2012).

2. From cultural heritage protection to heritage management: conceptual and policy foundations

The concept of cultural heritage protection emerged formally in the early twentieth century and was consolidated through a series of international conventions adopted after the Second World War. Initially, the primary concern of the international community was safeguarding cultural property from destruction, particularly during armed conflicts. Legal instruments such as the 1907 Hague Conventions laid early foundations for the protection of cultural assets, while the devastating losses of libraries, archives, and monuments during the world wars highlighted the urgent need for stronger international frameworks.

A decisive turning point occurred in 1954 with the adoption of the Hague Convention for the Protection of Cultural Property in the Event of Armed Conflict under the auspices of UNESCO. For the first time, the term "cultural property" was formally codified in international law, establishing principles of protection and restitution. Subsequent developments, particularly the 1972 Convention Concerning the Protection of the World Cultural and Natural Heritage, broadened the scope of heritage governance by defining categories of cultural value and introducing the World Heritage List as a global recognition mechanism (Gilliland, 2016).

While these instruments primarily emphasised preservation and safeguarding, the late twentieth century witnessed a conceptual expansion from protection toward management. This shift was driven by several factors: the growing complexity of heritage assets, increased public expectations for access, and the rapid development of digital technologies. UNESCO's Memory of the World Programme, established in 1992, marked a critical step in recognising documentary heritage as a distinct and globally significant category. By promoting registers of documentary heritage and encouraging digitisation initiatives, the programme underscored not only preservation but also accessibility and public awareness.

The transition from protection to management was further institutionalised through methodological guidelines that introduced the concept of the "management plan" for cultural heritage assets. These guidelines emphasised strategic planning, stakeholder coordination, budgeting, documentation, monitoring, and periodic evaluation. Heritage governance was thus reframed as a continuous, policy-driven process rather than a purely reactive conservation effort.

In the contemporary era, international policy frameworks increasingly integrate digitization and open access as central pillars of heritage

management. Initiatives such as UNESCO's Information for All Programme (IFAP) and European digitisation strategies have promoted long-term digital preservation, online accessibility, and inclusive cultural participation. The principle of "culture accessible to all" reflects a broader democratic vision of heritage governance in the digital age.

Within the Jordanian context, this global evolution has significant implications. Jordan possesses a rich documentary and archival heritage reflecting administrative, political, and cultural developments across different historical periods. While traditional protection mechanisms remain essential, they are no longer sufficient to address the challenges of digital transformation and expanding public demand for transparency and research access.

Reconceptualising archival heritage management in Jordan, therefore, requires moving beyond a preservation-centred model toward an integrated framework grounded in policy coherence, digitisation strategies, and inclusive access mechanisms. This entails the development of structured national management plans for documentary heritage, investment in digital infrastructure, and alignment with international standards such as the Memory of the World Programme.

Ultimately, the distinction between "protection" and "management" is not merely terminological. Protection represents a necessary but limited defensive approach, whereas management reflects a proactive, strategic, and sustainable model of governance. For Jordan, adopting this reconceptualised approach offers an opportunity to strengthen archival institutions as dynamic cultural assets that contribute to national identity, knowledge production, institutional transparency, and long-term cultural sustainability (Consultative Committee for Space Data Systems, 2012).

3. A project-based approach to documentary heritage management in Jordan

The responsibility of the state toward cultural and documentary heritage extends beyond mere protection and physical preservation. It also includes the creation of institutional, legal, and technological conditions that ensure effective use, public engagement, and sustainable dissemination. In the contemporary governance framework, equal access to national heritage implies that different categories of citizens will engage with archives in diverse ways, often beyond the traditional reading room environment.

Historically, archival users were generally divided into two primary categories: scholars conducting academic research and citizens seeking administrative or legal documentation. However, the expansion of the concept of cultural values and the growing recognition of archives as institutions of collective memory have significantly broadened the profile of archival users. Today, archives increasingly serve educators, students, civil society actors, media professionals, and members of the general public whose interaction with

archival documents is motivated by educational, cultural, or identity-related interests rather than strictly scientific research (Rick et al., 2013).

This transformation necessitates a shift in service delivery models. Within a modern heritage management paradigm, archives are expected to adopt a project-based approach that promotes documentary heritage in accessible and innovative ways. Such projects go beyond traditional document provision; they present archival materials as cultural artefacts embedded within historical narratives. This approach integrates contextual interpretation, biographical information, visual representation, and digital storytelling, thereby enhancing public understanding and engagement (Rothenberg, 1999).

In the Jordanian context, a project-based management strategy could include a range of initiatives:

- physical and digital exhibitions of archival documents;
- online documentary publications and thematic digital collections;
- educational workshops and training programs on archival literacy;
- public lectures, roundtables, and community outreach events;
- development of searchable digital databases;
- virtual tours and interactive digital platforms;
- collaborative digitisation and transcription initiatives involving universities and civil society organisations.

International experiences demonstrate the effectiveness of such approaches. Large-scale digital heritage platforms have successfully integrated millions of cultural records while enabling public participation through transcription, annotation, and geotagging tools. These models highlight the importance of partnerships between state institutions, academic bodies, and the private sector in expanding access and technological capacity.

For Jordan, adopting a structured project-based framework requires coherent policy planning and sustainable funding mechanisms. While digitisation efforts have begun in several institutions, the level of digital infrastructure and open-access systems remains uneven. A comprehensive management model should therefore include:

- a national digitisation strategy for archival materials;
- clear standards for metadata, digital preservation, and cybersecurity;
- mechanisms for public-private partnerships;
- evaluation tools to assess user engagement and societal impact;
- continuous revision of project plans based on feedback and performance indicators.

Importantly, the effectiveness of project-based archival management depends not only on the creation of digital content but also on systematic monitoring and policy adaptation. Without structured assessment mechanisms, projects risk remaining isolated initiatives rather than components of a sustainable heritage governance strategy (Throsby, 2012).

Thus, reconceptualising archival heritage management in Jordan requires embedding project development within a broader policy-driven framework that balances preservation, digitisation, and inclusive public access. By institutionalizing this approach, Jordan can strengthen the role of its archives as dynamic cultural institutions that support education, transparency, national identity, and knowledge production in the digital age (*Table*).

Table

From protection-oriented archives
to integrated archival heritage management in Jordan

Dimension	Traditional protection model	Integrated management model (reconceptualised approach for Jordan)
Philosophical foundation	Preservation of physical documents as state property	Recognition of archives as dynamic cultural assets and instruments of collective memory
Primary objective	Safeguarding and preventing loss or damage	Strategic governance integrating preservation, digitisation, accessibility, and societal engagement
Institutional role	Custodial repository	Cultural, educational, communicative, and governance-oriented institution
Policy orientation	Reactive and conservation-focused	Proactive, policy-driven, and aligned with national development strategies
User categories	Researchers and individuals seeking legal documentation	Scholars, students, educators, civil society, media, policymakers, and the general public
Access mechanisms	Physical reading rooms, restricted consultation	Hybrid access: digital platforms, online databases, virtual exhibitions, open-access tools
Digitization strategy	Limited or ad hoc digitisation	National digitisation strategy with metadata standards, digital preservation protocols, and cybersecurity safeguards
Public engagement	Minimal outreach activities	Project-based initiatives: exhibitions, educational programs, workshops, digital storytelling
Governance framework	Administrative regulations focused on document custody	Comprehensive management plans with monitoring, evaluation, and stakeholder coordination
International alignment	Compliance with basic protection conventions	Alignment with UNESCO Memory of the World Programme and global digital heritage standards
Impact measurement	No systematic performance assessment	Impact evaluation based on accessibility indicators, user engagement metrics, and societal contribution

Source: developed by the author.

As illustrated in *Table*, the transition from a protection-oriented paradigm to an integrated management framework represents not merely an administrative reform, but a conceptual transformation in the governance of documentary heritage in Jordan. This reconceptualisation positions archives at the intersection of policy, technology, and public access, thereby enhancing their relevance within contemporary cultural and knowledge systems.

4. Results

The findings of this study reveal a clear conceptual and structural gap between the traditional protection-oriented model of archival governance and the requirements of an integrated management paradigm suited to the digital era. The analysis demonstrates that while foundational preservation principles remain essential, they are insufficient to address contemporary challenges related to digitisation, accessibility, and public engagement.

4.1. Persistence of the protection-oriented paradigm

The review of institutional and policy frameworks indicates that archival governance in Jordan remains predominantly influenced by a custodial logic. Emphasis is placed on safeguarding physical records, maintaining provenance, and ensuring legal authenticity. While these functions form the backbone of archival integrity, they reflect a defensive and preservation-centred philosophy rather than a proactive management strategy.

4.2. Emerging but fragmented digitisation efforts

The study identifies ongoing digitisation initiatives; however, these efforts appear fragmented and institution-specific rather than embedded within a unified national strategy. The absence of standardised metadata frameworks, long-term digital preservation policies, and integrated public access platforms limits the transformative potential of digitisation. As a result, digital access remains partial and uneven.

4.3. Limited public engagement mechanisms

The analysis confirms that archival services are still primarily oriented toward researchers and administrative users. Although awareness of broader educational and cultural functions is increasing, structured outreach programs, interactive digital platforms, and participatory initiatives remain underdeveloped. This limits the archive's capacity to function as a dynamic institution of collective memory.

4.4. Absence of comprehensive management plans

One of the most significant findings is the lack of comprehensive, policy-driven management plans tailored specifically to documentary heritage governance. International best practices emphasise strategic planning, stakeholder coordination, performance indicators, and continuous evaluation. The absence of such structured planning mechanisms constrains institutional adaptability and long-term sustainability.

4.5. Need for an integrated governance framework

The comparative analytical framework developed in this study highlights the necessity of transitioning toward an integrated management model characterised by:

- strategic national digitisation policies;
- hybrid access systems combining physical and digital services;
- project-based public engagement initiatives;
- institutional performance monitoring and evaluation;
- alignment with international standards such as UNESCO's Memory of the World Programme.

This reconceptualised approach positions archives not merely as custodians of documents but as active cultural and governance institutions contributing to transparency, education, and national identity formation.

4.6. Strategic implications for Jordan

The results suggest that adopting a comprehensive archival heritage management model would significantly enhance the societal relevance and international visibility of Jordan's documentary heritage. By integrating policy coherence, digital infrastructure, and inclusive access mechanisms, archives can evolve into strategic assets within the broader framework of cultural governance and knowledge-based development.

5. Discussion

The findings of this study confirm that archival governance in Jordan stands at a transitional stage between a traditional custodial paradigm and an emerging, yet not fully institutionalised, management-oriented framework. This transition mirrors broader global developments in archival science, where the emphasis has shifted from physical preservation toward strategic governance integrating digitisation, policy alignment, and inclusive access.

From a theoretical perspective, the persistence of a protection-centred approach reflects the historical foundations of archival institutions as instruments of legal authority and state administration. However, contemporary archival discourse—particularly within the context of the "archival turn" in the humanities—redefines archives as active cultural agents shaping collective memory, identity formation, and public knowledge. The results of this study demonstrate that while the philosophical recognition of this transformation is gradually emerging, its practical institutionalisation within Jordan remains incomplete.

The fragmentation of digitisation initiatives identified in the Results section highlights a structural challenge. Digitisation, when implemented without a unified national strategy, risks becoming a technical exercise rather than a transformative governance tool. International experiences demonstrate that successful archival digitisation requires standardised metadata systems, interoperable platforms, cybersecurity safeguards, and sustainable funding

models. Without these components, digital efforts may increase visibility but fail to ensure long-term preservation or equitable access.

Moreover, the limited scope of public engagement suggests that archives have not yet fully embraced their educational and communicative functions. In modern heritage governance, public outreach is not an auxiliary activity but a core institutional responsibility. Project-based initiatives—such as digital exhibitions, collaborative transcription platforms, and educational partnerships—enable archives to interact dynamically with diverse user communities. The absence of systematic evaluation mechanisms further limits the ability to measure societal impact and adjust policies accordingly.

The discussion also underscores the importance of policy coherence. A comprehensive management plan for documentary heritage should articulate long-term objectives, define institutional responsibilities, allocate resources strategically, and establish measurable performance indicators. Such planning mechanisms transform archival governance from reactive administration into proactive cultural management. In the Jordanian context, integrating archival policy within broader national digital transformation strategies would significantly enhance institutional efficiency and international alignment (World Bank, n. d.).

Importantly, the distinction between protection and management is not merely operational but conceptual. Protection emphasises safeguarding against loss; management emphasises maximising value. In the digital age, the cultural, educational, and governance value of archives depends not only on their preservation but also on their accessibility and usability. By reconceptualising archives as strategic cultural assets rather than passive repositories, Jordan can strengthen transparency, support academic research, and reinforce national identity.

Thus, the discussion reinforces the central argument of this study: that effective archival heritage governance in Jordan requires an integrated model grounded in policy innovation, structured digitisation strategies, and inclusive public access mechanisms. The transition toward this model is both a necessity and an opportunity—one that aligns archival institutions with contemporary expectations of openness, participation, and knowledge-based development (Yakel, 2007).

6. Policy recommendations

Based on the findings and discussion of this study, the following policy recommendations are proposed to support the transition from a protection-oriented archival framework to an integrated management model in Jordan.

6.1. *Develop a national archival heritage management strategy*

A comprehensive national strategy should be formulated to define long-term objectives for documentary heritage governance. This strategy must integrate preservation, digitisation, access, and public engagement

within a unified policy framework. Clear institutional mandates, timelines, performance indicators, and evaluation mechanisms should be established to ensure accountability and sustainability.

6.2. Establish a structured national digitisation plan

Digitisation efforts should move beyond isolated institutional initiatives toward a coordinated national program. This plan should include:

- standardised metadata and cataloguing systems;
- long-term digital preservation protocols;
- cybersecurity and data protection measures;
- interoperable digital platforms linking archival institutions;
- sustainable funding mechanisms.

A centralised digital portal for Jordanian documentary heritage could significantly enhance accessibility and international visibility.

6.3. Strengthen legal and regulatory frameworks

Existing archival legislation should be reviewed and updated to reflect contemporary digital realities. Legal reforms should address electronic records management, digital authenticity standards, public access policies, and data governance principles. Clear guidelines regarding open access and privacy protection are essential for balancing transparency with legal safeguards.

6.4. Institutionalise project-based public engagement

Archives should systematically adopt project-based initiatives to expand their educational and cultural functions. Recommended initiatives include:

- digital and physical thematic exhibitions;
- educational partnerships with schools and universities;
- public lectures and community outreach programs;
- collaborative digitisation and transcription projects;
- virtual tours and interactive online platforms.

these initiatives should be integrated into annual institutional planning cycles and evaluated through measurable engagement indicators.

6.5. Promote capacity building and professional development

Archival staff training must expand beyond traditional preservation skills to include digital competencies, data management, public communication, and project management. Partnerships with universities and international heritage organisations can facilitate knowledge transfer and professional development.

6.6. Encourage public-private and academic partnerships

Strategic collaboration with universities, research centres, civil society organisations, and the private sector can enhance technological capacity and financial sustainability. Such partnerships may support digitisation projects, digital platform development, and community-based heritage initiatives.

6.7. Implement monitoring and impact evaluation mechanisms

Effective heritage management requires systematic performance assessment. Institutions should develop measurable indicators related to:

- digital access rates;
- user diversity;
- educational outreach impact;
- research utilisation;
- international cooperation outcomes.

Continuous evaluation will enable evidence-based policy adjustments and long-term strategic improvement.

Strategic outlook

By adopting these recommendations, Jordan can transform its archival institutions into dynamic, policy-driven cultural assets aligned with international standards. The shift toward integrated archival heritage management will not only strengthen preservation efforts but also enhance transparency, knowledge production, and national identity formation in the digital age.

Conclusions

This study set out to reconceptualize archival heritage management in Jordan by examining the transition from a traditional protection-oriented paradigm to an integrated management framework. The findings directly address this objective by demonstrating that preservation alone is no longer sufficient to meet the demands of the digital era. Instead, effective archival governance requires the integration of policy development, digitization strategies, and public access mechanisms within a unified system.

The study confirms the proposed hypothesis that a shift toward an integrated management model enhances the efficiency, accessibility, and societal value of archival institutions. The analysis shows that archives must move beyond custodial roles to function as dynamic entities contributing to knowledge dissemination, transparency, and cultural identity. At the same time, the findings highlight that the absence of coordinated national strategies in Jordan—particularly in digitisation and public engagement—remains a key limitation that must be addressed.

Furthermore, the results demonstrate that aligning national practices with international frameworks, such as UNESCO's Memory of the World Programme, provides a viable pathway to strengthen institutional capacity and improve global integration. The study also confirms that the combination of policy coherence, structured digitization, and inclusive access forms the foundation of a sustainable archival management model.

In conclusion, the research verifies that adopting a management-oriented paradigm is essential for enhancing the role and impact of archival institutions in Jordan.

Future research may focus on empirical validation of the proposed framework through field studies and institutional performance assessments, as well as the development of quantitative indicators to measure the effectiveness of archival governance models.

REFERENCES

-
- Conway, P. (2010). Preservation in the age of Google: Digitization, digital preservation, and dilemmas. *The Library Quarterly*, 80(1), 61–79. <https://doi.org/10.1086/648463>
-
- Consultative Committee for Space Data Systems. (2012). *Reference model for an open archival information system (OAIS)* (Magenta Book CCSDS 650.0-M-2). <https://public.ccsds.org/pubs/650x0m2.pdf>
-
- Department of Antiquities of Jordan. (n. d.). *Official institutional framework for cultural heritage management in Jordan*. <http://doa.gov.jo>
-
- Gilliland, A. J. (2016). Archival and recordkeeping traditions in the multidisciplinary context. *Journal of Contemporary Archival Studies*, 3(1). <https://elischolar.library.yale.edu/jcas/vol3/iss1/6/>
-
- Harrison, R. (2013). *Heritage: Critical approaches*. Routledge. <https://doi.org/10.4324/9780203108857>
-
- Jordan National Library. (n. d.). *National records management and digitization initiatives*. <http://www.nl.gov.jo>
-
- Rick, T. C., Erlandson, J. M., Jew, N. P., & Reeder-Myers, L. A. (2013). Archaeological survey, paleogeography, and the search for Late Pleistocene Paleocoastal peoples of Santa Rosa Island, California. *Journal of Field Archaeology*, 38(4), 324–331. <https://doi.org/10.1179/0093469013Z.00000000065>
-
- MaDiH Project. (n. d.). *Mapping digital cultural heritage in Jordan*. <https://madih.eu>
-
- Rothenberg, J. (1999). *Avoiding technological quicksand: Finding a viable technical foundation for digital preservation*. Council on Library and Information Resources. ISBN: 9781887334518
-
- Throsby, D. (2010). *The economics of cultural policy*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511845253>
-
- UNESCO. (2015). *Recommendation concerning the preservation of, and access to, documentary heritage including in digital form*. <https://unesdoc.unesco.org/ark:/48223/pf0000243720>
-
- World Bank. (n. d.). *Digital transformation and governance in the Middle East*. <https://www.worldbank.org/en/topic/digitaldevelopment>
-
- Yakel, E. (2007). Archives and access in the digital age. *OCLC Systems & Services*, 23(1), 4–6. <https://www.emerald.com/dlp/article-abstract/23/4/335/305089/Digital-curation?redirectedFrom=fulltext>
-

Conflict of interest. The authors certify that they have no financial or non-financial interest in the subject matter or materials discussed in this manuscript; the authors have no association with state bodies, any organizations, or commercial entities having a financial interest in or financial conflict with the subject matter or research presented in the manuscript.

The author received no direct funding for this study.

Alamr, A. (2026). Conceptualising archival heritage management in Jordan: policy, digitisation, and public access. *Scientia fructuosa*, 4(168), 16–31. [http://doi.org/10.31617/1.2026\(168\)02](http://doi.org/10.31617/1.2026(168)02)

Received by the editorial office 04.03.2026.

Sent for revision 25.03.2026.

Accepted for printing 16.07.2026.

Publication online 07.09.2026.

POLOZOVA Tetiana <https://orcid.org/0000-0001-9956-8816>

Doctor of Science (Economics),
Professor, Head of the Department of Economic
Cybernetics and Economic Security Management
Kharkiv National University
of Radio Electronics,
14, Nauky Ave., Kharkiv, 61166, Ukraine
tetiana.polozova@nure.ua

SALIKHOV Mykhailo <https://orcid.org/0009-0003-7356-5344>

Senior Specialist, Department for Development
of the Real Sector of the Economy, Ministry
of Economy and Environment, of Ukraine
14, Nauky Ave., Kharkiv, 61166, Ukraine
mykhailo.salikhov@nure.ua

EU POLICY ON ARTIFICIAL INTELLIGENCE INTEGRATION IN MANUFACTURING

EU policy in the field of artificial intelligence (AI) is becoming an important instrument for industrial modernization, enhancing competitiveness, and ensuring technological sovereignty. We base our work on the idea that EU public policies directly drive technology adoption among manufacturing firms. To test this, we combine normative-doctrinal, comparative, and economic-statistical methods. This approach makes it easier to follow changes in policy decisions over time. It also helps us see how different industrial sectors actually adopt AI tools. It has been established that EU policy in the field of AI during the period 2018–2025 evolved through stages ranging from strategic positioning to institutional and infrastructural consolidation, as well as industrialization and large-scale deployment of technologies. The share of enterprises using at least one AI technology increased from 6.93 % in 2021 to 17.27 % in 2025. The highest growth was observed in the pharmaceutical industry, the production of computer products, the chemical and metallurgical industries, and the manufacture of coke and refined petroleum products. These findings suggest that Ukraine can actively use European frameworks to shape its domestic AI agenda. To succeed, this

ПОЛОЗОВА Тетяна <https://orcid.org/0000-0001-9956-8816>

д. е. н., професор,
завідувач кафедри економічної кібернетики та
управління економічною безпекою
Харківського національного університету
радіоелектроніки
пр. Науки, 14, м. Харків, 61166, Україна
tetiana.polozova@nure.ua

САЛІХОВ Михайло <https://orcid.org/0009-0003-7356-5344>

головний спеціаліст, Департамент розвитку
реального сектору економіки, Міністерство
економіки та довкілля України
пр. Науки, 14, м. Харків, 61166, Україна
mykhailo.salikhov@nure.ua

ПОЛІТИКА ЄС ЩОДО ІНТЕГРАЦІЇ ШТУЧНОГО ІНТЕЛЕКТУ В ПРОМИСЛОВІСТЬ

Політика ЄС у сфері штучного інтелекту (ШІ) дедалі більше стає важливим інструментом модернізації промисловості, підвищення конкурентоспроможності та забезпечення технологічного суверенітету. З огляду на припущення, що публічна політика ЄС безпосередньо впливає на впровадження технологій у виробничих компаніях, для перевірки виконано поєднання юридичного аналізу документів, порівняльні дослідження та економіко-статистичні методи. Такий підхід дозволяє простежити, як змінюються політичні рішення з часом, а також показує, як різні виробничі сектори реально впроваджують інструменти ШІ. Дослідження показало, що європейська політика у сфері ШІ протягом 2018–2025 рр. пройшла кілька чітких хвиль: від перших стратегічних планів до побудови реальних інституцій, цифрової інфраструктури та запуску технологій безпосередньо у виробництво. За цей час частка підприємств ЄС, які інтегрували бодай один інструмент ШІ, помітно підскочила – з 6,9 % у 2021 р. до 17,27 % у 2025 р. Найшвидше технології опанували високотехнологічні сектори, зокрема фармацевтика, виробництво комп'ютерної техніки, хімічна й металургійна галузі, а також підприємства з переробки нафти й



strategy must span a complete governance cycle: framing policy goals, applying specific regulatory mechanisms, and running regular evaluations. Building this comprehensive structure helps make local technology governance more coordinated and efficient.

Keywords: AI adoption, EU industrial policy, manufacturing subsectors, digital transformation, technological innovation, NACE classification.

JEL Classification: C18, L60, O31, O32.

коксу. Отримані цифри підтверджують, що Україна може активно спиратися на європейський досвід для формування власної стратегії розвитку ІІІ. Для успіху така стратегія має охоплювати весь цикл управління: визначення цілей політики, застосування конкретних регуляторних механізмів і регулярну оцінку результатів. Побудова такої комплексної системи допомагає зробити управління технологіями на місцевому рівні більш узгодженим та ефективним.

Ключові слова: впровадження ІІІ, промислова політика ЄС, підсектори виробництва, цифрова трансформація, технологічні інновації, класифікація NACE.

Introduction

Global technological competition makes artificial intelligence (AI) very important for industrial and economic policy. Today, AI is not only a general-purpose technology; its actual use directly affects productivity, industrial structures, and the digitalisation of manufacturing. In the European Union, AI policy is part of broader plans to boost technological independence and modernise industries.

Ursula von der Leyen, President of the European Commission, noted that "European AI is critical to our strategic independence and will drive the development of key sectors of industry and society" (European Commission, 2025a). This shows that the EU does not see AI just as a technical tool; rather, it is treated as a strategic instrument to support industrial modernisation and long-term technological growth.

Ukraine is moving closer to the EU and developing its own industrial and economic policy. Because of this, the European experience in digitalisation and the use of AI in industry is very important for the country. For these reasons, it is useful to examine how EU policies influence industrial digitalisation and how businesses adopt AI technologies in their operations.

Hulok (2025) studies the institutional aspects of AI regulation in the EU. This author describes EU digital laws as a "digital constitution," which helps make the use of technology more predictable. On the other hand, Cancela-Outeda (2024) examines how supranational and national bodies cooperate within the EU's multi-level AI governance system.

Some researchers also analyse regulatory and ethical issues. For example, Bolgouras et al. (2025) argue that clearer regulation can improve transparency, accountability, and public trust. Vannuccini (2025) notes that it is important to balance technological autonomy with competitiveness and the public interest. These studies show that regulation is not only a technical problem, but also a strategic question.

At the same time, some studies focus on the use of AI in industry, particularly in smart manufacturing and supply chain optimisation within Industry 4.0 (Zeba et al., 2021; Samuels, 2025; Nurainia & Apriadi, 2025). However, there is still not enough research on how AI adoption interacts with business processes at the firm level.

In Ukraine, AI research is generally more applied. Studies have examined areas such as judicial practice (Tsuvin, 2025), digital marketing (Ponomarenko, 2024), accounting automation (Korol & Romashko, 2024), and the digital transformation of the economy (Bashlay & Yaremko, 2023). These publications demonstrate that Ukrainian research is strongly practice-oriented. However, there remains a lack of institutional and strategic analysis of AI adoption.

Bazhal (2025) substantiates the expediency of applying the neo-Schumpeterian approach to the use of AI as a driver of economic growth that shapes a new technological paradigm for the development of production systems. In this context, the author considers AI a key driver of innovation that transforms the cost structure, reduces the cost per unit of useful effect, contributes to the emergence of new products and the improvement of traditional ones, and shapes the long-term dynamics of sectoral development within the life cycle of technological transformation.

Some studies point out that AI technologies create several important challenges for the global economy. These challenges include privacy concerns, economic inequality, job losses in certain professions, and issues related to intellectual property rights (Pereguda & Chaliuk, 2026). Chabanna (2025) suggests that the European approach to AI policy – which relies on ethical rules and human-centric principles – can serve as a useful example for regulation in other countries.

At the same time, Buchynska (2025) examines the institutional and legal aspects of EU policy. She emphasises the importance of balancing innovation with public trust in digital technologies.

The literature review shows that although many studies examine EU AI policy, research on its actual effects on industrial digitalisation remains quite limited. Therefore, it is important to study the role of EU policy instruments in supporting the integration of AI into business processes and manufacturing systems of industrial enterprises.

The aim of this article is to examine how EU AI policy has evolved, to assess AI adoption in the EU manufacturing sector using available empirical data, and to consider how European experience could be applied in Ukraine.

The hypothesis of this study is that the EU's emphasis on integrating AI into industry has contributed to the faster, more gradual adoption of these technologies by companies. Consequently, a growing number of enterprises have started using AI in their activities.

The empirical base of this study includes strategic and regulatory documents of the European Commission and the European Parliament. We also used statistical and analytical data from Eurostat.

In this study, we examine EU AI policy as a multi-level system. This system brings together strategic, regulatory, and infrastructural mechanisms to create conditions for industrial digital transformation. Its development – from strategic initiatives to risk-based regulation – shows a clear shift toward the practical use of AI in industry. These mechanisms help reduce barriers to technology adoption and increase regulatory certainty. This, in turn, makes it easier for enterprises to integrate AI into their production processes.

As a result, AI technologies are unevenly diffused across the corporate sector, depending on both the functional areas of activity and the technological complexity of the solutions. Eurostat statistical data reflect this pattern and serve as a quantitative measure of the effectiveness of EU AI policy.

The suggested analytical model ‘policy – mechanisms – implementation – indicators’ is designed to link the institutional and regulatory aspects of EU policy with the practical processes of digital transformation in industrial companies.

In this study, we use a combination of normative-doctrinal, comparative, functional, and economic-statistical approaches. The data are classified according to NACE Rev. 2. A limitation of the study is that Eurostat data are aggregated, and differences in digital development across EU countries may affect the interpretation of the findings.

The article is organised into three parts: first, an analysis of the evolution of EU AI policy; second, an empirical assessment of AI adoption in the EU manufacturing sector; and third, a discussion of how the European experience can be applied in Ukraine.

1. The evolution of EU AI policy: a focus on the industrial sector

This study uses a functional approach to analyse EU AI policy in the context of industrial development. The empirical base consists of EU regulatory and strategic documents selected for their relevance to the research problem. In the first stage, these documents were systematised and analysed through content analysis.

The analysis of EU documents reveals three main directions: global positioning, coordination among Member States, and support for an innovation-investment cycle. Naturally, not all regions were equally ready for digital transformation; some developed quickly, while others moved much more slowly.

1.1. Formation of the strategic framework for AI policy (2018–2020)

One of the first steps was the EU strategy Artificial Intelligence for Europe (European Commission, 2018a), which outlined priority areas such as industry, transport, energy, healthcare, and public administration. However, in practice, implementation in these sectors was uneven. Public-

private partnerships, data platforms, and innovation hubs frequently encountered delays, and in some Central and Eastern European countries, including Bulgaria and Romania, projects took considerably longer than in older Member States.

At the company level, AI adoption also varied. Some enterprises, such as Siemens in Germany (van Giffen et al., 2023), experimented with new technologies almost immediately. They were quick to implement predictive maintenance tools, although initial difficulties revealed that staff required additional training. Smaller companies, in contrast, often need several years to catch up because they face more practical challenges than larger firms. This structural gap emphasises why a company's – or even a country's – capacity to absorb new knowledge is so critical. Absorptive capacity involves recognising useful external information, learning from it, and applying it to products or business processes. Achieving this is not always straightforward, and no single document fully captures these local challenges.

To address these differences, the EU introduced the Coordinated Plan on AI (European Commission, 2018b). Germany and the Netherlands were quick to launch industrial AI programs, while Belgium and Sweden placed greater emphasis on developing data platforms and innovation hubs. In contrast, countries such as Bulgaria and Romania encountered administrative barriers that slowed down progress. These variations suggest that local readiness and the capacity to absorb knowledge strongly influence how effectively a country can turn policy objectives into actual economic outcomes. This also raises questions about whether it is realistic for all national innovation systems to develop at the same pace.

The European Parliament (2019) clarified the role of AI in economic transformation. Industry is one of the main areas where new technologies are introduced alongside human-centred approaches. The pace of adoption depends on both the technology itself and how ready people and organisations are for change. When preparation is insufficient, implementation tends to be slower. Companies that are better prepared usually manage to integrate new tools more quickly.

Building a supportive ecosystem for AI remains a key priority. This system brings together different elements that can be used in healthcare, industry, and public services. Some digital innovation hubs give small companies the opportunity to experiment with new solutions. Gradual adoption allows both businesses and society to adjust to new tools, which helps increase trust in AI.

Regulatory "sandboxes" provide a controlled space for testing. They allow organisations to evaluate risks and assess performance while adapting rules. Sandboxes are applied in areas such as autonomous transport, telemedicine, energy, and industrial systems. Experience from Germany shows that combining technical skills with ethical principles can make implementation both more effective and safer.

The 2019 update of the Coordinated Plan (European Commission, 2019) focused on AI integration, particularly in industry. One of the first steps was

to create a network of digital centres, which gave companies – including small and medium-sized ones – access to technologies, data tools, and testing spaces. This contributed to the modernisation of production, though some firms adopted new tools faster than others. High-performance computing (EuroHPC) proved important for handling large datasets and training algorithms. In general, the technology itself and the readiness of the local environment determine whether AI succeeds in a region. Some areas catch up quickly, whereas others progress more slowly.

The White Paper on AI (European Commission, 2020) introduced a more integrated approach by linking technological development, economic tools, and regulatory measures. Because manufacturing is a priority area for AI, this framework tries to balance innovation with public trust. However, actual industry practice shows that smaller companies face more practical challenges than larger corporations. This approach relies on existing EU infrastructure, including high-performance computing, robotics, and industrial datasets. In practice, AI tools help to improve production, logistics, and engineering. For example, predictive maintenance reduces machinery downtime, while precision farming saves natural resources.

Yet, access to shared data and skilled workers varies across regions, leading to different adoption speeds. For instance, a medium-sized German manufacturer reported deployment delays due to older factory machinery. Key industrial applications include digital twins, predictive maintenance, and the optimisation of resource flows. Instead of relying on abstract theories, companies use digital twins as virtual models of physical systems to anticipate technical problems and improve factory operations. Still, coordinating shared datasets and keeping algorithms reliable remain difficult tasks. Larger companies adapt to these tools more quickly, while smaller firms often need additional institutional support. Investment strategies focus on scaling up technology deployment through public-private partnerships and industrial testing facilities. In practice, whether AI is adopted smoothly depends on company readiness and local economic conditions. These factors also influence whether different regions can benefit equally from the policy. The White Paper establishes a framework to increase production capacity and support SMEs, though local industrial circumstances continue to play a decisive role.

1.2. Formation of the institutional and infrastructural foundation (2021–2024)

At this stage, the EU framework for AI developed into a more systematic structure. The emphasis shifted from basic strategic planning to building real institutions and the infrastructure needed for technology adoption.

Regulatory, innovation, and infrastructural instruments were consolidated within an integrated ecosystem that combines technological development, trust-building, and the creation of conditions for the industrial

scaling of AI. A key feature of this period is the establishment of the dual architecture of AI policy based on the interaction between the "ecosystem of excellence" and the "ecosystem of trust." The former is aimed at stimulating research, innovation, and the commercialisation of technologies, particularly through the Horizon Europe and Digital Europe programmes.

The second set of documents focused on rules and values for AI, covering safety, fundamental rights, and ethical responsibilities. These elements were meant to work together, though coordination was sometimes difficult. At that time, the European Approach to AI (European Commission, 2021, COM (2021) 205 final) became an important reference. It brought together earlier EU initiatives and aimed to make the policy more coherent, forming a connected ecosystem. The approach highlighted both the opportunities and risks of AI and suggested actions for the EU and member states, such as mobilising investments, aligning policies, and developing digital infrastructure. In practice, implementing these measures was not always straightforward. Some regions moved quickly, while others needed more time, and coordinating all actions could be challenging.

The infrastructural dimension of policy was further strengthened, within which access to data, computing resources, and a unified digital environment came to be regarded as a fundamental prerequisite for the development of industrial AI. In this context, the European Alliance for Industrial Data, Edge and Cloud was established to coordinate investments in critical digital infrastructure. This initiative is complemented by the development of sectoral Data Spaces, which ensure the integration of industrial data into a common European digital space.

This stage concluded with the adoption of Regulation (EU) 2024/1689, known as the AI Act (European Union, 2024), which moved AI policy toward harmonised regulatory governance. The Act sets out a risk-based model for classifying AI systems into four categories: unacceptable, high, limited, and minimal risk. This allows regulatory measures to vary according to the potential impact of each technology.

High-risk systems – especially in industry, energy, robotics, employment, and public services – face stricter requirements regarding data quality, transparency, cybersecurity, human oversight, and risk management. Their phased rollout in 2026–2027 lays the groundwork for building trust in AI. Ultimately, this transparency and regulatory clarity determine whether the technology can achieve wider use in industrial applications.

The European Commission set up the European Artificial Intelligence Office (European Commission, 2024a) to oversee the AI Act. Its tasks include coordinating the application of the regulation, supporting national regulatory authorities, and developing technical standards and codes of practice, particularly for general-purpose AI (GPAI) models. In industry, these processes create a clearly defined framework for the use of AI in production systems, energy, robotics, and engineering technologies. This framework helps companies scale digital solutions, improve technological capabilities, and align regulatory, innovation, and industrial policies across the EU.

In summary, the years 2021–2024 marked a shift toward an institutional and infrastructural approach to AI development in the EU. During this period, the EU established regulatory, organisational, and technological foundations that paved the way for wider industrial use and the systematic scaling of AI technologies. The year 2024, in particular, represents a transitional phase, as the EU concluded much of its institutional setup while beginning to roll out tools for the industrial deployment of AI.

1.3. Industrialisation and scaling (2024–2025)

In summary, the years 2021–2024 marked a shift toward an institutional and infrastructural approach to AI development in the EU. During this period, the EU established regulatory, organisational, and technological foundations that paved the way for wider industrial use and the systematic scaling of AI technologies. The year 2024 represents a transitional phase, as the EU concluded much of its institutional setup while beginning to roll out tools for the industrial deployment of AI.

By 2024, EU AI policy had started to emphasise the industrial use of AI, paying close attention to how these technologies are integrated into production lines and value chains. The agenda moves beyond preparing the ground for innovation, focusing instead on putting AI to work in real-world applications across the economy. The document *Boosting Startups and Innovation in Trustworthy AI* (European Commission, 2024b) describes an innovation ecosystem intended to help startups and small and medium-sized enterprises bring AI solutions to market. In this context, the industrial sector is the primary arena for these technologies, especially generative AI, which companies can use to improve efficiency and remain competitive.

The core of this approach is the GenAI4EU initiative, which focuses on expanding the use of generative AI and integrating it into manufacturing and engineering processes. This reflects a move toward an applied innovation model, in which technologies are evaluated based on their practical performance in industry and their potential for rapid adoption.

The infrastructural side of the policy is supported by the establishment of AI Factories and European Data Spaces, offering access to computing power, industrial datasets, and development environments. Together, these efforts provide a coherent foundation for connecting innovation actors with industrial ecosystems and help speed up the transfer of technologies into production and value chains.

The "AI Continent Action Plan" (European Commission, 2025b) builds on previous EU initiatives and introduces a platform approach to developing AI. At its core is a system that integrates computing resources, data, and innovation environments, enabling industries to use these elements effectively. The plan focuses on strategic sectors such as advanced manufacturing, energy, transport, and robotics. To make this work, European institutions combine research projects with innovation support and infrastructure development. These efforts help new AI technologies reach production quickly and support their adoption across industrial sectors.

The "AI Continent Action Plan" builds on previous EU initiatives and introduces a platform approach to developing AI. At its core is a system that links computing resources, data, and innovation environments, allowing industries to use these elements together effectively. The plan focuses on strategic sectors such as advanced manufacturing, energy, transport, and robotics. To make this work, European institutions combine research projects with innovation support and infrastructure development. These efforts help new AI technologies reach production quickly and support their adoption across industrial sectors.

The AI Application Strategy (European Commission, 2025c) focuses on moving from creating conditions for technological development toward putting AI into practical use. The strategy encourages the systematic integration of AI into production processes and value chains. Applied AI cases—such as robotics, cobots, digital twins, and predictive analytics—help increase operational efficiency and optimise production systems. Specialised support for SMEs provides easier access to technologies, infrastructure, and financial resources, promoting a more balanced digital transformation. Policies now guide AI toward large-scale industrial use, consolidating a model in which these technologies are embedded directly into production systems.

A synthesis of EU AI policy reveals the distinct milestones of its long-term transformation. Each period reflects clear changes in the Union's approach: starting with defining AI as a strategic driver of economic development, moving to building regulatory and infrastructural structures, and finally leading to the real use of technologies within production systems. This progression highlights how theoretical goals gradually turned into practical frameworks across three chronological steps.

From 2018 to 2020, the EU set basic goals to apply AI in traditional industries. European officials identified industry as the main area for AI tools and started the first innovation cycles by connecting research with market deployment. Constructing digital infrastructure became a priority, including early data sharing, regional innovation hubs, and EuroHPC systems. At the same time, Member States aligned national rules and adjusted investment priorities, while the European Commission issued initial guidelines to ensure that AI development adhered to ethical and safety standards.

Between 2021 and 2024, the focus shifted toward strengthening regulations and building administrative bodies to manage technology adoption. Different countries introduced risk-based rules for AI, and shared standards, ethics, and harmonised regulations helped build trust. Technology programs expanded digital infrastructure through Data Spaces, cloud systems, and edge platforms. The AI Office and industrial alliances improved coordination, allowing policymakers to connect innovation directly with the practical needs of manufacturing.

From 2024 to 2025, EU policy emphasised the large-scale industrial use of AI in factories and production lines. AI Factories became the primary infrastructure for deploying new tools, and companies began applying generative AI to engineering and manufacturing processes. Technology

initiatives concentrated on sectors such as advanced manufacturing, energy, transport, and robotics. EuroHPC provided the computing backbone, and EU initiatives supported the broader adoption of AI across industries, helping companies stay competitive in a rapidly evolving global market

2. Empirical analysis of the scale and dynamics of AI adoption in the EU manufacturing industry

2.1. Data sources and methodological approaches to assessing AI adoption

For the empirical part of this study, we use data provided by Eurostat. As part of the EU digital statistical system, this platform regularly monitors how enterprises digitalise their operations and adopt AI tools. The main source is the annual survey "ICT Usage and e-commerce in Enterprises" (Salikhov, 2025). This database ensures cross-country comparability and allows us to track the long-term dynamics of how the EU economy undergoes digital transformation.

Starting in 2023, Eurostat integrated a specialised AI module into its statistical system. This update enables regular measurement of AI use at the company level, covering areas such as data analysis, forecasting, process automation, and decision-making support. This lets us see which AI tools companies actually use. Currently, Eurostat distinguishes eight specific domains of AI application. These include text data analysis (AI_TTM), speech recognition (AI_TSR), natural language generation (AI_TNLG), image processing (AI_TIR), and machine learning (AI_TML). The system also tracks decision automation (AI_TPA), autonomous systems (AI_TAR), and generative AI (E_AI_TPVSG). This last category was added in 2024 to reflect the newest technological wave.

The functional dimension of AI use is defined through nine business domains: marketing and sales (E_AI_PMS), production (E_AI_PPP), business administration (E_AI_PBA), enterprise management (E_AI_PME), logistics (E_AI_PLOG), ICT security (E_AI_PITS), HR (E_AI_PHR), finance and controlling (E_AI_BNU), and R&D (E_AI_RDI). This approach allows us to evaluate how deeply AI is integrated into the core functions of enterprises.

For the empirical analysis, we focus on EU manufacturing firms (NACE Rev. 2, Manufacturing, with 10 or more employees). The main metric we use is the proportion of firms that have adopted at least one AI technology.

2.2. Dynamics and sectoral features of AI adoption in the EU manufacturing industry

The statistical results show a clear upward trend in the adoption of AI tools by EU manufacturing companies. Based on the figures in Table 3, the percentage of enterprises using at least one AI technology rose from 6.93% in 2021 to 17.27% in 2025. We observe a minor slowdown in 2023, with the indicator dropping slightly to 6.79% (see Table 1).

Table 1
Adoption dynamics of artificial intelligence tools across EU manufacturing subsectors

Industry Sector (NACE Rev. 2)	Year 2021 – % of Enterprises Using AI	Year 2023 – % of Enterprises Using AI	Year 2024 – % of Enterprises Using AI	Year 2025 – % of Enterprises Using AI	Net Change 2021–2025 (p. p.)
C – Total Manufacturing	6.93	6.8	10.57	17.3	10.34
C10–C12 – Food, Beverages, Tobacco	5.04	5.42	6.79	12.47	7.43
C13–C15 – Textiles, Apparel, Leather	3.66	4.2	5.98	12	8.35
C16–C18 – Wood, Paper, Printing & Related	6.35	5	9.37	15.63	9.28
C19 – Coke and Refined Petroleum Products	17.81	13.9	20.35	30.41	12.6
C20 – Chemicals and Chemical Products	9.77	11.1	16.7	28.45	18.68
C21 – Pharmaceuticals & Preparations	15.73	17.32	25.8	41.3	25.59
C22–C23 – Rubber, Plastics & Non-Metallic Minerals	7.91	7.68	11.98	16.77	8.86
C24–C25 – Basic and Fabricated Metals (Excl. Machinery)	5.94	5.7	8.59	14.33	8.39
C26 – Computers, Electronics, Optical Products	16.83	16.9	25.29	37.44	20.61
C27 – Electrical Equipment	10.39	10.64	16.37	25.9	15.5
C28 – Machinery and Equipment n.e.c.	11.85	9.83	14.85	25.45	13.6
C29–C30 – Motor Vehicles, Trailers, Transport Equipment	11.39	11.58	14.59	23.86	12.47
C31–C33 – Furniture, Jewellery, Toys & Misc. Manufacturing	4.7	5.21	11.45	17.16	12.46

Source: compiled by the authors based on data from the Eurostat (n. d.).

This dip suggests that companies needed some time to adjust their internal processes and adapt to new regulations. However, from 2024 onward, the growth resumed, reaching 10.57%. This recovery quickly led to rapid expansion by 2025.

Overall, the observed trajectory is consistent with the phased evolution of EU policy – from the strategic formation of the framework, to the institutional and infrastructural model, and subsequently to the industrialisation of AI.

The empirical data show that different manufacturing subsectors adopt AI tools at markedly different rates. In 2021, the highest proportion of companies using these tools was found in coke and refined petroleum production (C19) and the computer and electronics sector (C26). High adoption rates also characterised pharmaceutical manufacturing (C21), machinery and equipment (C28), and the automotive industry (C29–C30). These industries started earlier due to their reliance on advanced technologies and stronger innovation capacity.

Between 2021 and 2025, AI adoption expanded significantly across all studied subsectors. The most rapid growth occurred in pharmaceutical manufacturing (C21), where the indicator surged to 41.32% by the end of the period. High growth rates were also visible in the computer and electronics industry (C26), which reached 37.44%, and in coke and refined petroleum production (C19), at 30.41%. Additionally, sectors such as chemicals (C20) and electrical equipment (C27) showed strong upward trends, climbing to 28.45% and 25.90%, respectively.

The empirical data show that AI adoption strongly depends on enterprise size. Large companies form the innovation core of the economy. They drive AI adoption because they have better access to infrastructure, skilled personnel, and financial resources. Medium-sized firms adopt AI less actively, and small enterprises often lag behind (Polozova & Salikhov, 2025; Polozova & Salikhov, 2026a).

This structural gap leads to a high concentration of AI technologies within certain fields. Consequently, some sectors embrace these tools more readily, becoming early hubs of innovation, while others remain slower to implement them.

The empirical data highlight that the pharmaceutical sector has the highest concentration of enterprises using AI. This pattern reflects a growing demand for machine learning and deep learning applications. In practice, companies use these technologies to speed up drug development and model complex molecular interactions. They also rely on algorithms to optimise compound structures and identify the best candidates for clinical trials.

The pharmaceutical industry's high technological intensity is reinforced by the large share of big companies in this sector. Their presence further strengthens this field's leading position in AI adoption.

The empirical data show that the computer, electronic, and optical products sector uses AI mainly to improve operational efficiency. Companies apply it for predictive maintenance and automated quality checks. They also process production data in real time and adjust technological processes using

machine learning and computer vision. These patterns suggest that sectors with complex production systems and advanced technologies adopt AI more readily than others.

The European Green Deal also plays a role in shaping AI adoption. It encourages companies to use AI to save energy, reduce emissions, and make better use of resources, especially in the chemical and metallurgical sectors. Overall, AI adoption across EU industries is uneven. This pattern depends on a mix of company size, technological complexity, and policy incentives.

The data show that AI adoption in EU manufacturing has been growing steadily. This growth is influenced by both the technological evolution of enterprises and the gradual rollout of European AI policies between 2018 and 2025. These policies combine support for innovation, investment in infrastructure, and regulatory measures, creating a three-level framework that guides the industry's adoption of AI tools.

2.3. Technological structure of AI adoption

As illustrated in *Figure 1*, AI adoption in EU manufacturing shows clear differences across sectors. Cognitive software tools are spreading faster than technologies that require heavy infrastructure. In 2021, only 1.6% of companies used text analysis (AI_TTM), but by 2025 this figure had grown to 9.4%. Natural language generation (AI_TNLG) started at 0.9% and reached 7.1% in 2025. These increases reflect the gradual prioritisation of automating tasks such as document handling, analytics, and managerial communications. Companies often begin with these cognitive functions before applying AI to more complex production processes.

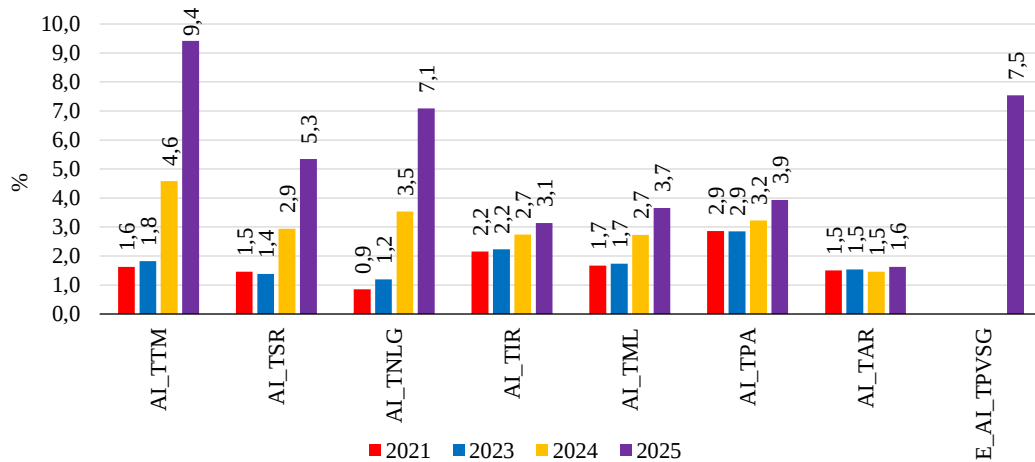


Figure 1. Technological Structure of AI Implementation in the EU Manufacturing Sector.

Source: compiled by the author based on data from the Eurostat (n. d.).

High growth rates were also recorded in the segment of speech recognition (AI_TSR), where the level of use increased from 1.5% to 5.3% (+3.8 percentage points), as well as in machine learning (AI_TML), which rose from 1.7% to 3.7% (+2.0 percentage points) (Eurostat, n. d.). The digital

maturity of enterprises has been steadily improving. Companies are increasingly able to incorporate algorithmic models into both production workflows and managerial decision-making.

Moderate dynamics are characteristic of image recognition technologies (AI_TIR), where the indicator increased from 2.2% to 3.1% (+0.9 percentage points), and of process automation and decision-support technologies (AI_TPA), which grew from 2.9% to 3.9% (+1.0 percentage points). AI adoption is gradually spreading across factory operations, but overall growth is still modest. Interestingly, autonomous systems and transport solutions (AI_TAR) show very slow progress. Between 2021 and 2025, the share of companies using these tools rose only from 1.5% to 1.6% (Eurostat, 2025). Deploying automated vehicles or robots requires large capital investments, careful integration into production lines, and strict safety testing, which limits their adoption.

Notably, generative AI tools (E_AI_TPVSG), which appear in EU statistics from 2025, already reached 7.5% usage. This early uptake indicates that software-based cognitive solutions spread faster than hardware. Across the sector, factories increasingly focus on language- and text-oriented AI models. While software-driven analytics continue to expand dynamically, heavy automated equipment remains at an early stage due to high financial and operational barriers.

2.4. Functional structure of AI adoption

An analysis of the dynamics of AI technology use in the manufacturing industry indicates a gradual expansion of the integration of digital solutions into the functional areas of enterprise activity during the period 2021–2025.

As *Figure 2* shows, the most pronounced growth is observed in the area of marketing and sales (E_AI_PMS), where the level of AI use increased from 0.94% in 2021 to 5.25% in 2025 (+4.31 percentage points). AI adoption is particularly noticeable in customer-oriented and analytical business functions. Companies increasingly apply AI in demand forecasting, tailoring offerings to clients, and improving communication strategies (Eurostat, 2025).

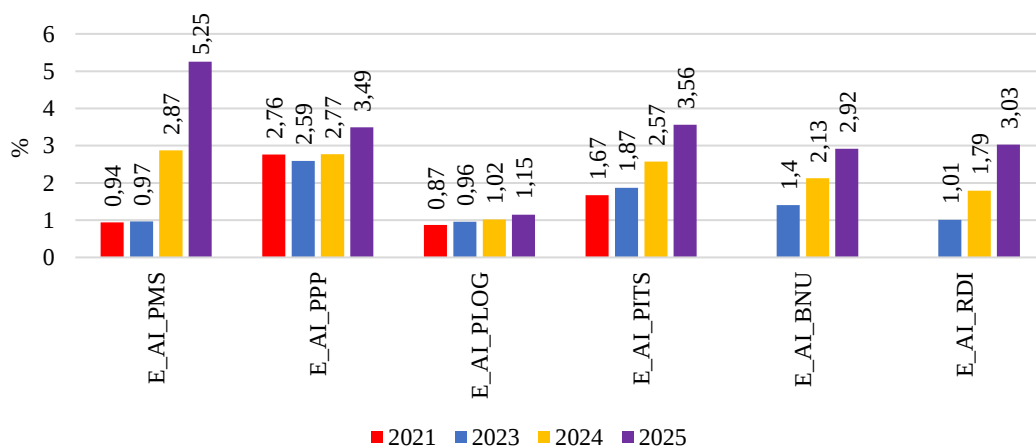


Figure 2. Functional distribution of AI adoption across EU manufacturing subsectors

Source: compiled by the author based on data from the Eurostat (n. d.).

Overall, the empirical evidence indicates that AI adoption in EU manufacturing has moved beyond the initial stage of experimentation and entered a phase of broader diffusion. At the same time, this process remains structurally uneven. Differences are observed across manufacturing industries, AI technologies, and business functions, suggesting that the pace of adoption is determined not only by technological availability but also by sectoral characteristics, enterprise innovation capacity, implementation costs, and the broader institutional environment. The results therefore indicate that AI adoption in manufacturing should be viewed as part of a wider process of industrial transformation rather than as the diffusion of individual digital technologies. In this context, the effectiveness of AI increasingly depends on the coherence between industrial policy, digital infrastructure, and firms' ability to absorb and integrate new technological solutions into production.

3. Adaptation of EU AI policy instruments for Ukraine

An analysis of Ukraine's strategic and policy documents (Polozova & Salikhov, 2026b) indicates the formation of a consistent state policy in the field of AI aimed at the digital transformation of the economy. At the same time, its industrial dimension remains limited. Institutional, regulatory, and infrastructural components dominate the action plans, whereas mechanisms for the direct implementation of AI in production processes (robotisation, digital twins, smart manufacturing, industrial clusters) remain in their early stages of development. This creates a gap between the development of digital infrastructure and the actual use of AI in the manufacturing sector, thereby limiting the possibilities for its scaling. At the same time, the development of infrastructural and regulatory preconditions alone does not ensure economic impact unless they are integrated into production processes. In view of the above, recourse to the EU experience appears justified, as the European model, as demonstrated by this study, reflects a gradual transition from the creation of foundational conditions to the integration of AI into industrial policy and the diffusion of technologies across manufacturing industries.

Policy works best when specific instruments are not only present but also coordinated within a single regulatory framework. At the same time, transferring European experience directly remains difficult, as national innovation systems differ in how quickly they can absorb new technologies. For example, established industrial ecosystems in the EU support fairly rapid technological diffusion. In Ukraine, this process is still fragmented.

To improve the situation, AI policy should focus on selecting and combining practical elements of the European model, taking into account national limitations and the current technological readiness of local industry. In practice, this means creating a policy framework in which regulation, data infrastructure, computing resources, and manufacturing applications work together seamlessly.

A coherent governance cycle—covering policy design, instruments, implementation, and regular review—helps keep actions practical and consistent. Building industrial data infrastructure, expanding computing resources, and establishing testing centres are crucial steps that enable companies to move from initial experiments to broader, systemic use of AI across production.

The institutional strengthening of this process presupposes the creation of a coordination capacity (including a national AI office) and the introduction of a risk-based regulatory model with mechanisms for auditing and certification, which reduce uncertainty and increase the predictability of the regulatory environment.

An important direction is the development of a policy for the industrial deployment of AI as a distinct strategic block oriented toward the integration of technologies into the logic of Industry 4.0, including robotisation, digital twins, and predictive analytics.

Thus, the effective adaptation of the European experience lies not in the fragmented borrowing of individual instruments, but in the formation of a comprehensive AI policy architecture in which institutional, infrastructural, and production components function as interconnected elements of a unified system of economic transformation.

Conclusions

The analysis makes it possible to draw three principal conclusions corresponding to the objectives of this study.

EU AI policy did not evolve as a single regulatory project. Over 2018–2020, the main effort was directed toward agenda-setting, coordination among Member States, and the formation of an initial regulatory basis for AI. In 2021–2024, this agenda was translated into a more institutionalised framework through the development of European Data Spaces, the expansion of data and cloud infrastructure, and the adoption of the AI Act. By 2024–2025, however, the centre of gravity had shifted more clearly toward industrial deployment. Initiatives such as AI Factories and GenAI4EU linked AI policy with practical applications in manufacturing, transport, and energy, extending it beyond general strategic coordination toward the creation of instruments for broader industrial use. This evolution created the institutional and policy conditions for the wider industrial deployment of AI.

The empirical evidence presented in this study shows that AI adoption in EU manufacturing has expanded substantially, although the pace and pattern of diffusion remain uneven across subsectors, technologies, and business functions. The share of manufacturing enterprises using at least one AI technology increased from 6.93% in 2021 to 17.3% in 2025. This trajectory was not linear: after a temporary decline to 6.8% in 2023, the indicator recovered to 10.57% in 2024 and accelerated further in 2025. In sectoral terms, the highest adoption rates in 2025 were recorded in pharmaceutical manufacturing (41.3%), computers, electronics and optical products (37.44%), coke and refined petroleum products (30.41%),

chemicals (28.45%), and electrical equipment (25.9%). This sectoral pattern indicates that AI has spread most rapidly in technologically intensive industries, where innovation activity is stronger and production processes rely more heavily on digital and data-based solutions.

The aggregate dynamics conceal important technological and functional differences. Diffusion in EU manufacturing has so far been driven mainly by software-based and cognitive applications, whereas capital-intensive autonomous systems have spread much more slowly. Between 2021 and 2025, the share of firms using text mining increased from 1.6% to 9.4%, natural language generation from 0.9% to 7.1%, and speech recognition from 1.5% to 5.3%, while the use of autonomous systems changed only marginally, from 1.5% to 1.6%. A similar asymmetry is visible across business functions. AI expanded most rapidly in marketing and sales, where adoption rose from 0.94% to 5.25%. In production processes, the increase was more moderate, from 2.76% to 3.49%, while logistics remained the least digitalised area, with growth from 0.87% to 1.15%. Taken together, these patterns show that the spread of AI in manufacturing is shaped not only by access to technology but also by the cost and organisational complexity of implementation, the technological profile of production, and the innovation capacity of firms. AI diffusion therefore reflects broader structural characteristics of manufacturing rather than the availability of digital technologies alone.

For Ukraine, the practical value of the European experience lies not in a ready-made set of instruments to be copied, but in the policy logic behind them. Ukrainian AI policy is still concentrated mainly on institutional, legal, and infrastructural foundations, whereas the instruments needed for practical deployment in manufacturing remain weakly developed. This applies, in particular, to industrial data ecosystems, digital twins, smart manufacturing solutions, testing environments, and broader automation tools. As a result, the creation of enabling digital conditions has not yet been matched by the spread of AI in production processes. For Ukraine, the key lesson from the EU experience is the need to build an integrated policy architecture in which regulation, industrial policy, data infrastructure, computing capacity, financing mechanisms, and deployment tools operate as interconnected elements of a single system. Without such a link, AI policy risks remaining largely institutional in form while producing only limited effects for industrial modernisation.

The results support the proposed hypothesis, though not in a simplified causal sense. The EU experience shows that integrating AI into industrial policy creates more favourable conditions for the gradual diffusion of AI technologies in manufacturing, but does not by itself guarantee rapid firm-level adoption. The pace and scale of diffusion depend on a broader combination of factors, including regulatory certainty, access to data and computing infrastructure, the technological profile of industries, and the absorptive capacity of enterprises. In other words, industrial AI deployment is shaped not by regulation alone, but by the coherence of the wider policy

framework within which strategic priorities, industrial instruments, infrastructure, and implementation capacity are aligned.

Further research appears most relevant in two interconnected areas. One concerns the development of an integrated AI policy model for Ukraine that would link strategic priorities with concrete instruments of industrial deployment and institutionalise the governance cycle "policy – instruments – implementation – evaluation." The other concerns the quantitative assessment of the factors shaping the intensity of AI adoption in manufacturing, in particular regulatory certainty, access to data and computing resources, and the innovation capacity of enterprises.

REFERENCES / СПИСОК ВИКОРИСТАНИХ ДЖЕРЕЛ

- | | |
|--|--|
| Bashlai, S., & Yaremko, I. (2023). Digitalization of Ukraine's economy in the conditions of European integration processes. <i>Economy and Society</i> , (48). https://doi.org/10.32782/2524-0072/2023-48-48 | Башлай, С., & Яремко, І. (2023). Цифровізація економіки України в умовах євроінтеграційних процесів. <i>Економіка та суспільство</i> , (48). https://doi.org/10.32782/2524-0072/2023-48-48 |
| Bazhal, Yu. M. (2025). <i>Digital transformations in the economy as the action of a key factor of the technological paradigm</i> . Proceedings from <i>Digital economy: III International Scientific and Practical Conference</i> (pp. 63–66). https://doi.org/10.33111/978-966-926-559-3 | Бажал, Ю. М. (2025). Цифрові трансформації в економіці як дія ключового фактору технологічної парадигми. <i>Цифрова економіка: зб. матеріалів III Міжнародної науково-практичної конференції</i> (с. 63–66). К.: КНЕУ. https://doi.org/10.33111/978-966-926-559-3 |
| Bolgouras, V., Zarras, A., & Leka, C. (et al). (2025). EU regulatory ecosystem for ethical AI. <i>AI Ethics</i> , (5), 5063–5080. https://doi.org/10.1007/s43681-025-00749-x | |
| Buchynska, A. Y. (2025). Legal regulation of artificial intelligence in the European Union: Stages, challenges, and prospects. <i>Analytical and Comparative Jurisprudence</i> , 3(3), 259–265. https://doi.org/10.24144/2788-6018.2025.03.3.40 | Бучинська, А. Й. (2025). Нормативне регулювання штучного інтелекту в Європейському Союзі: етапи, виклики, перспективи. <i>Аналітично-порівняльне правознавство</i> , 3(3), 259–265. https://doi.org/10.24144/2788-6018.2025.03.3.40 |
| Cancela-Outeda, C. (2024). The EU's AI Act: A framework for collaborative governance. <i>Internet of Things</i> , (27), 101291. https://doi.org/10.1016/j.iot.2024.101291 | |
| Chabanna, M. (2025). <i>Methodology for assessing the effectiveness of public administration using artificial intelligence technologies in Ukraine under martial law conditions</i> . The Journal of V.N. Karazin Kharkiv National University. Issues of Political Science, (48), 16–32. https://doi.org/10.26565/2220-8089-2025-48-02 | Чабанна, М. (2025). Методологія оцінювання ефективності державного управління із застосуванням технологій ШІ в Україні в умовах воєнного стану. <i>Вісник ХНУ імені В. Н. Каразіна. Серія "Питання політології"</i> , (48), 16–32. https://doi.org/10.26565/2220-8089-2025-48-02 |
| European Commission. (2018a). <i>Artificial intelligence for Europe</i> (COM(2018) 237 final). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52018DC0237 | |
| European Commission. (2018b). <i>Coordinated plan on artificial intelligence</i> (COM(2018) 795 final). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52018DC0795 | |
| European Commission. (2019). <i>Coordinated plan on artificial intelligence – 2021 review</i> (COM(2019) 168 final). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52019DC0168 | |
| European Commission. (2020). <i>White paper on AI: A European approach to excellence and trust</i> (COM(2020) 65 final). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0065 | |
| European Commission. (2021). <i>Fostering a European approach to AI</i> (COM(2021) 205 final). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021DC0205 | |

European Commission. (2024a). *Commission decision establishing the European AI Office* (C(2024) 390 final). <https://digital-strategy.ec.europa.eu/en/library/commission-decision-establishing-european-ai-office>

European Commission. (2024b). *Communication on boosting startups and innovation in trustworthy AI* (COM(2024) 28 final). <https://digital-strategy.ec.europa.eu/en/library/communication-boosting-startups-and-innovation-trustworthy-artificial-intelligence>

European Commission. (2025a). *2025 State of the Union Address by President von der Leyen*. https://ec.europa.eu/commission/presscorner/detail/ov/SPEECH_25_2053

European Commission. (2025b). *The AI Continent Action Plan*. <https://digital-strategy.ec.europa.eu/en/library/ai-continent-action-plan>

European Commission. (2025c). *AI Application Strategy*. <https://digital-strategy.ec.europa.eu/en/policies/apply-ai>

European Parliament. (2019). *Resolution on comprehensive EU industrial policy on AI and robotics* (2018/2088(INI)). Retrieved from https://www.europarl.europa.eu/doceo/document/TA-8-2019-0081_EN.html

European Union. (2024). *Regulation (EU) 2024/1689 on harmonised rules on AI (AI Act)*. <https://eur-lex.europa.eu/eli/reg/2024/1689/oj/eng>

Eurostat. (n. d.). *Digital economy and society*. <https://ec.europa.eu/eurostat/web/digital-economy-and-society>

Hulok, M. (2025). The EU model of AI governance: Regulating artificial intelligence through law and policy. *ERA Forum*, (26), 527–547. <https://doi.org/10.1007/s12027-025-00869-1>

Korol, S., & Romashko, O. (2024). Artificial intelligence in accounting. *Scientia Fructuosa*, 154(2), 145–157. [https://doi.org/10.31617/1.2024\(154\)08](https://doi.org/10.31617/1.2024(154)08)

Король, С., & Ромашко О. (2024). Штучний інтелект у бухгалтерській діяльності. *Scientia Fructuosa*, 154(2), 145–157. [https://doi.org/10.31617/1.2024\(154\)08](https://doi.org/10.31617/1.2024(154)08)

Nurainia, N., & Apriadi, E. A. (2025). A literature review on the role of AI in Industry 4.0 transformation. *International Journal of Technology and Computer Science*, 1(1), 25–37. <https://doi.org/10.58290/ijtc.v1i1.123>

Pereguda, Y., & Chaliuk, Y. (2026). Artificial intelligence as a factor of structural changes in the global economy under conditions of entropy: challenges and opportunities. *Current Problems of Sustainable Development*, 3(3), 105–113. [https://doi.org/10.60022/3\(3\)-135](https://doi.org/10.60022/3(3)-135)

Перегуда, Ю. А., & Чалюк, Ю. О. (2026). ШІ як фактор структурних змін у глобальній економіці в умовах ентропії. *Актуальні проблеми сталого розвитку*, 3(3), 105–113. [https://doi.org/10.60022/3\(3\)-135](https://doi.org/10.60022/3(3)-135)

Polozova, T. V., & Salikhov, M. M. (2026a). Implementation of Artificial Intelligence in EU Industry: Trends Analysis. *Statystyka Ukrainy – Statistics of Ukraine*, (1), 108–116. Doi:10.31767/su.1(112)2026.01.10

Полозова, Т. В., & Саліхов, М. М. (2026а) Упровадження штучного інтелекту у промисловість ЄС: аналіз тенденцій. *Статистика України*, 2026. (1), 108–116. Doi:10.31767/su.1(112)2026.01.10

Polozova, T. V., & Salikhov, M. M. (2025). *Economic and statistical aspect of artificial intelligence application*. Successes and Achievements in Science, 12(22), 1696–1708. [https://doi.org/10.52058/3041-1254-2025-12\(22\)-1696-1708](https://doi.org/10.52058/3041-1254-2025-12(22)-1696-1708)

Полозова Т. В., Саліхов М. М. (2025). Економіко-статистичний аспект застосування ШІ. *Успіхи і досягнення у науці*, 12, 1696–1708. [https://doi.org/10.52058/3041-1254-2025-12\(22\)-1696-1708](https://doi.org/10.52058/3041-1254-2025-12(22)-1696-1708)

Polozova, T. V., & Salikhov, M. M. (2026b). State Policy in the Field of Artificial Intelligence in Ukraine under Conditions of Industrial Transformation // *Achievements and Advances in Applied and Fundamental Sciences of the 21st Century: Collection of Scientific Papers with Materials of the XI International Scientific Conference*, May 1, 2026. – Vinnytsia: LLC "UKRLOGOS Group", 2026. Pp. 27–31. <https://doi.org/10.62731/mcnd-07.11.2025>

Полозова, Т. В., & Саліхов, М. М. (2026б). Державна політика у сфері штучного інтелекту в Україні в умовах індустріальної трансформації // *Здобутки та досягнення прикладних та фундаментальних наук ХХІ століття: збірник наукових праць з матеріалами XI Міжнародної наукової конференції*, 1 травня, 2026 р. – Вінниця: ТОВ "УКРЛОГОС Груп", 2026. С.27-31. <https://doi.org/10.62731/mcnd-07.11.2025>

Ponomarenko, I. (2024). *Artificial intelligence in digital marketing*. *Scientia Fructuosa*, 155(3), 58–70. [https://doi.org/10.31617/1.2024\(155\)04](https://doi.org/10.31617/1.2024(155)04)

Пономаренко, І. (2024). Штучний інтелект у цифровому маркетингу. *Scientia Fructuosa*, 155(3), 58–70. [https://doi.org/10.31617/1.2024\(155\)04](https://doi.org/10.31617/1.2024(155)04)

Salikhov, M. M. (2025). Digitalization of the EU manufacturing sector: The use of AI. *Statistics of Ukraine*, (3), 88–101. [https://doi.org/10.31767/su.3\(110\)2025.03.07](https://doi.org/10.31767/su.3(110)2025.03.07)

Samuels, A. (2025). Examining AI integration in supply chain management from Industry 4.0 to 6.0: A systematic review. *Frontiers in Artificial Intelligence*, (7), 1477044. <https://doi.org/10.3389/frai.2024.1477044>

Tsvina, T. (2025). AI technologies in the judiciary: European standards and Ukrainian practice. *Foreign Trade: Economics, Finance, Law. Legal Sciences*, 2(139), 4–13. [https://doi.org/10.31617/3.2025\(139\)03](https://doi.org/10.31617/3.2025(139)03)

van Giffen, B., & Ludwig, H. (2023). How Siemens democratized AI. *MIS Quarterly Executive*, 22(1), Article 3. <https://aisel.aisnet.org/misqe/vol22/iss1/3>

Vannuccini, S. (2025). Move fast and integrate things: The making of a European industrial policy for AI. *MIOIR Working Paper Series*, No. 2025/02. University of Manchester. <https://www.econstor.eu/handle/10419/336627>

Zeba, G., Dabić, M., Čičak, M., Daim, T. U., & Yalcin, H. (2021). Technology mining: AI in manufacturing. *Technological Forecasting and Social Change*, (171), 120971. <https://doi.org/10.1016/j.techfore.2021.120971>

Conflict of interest. The authors certify that don't they have no financial or non-financial interest in the subject matter or materials discussed in this manuscript; the authors have no association with state bodies, any organizations or commercial entities having a financial interest in or financial conflict with the subject matter or research presented in the manuscript. The authors are not affiliated with an institution that is structurally connected to the journal publisher.

The authors did not receive direct funding for this research.

Polozova, T., & Salikhov, M. (2026). EU policy on artificial intelligence integration in manufacturing. *Scientia fructuosa*, 4(168), 32–51. [http://doi.org/10.31617/1.2026\(168\)03](http://doi.org/10.31617/1.2026(168)03)

Received by the editorial office 11.05.2026.

The article has been revised 14.06.2026.

Accepted for printing 10.07.2026.

Publication online 07.09.2026.

DOBRODUM Olga

 <http://orcid.org/0000-0001-7651-4946>

Doctor of Sciences (Philosophy), Professor,
Professor of the Department
of Journalism and Advertising
State University of Trade and Economics
19, Kyoto St., Kyiv, 02156, Ukraine
o.dobrodum@knute.edu.ua

DIGITAL CONSUMERISM IN THE DEVELOPMENT OF VIRTUAL COMMUNITIES

The article examines the transformation of consumer communication in the digital age and the role of social media in shaping qualitatively new types of communities around brands. The relevance of the study is determined by fundamental changes in social ties and identity under digitalisation when traditional institutions lose their monopoly on community formation, and brands increasingly assume functions of creating meanings, values, and rituals, which is particularly significant in the context of post-secular society. The research hypothesis is that brand communication strategies on social media evolve from instrumental to sacred, borrowing elements of religious discourse to form a deep emotional connection with the audience, leading to brand communities as a new form of sociality. The methodology is based on discourse analysis of social media content (Instagram, TikTok, YouTube, Facebook), content analysis of marketing communications of leading brands (Nike, Apple, Starbucks, Glossier), and secondary analysis of sociological data on consumer behaviour in the digital environment. The results show that modern brands use communication strategies (storytelling, gamification, unique symbolism, co-creation) aimed at ritualising consumption and forming emotional attachment.

ДОБРОДУМ Ольга

 <http://orcid.org/0000-0001-7651-4946>

д. філос. н., професор, професор кафедри
журналістики та реклами
Державного торговельно-економічного
університету
вул. Кіото, 19, м. Київ, 02156, Україна
o.dobrodum@knute.edu.ua

ЦИФРОВИЙ КОНСЬЮМЕРИЗМ У ФОРМУВАННІ ВІРТУАЛЬНИХ СПІЛЬНОТ

Висвітлено результати дослідження трансформації споживчої комунікації в цифрову епоху та ролі соціальних мереж у формуванні якісно нових типів спільнот навколо брендів. Актуальність визначається кардинальними змінами в характері соціальних зв'язків та ідентичності під впливом цифровізації, коли традиційні інститути втрачають монополію на формування спільнот, а бренди дедалі частіше перебирають на себе функції створення смислів, цінностей та ритуалів, що набуває особливої значущості в контексті постсекулярного суспільства. Висунуто гіпотезу, що комунікативні стратегії брендів у соціальних мережах еволюціонують від інструментальних до сакральних, запозичуючи елементи релігійного дискурсу для формування глибокого емоційного зв'язку з аудиторією, що призводить до виникнення бренд-спільнот як нової форми соціальності. Методологія дослідження ґрунтується на комплексному застосуванні дискурс-аналізу контенту соціальних мереж (Instagram, TikTok, YouTube, Facebook), контент-аналізу комунікативних стратегій (сторітелінгу, гейміфікації, створення унікальної символіки, залучення до співтворчості), спрямованих на ритуалізацію споживання та формування емоційної прив'язаності, та вторинного аналізу соціологічних даних щодо споживчої



Copyright © 2026. The Author(s). This is an open access article distributed under the terms of the [Creative Commons Attribution License 4.0 International License \(CC-BY\)](https://creativecommons.org/licenses/by/4.0/)

It was revealed that brand communities function similarly to traditional communities: they have hierarchy, value system, rituals, symbolism, and moral responsibility. It is proved that marketing communications increasingly borrow religious rhetoric, reflecting a trend towards the sacralization of consumption in post-secular society, where consumption becomes a key tool for constructing identity, and brand choice becomes a way of self-presentation and finding like-minded people. Scientific novelty lies in the comprehensive analysis of digital consumerism as a socio-cultural practice, identification of mechanisms of borrowing religious rhetoric in marketing, and characterisation of brand communities as a new form of sociality in the digital age.

Keywords: digital consumerism, virtual communities, brand communication, social media, discursive practices, individuality.

JEL Classification: Z13, L82, O33.

поведінки у цифровому середовищі. Виявлено, що бренд-спільноти функціонують за законами маркетингових комунікацій провідних брендів (Nike, Apple, Starbucks, Glossier). Отримані результати засвідчують, що сучасні бренди використовують комплекс, подібний до традиційних спільнот: мають власну ієрархію, систему цінностей, ритуали, символіку та почуття моральної відповідальності. Доведено, що маркетингові комунікації дедалі частіше запозичують релігійну риторику, що відображає глибшу тенденцію до сакралізації споживання в постсекулярному суспільстві, де споживання постає як ключовий інструмент конструювання ідентичності, а вибір брендів стає способом самопрезентації та пошуку однодумців. Наукова новизна полягає в комплексному аналізі цифрового консьюмеризму як соціокультурної практики, виявленні механізмів запозичення релігійної риторики в маркетингу та характеристики бренд-спільнот як нової форми соціальності в цифрову епоху.

Ключові слова: цифровий консьюмеризм, віртуальні спільноти, бренд-комунікація, соціальні мережі, дискурсивні практики, особистість.

Introduction

In the digital age, consumer behaviour undergoes fundamental transformations. Social media platforms have transformed into spaces where brand loyalty takes on religious-like features: consumption rituals emerge, symbolic brand capital accumulates, communities of devoted followers form, and "sacred texts" appear as brand manifestos. The relevance of this study is determined by changes in the nature of social ties under digitalisation, when traditional institutions (religion, family, territorial communities) lose their monopoly on community formation, and brands assume functions of creating meanings, values, and rituals in a post-secular society (Khan et al., 2025; Efendioğlu, 2024). The problem addressed lies in insufficient understanding of communicative strategies used by brands to form virtual communities and their impact on social relations transformation.

The theoretical foundation is formed by Anderson's "imagined communities" concept (Anderson, 2006), which allows interpreting brand communities as new community types based on shared ideas and symbols, in which print capitalism gives way to digital media. Castells' "network society" theory (Castells, 2010) explains the changing nature of communication in the digital age, in which power concentrates through horizontal information flows. Bourdieu's forms of capital (Bourdieu, 1986) enable analysing brands as sources of symbolic values converting into social status

and identity. Campbell's "digital religion" (Campbell, 2013) provides a basis for analysing religious rhetoric borrowing, proposing the "third space" concept where religious practice and digital culture intersect (Zamora, 2025). Hepp's research on mediatization (Hepp, 2020) helps understand media as an environment for the formation of social relations. Muniz and O'Guinn's "brand communities" research (Muniz & O'Guinn, 2001) identifies three key markers: shared consciousness, rituals and traditions, and moral responsibility (Zhang et al., 2022). Bauman's "liquid modernity" (Bauman, 2000) explains why brands become identity anchors in conditions of traditional social structures. Baudrillard's critique of "consumer society" (Baudrillard, 1998) analyses consumption as a system of signs and simulacra that structure social relations. Ritzer's "McDonaldization" (Ritzer, 2019) offers critical view of rationalization of consumption practices. Oldenburg's "third place" concept (Oldenburg, 1999) allows analysing brand stores and online spaces as informal social interaction sites performing functions similar to traditional public spaces (Chuang, 2020).

The aim is to identify and analyse communicative strategies used by brands in social media to form virtual communities and understand brand communities as a new form of sociality in the digital age. Tasks: analyse main communicative strategies; investigate ritualisation of consumption; identify mechanisms of borrowing religious rhetoric; characterise brand communities as a new social form; analyse consumption's role in identity construction.

The hypothesis is that brand communication strategies in social media evolve from instrumental to sacred, borrowing religious discourse elements (rituals, symbolism, unifying language) to form a deep emotional connection with the audience, leading to brand communities as a new social form.

Methodology: discourse analysis of social media content (Instagram, TikTok, YouTube, Facebook) to identify communication strategies and rhetorical devices; content analysis of marketing communications of leading brands (Nike, Apple, Starbucks, Glossier) to systematise tools used; secondary analysis of sociological data on consumer behaviour in digital environment (Efendioğlu, 2024). Limitations relate to concentration on brands operating primarily in Western cultural context and analysis of social media popular in this region.

Contemporary research on digital consumption focuses mainly on the economic, behavioural, and communicative aspects of brand interactions, while the symbolic and quasi-religious dimension of these processes remains insufficiently conceptualised. There is a lack of a comprehensive interpretation of brand communities as forms of post-secular sociality that arise at the intersection of digital communication and the symbolic production of meanings. Thus, the research gap lies in the need to integrate approaches from social philosophy, media theory, and consumption studies to analyse the sacralization of brand communication.

The article consists of five main sections.

Section 1, "Communication strategies of brands in social media," analyses four key strategies – storytelling, gamification, creation of unique symbolism, and co-creation – that brands employ to form emotional connections and virtual communities, drawing on theories of network society, imagined communities, symbolic capital, and liquid modernity.

Section 2, "Ritualisation of consumption in the digital environment," examines three major digital consumption rituals – unboxing, purchase demonstration, and participation in brand events – and their social functions in creating shared experience, confirming status, strengthening community ties, and countering anomie in conditions of liquid modernity.

Section 3, "Religious rhetoric in marketing communications," investigates the borrowing of elements of religious discourse in brand communications, including belief, manifestos as sacred texts, stores as temples, rituals as religious practices, and ambassadors as apostles, revealing a trend toward the sacralization of consumption in post-secular society.

Section 4, "Brand communities as a new form of sociality," characterises brand communities through their key markers – shared consciousness, rituals, and moral responsibility – as well as their hierarchical structure, value systems, language, and symbolism, positioning them as new "imagined communities" that provide belonging and identity in the digital age.

Section 5, "Consumption as identity construction in the digital age," explores the role of consumption in self-presentation, social differentiation, and like-minded people search, analysing how symbolic capital acquired through consumption converts into social status while also addressing the risks of excessive dependence on consumer markers, identity fragmentation, and authenticity loss.

1. Communication strategies of brands in social media

Brands move from direct advertising to emotionally rich content, forming a sense of belonging. This transformation is due to consumer audience changes under information overload, becoming increasingly demanding and sensitive to communication authenticity. Social media creates an environment for forming long-term emotional connections beyond rational choice (Sohaib, 2025). This phenomenon is interpreted through Castells' "network society" (Castells, 2010), in which horizontal information flows form the basis of a new social structure, and brands act as nodes around which communities form.

Storytelling creates emotional narratives evoking audience response. Nike's strategy is based on overcoming and self-improvement narratives; Apple creates narratives around creativity and innovation. Storytelling transforms consumption from a purchase act into joining a value system and identity, forming "imagined communities" (Anderson, 2006) around consumer narratives where shared stories create a sense of belonging.

Gamification uses game mechanics in non-game contexts, increasing audience engagement and creating positive emotional associations. Starbucks uses gamification through a loyalty program where customers

collect stars and earn levels; Nike Run Club turns running into a game with achievements, challenges, and social interaction, deepening consumer-brand connection (Zhu, 2025). Gamification creates shared experience becoming basis for community formation, resonating with Bauman's "liquid modernity" (Bauman, 2000) where stable social structures are replaced by temporary but intensive shared experience forms.

Unique language and symbolism creation make brands stand out in an oversaturated information space. Recognisable slogans, hashtags and visual images become cultural elements uniting brand followers. #ShotOniPhone became a global movement where users share iPhone photos; "Just Do It" became a cultural meme beyond sportswear advertising. Unique symbolism functions as a belonging marker, allowing followers to recognise each other and demonstrate identity, interpreted through Bourdieu's symbolic capital concept (Bourdieu, 1986), where brand symbol possession and demonstration convert into social status.

Co-creation fundamentally changes brand-audience relationships. Consumers become active participants in brand creation through contests, flash mobs, user-generated content calls and crowdsourcing. Glossier built a strategy on community interaction, involving customers in product development and marketing campaigns (Zamora, 2025). LEGO Ideas allows fans to propose set concepts that with community support can be produced. Co-creation creates a shared brand ownership sense, a powerful community formation factor, demonstrating the dialectic of "rationalisation" and "irrationality" described by Ritzer (2019): formal rationality of gamified systems creates irrational emotional attachment (Khan et al., 2025). The key communication strategies employed by brands and their functions in community formation are summarised in *Table 1*.

Table 1

Communication strategies of brands on social media

Strategy	Content	Brand examples	Function in community formation
Storytelling	Creation of emotional narratives around brand	Nike (overcoming, self-improvement), Apple (creativity, innovation)	Formation of "imagined community" through shared values
Gamification	Use of game mechanics (points, levels, achievements)	Starbucks (loyalty program), Nike Run Club	Creation of shared experience, increased engagement
Unique symbolism	Creation of recognisable slogans, hashtags and visual images	#ShotOniPhone (Apple), "Just Do It" (Nike)	Marker of belonging, symbolic capital
Co-creation	Involving consumers in product and content creation	Glossier, LEGO Ideas	Sense of shared brand ownership, deepening loyalty

Source: compiled by the author.

Collectively, these four strategies – storytelling, gamification, unique symbolism, and co-creation – do not operate in isolation but rather reinforce each other, constructing a coherent communicative ecosystem around the brand. Storytelling provides the narrative foundation, gamification adds interactive engagement, symbolism offers recognisable markers of identity, and co-creation transforms consumers into active co-producers of brand meaning. This synergy shifts the consumer-brand relationship from a transactional exchange to a participatory cultural experience, wherein brand loyalty is no longer merely a matter of repeated purchases but of emotional investment and social belonging (Sohaib, 2025; Zhu, 2025). In this sense, brands function as nodes within Castells' (2010) network society, generating horizontal flows of meaning that connect geographically dispersed individuals around shared values and aspirations (Anderson, 2006). Moreover, by offering consumers opportunities to accumulate and display symbolic capital (Bourdieu, 1986), these strategies lay the groundwork for the emergence of brand-centred communities that exhibit characteristics traditionally associated with kinship or religious congregations. However, this evolution also raises critical questions about the authenticity of such connections and the potential for consumer manipulation, which will be further addressed in the following sections. The emotional and symbolic bonds cultivated through these communicative practices inevitably give rise to new forms of consumer behaviour – most notably, the ritualisation of consumption, which becomes the focus of the next part of this study.

2. Ritualisation of consumption in a digital environment

Ritualisation reflects the transformation of consumption practices from utilitarian into symbolic and socially significant actions (Chuang, 2020). Rituals, as known from classical anthropological studies, strengthen social ties, confirm community belonging, and mark important life events. In a digital environment, consumption rituals take new forms while maintaining basic social functions.

Unboxing has become one of the most widespread consumption rituals. Thousands of YouTube videos demonstrate unpacking new products – from smartphones to cosmetics, from toys to luxury watches. Unboxing ritual has a clearly defined structure: packaging demonstration, opening, content review and first use. This ritual creates shared experience for the brand community, confirms the owner's status as the desired object owner, and serves as a social exchange form where viewers receive information and emotional satisfaction. For many brands, unboxing videos have become an important marketing tool, creating demand and fuelling interest in new products, illustrating Baudrillard's concept (Baudrillard, 1998) where signs and symbols become more important than material value.

Purchase demonstration on social media is another widespread ritual. Instagram, TikTok and Pinterest users regularly post photos of acquisitions

with descriptions, evaluations, and recommendations. This ritual performs a self-presentation function, allowing taste, status, lifestyle demonstration, and serves as a social interaction form where followers ask questions, give evaluations, and exchange opinions (Sohaib, 2025). For brands, user purchase demonstrations are extremely valuable content providing social proof of product quality and stimulating demand, representing conversion of consumption practices into symbolic capital (Bourdieu, 1986) where public consumption demonstration increases social status.

Participation in brand events becomes an important ritual for follower communities. Apple's annual new product presentations, Nike collection releases, Starbucks special promotions turn into events uniting thousands worldwide. These events have a ritual character: anticipation, synchronous observation (often through live broadcasts), discussion, purchase, demonstration, creating shared experience, strengthening community ties and confirming values, demonstrating how in the "network society" (Castells, 2010) mass rituals transform into synchronised online events preserving a socially integrating function of traditional rituals.

Ritualisation creates a sense of predictability in "liquid modernity" conditions (Bauman, 2000), giving consumption deeper meaning, turning it from simple need satisfaction into meaningful social practice, strengthening consumer identity by confirming belonging to a certain community and value system, acting as a compensatory mechanism countering anomie and social experience fragmentation (Zhang et al., 2022). The main types of digital consumption rituals, their manifestations, and social functions are systematised in *Table 2*.

Table 2

Digital consumption rituals and their functions

Ritual	Description	Examples	Social function
Unboxing	Video demonstration of unpacking a new product	YouTube, TikTok videos	Shared experience, status confirmation, social exchange
Purchase demonstration	Posting photos/videos of purchases on social media	Instagram, TikTok, Pinterest	Self-presentation, taste/lifestyle demonstration, social interaction
Participation in brand events	Synchronous observation and discussion of brand events	Apple presentations, Nike releases	Strengthening community ties, confirming shared values

Source: compiled by the author.

The ritualisation of consumption in the digital environment represents a profound transformation of consumer behaviour, wherein utilitarian acts of acquisition are elevated to culturally significant performances that serve both individual and collective functions. As the table illustrates, these rituals – whether unboxing, purchase demonstration, or collective brand event

participation – share common structural features: they are publicly performed, socially validated, and emotionally charged, thereby generating shared experiences that bind community members together (Chuang, 2020). This process resonates with Baudrillard's (1998) assertion that consumption increasingly operates as a system of signs rather than mere material exchange, with rituals acting as the grammar through which these signs acquire meaning and social value. Furthermore, the compensatory function of consumption rituals becomes particularly salient in Bauman's (2000) "liquid modernity," where the erosion of stable social structures leaves individuals searching for anchors of predictability and belonging – a void that brand rituals effectively fill (Zhang et al., 2022). However, the very success of these rituals raises critical questions about their authenticity and sustainability: when consumption practices are deliberately engineered by marketing departments to mimic organic social traditions, do they retain their capacity to generate genuine emotional connection, or do they risk devolving into hollow spectacles of simulated community? This tension between authentic sociality and manufactured experience points toward a deeper cultural logic at work – namely, the gradual sacralization of consumption itself, wherein brands increasingly borrow not only ritual forms but also the rhetorical and symbolic apparatus of religion. It is precisely this quasi-religious dimension of contemporary brand communication that warrants closer examination, and to which the following section now turns.

3. Religious rhetoric in marketing communications

Active borrowing of religious rhetoric and symbolism reflects a trend toward consumption sacralization in post-secular society, where traditional religious institutions lose monopoly on meaning formation, and brands increasingly take over these functions (Khan et al., 2025). Terminology associated with faith has become integral to marketing discourse. "Belief in brand," "loyalty," "devotion" acquire almost religious significance describing emotional consumer-brand connection. Most devoted followers are called "brand apostles" actively promoting the brand. This borrowing reflects brands' need to create a deep emotional connection that religion traditionally provided. Campbell's "digital religion" (Campbell, 2013) offers a framework for understanding "third space" where religious practice and digital culture intersect, creating new meaning-making forms (Zamora, 2025).

Brand manifestos function similarly to sacred texts, formulating values, mission, vision, creating meaning systems beyond utilitarian product characteristics. Nike's manifesto proclaiming sport, overcoming, victory values has inspired millions; Apple's manifesto proclaiming creativity, innovation, "thinking differently" values has formed an entire follower subculture. These texts can be seen as secular analogues of religious texts, offering moral code and life philosophy.

Brand stores are increasingly designed as temple-like spaces. Apple Store with minimalist design, spacious halls, attentive non-pressuring staff creates a sanctuary-like atmosphere where brand culture initiation occurs. Starbucks designs coffee shops as "third place" (Oldenburg, 1999) – a space between home and work for belonging, ritual and emotional support, paralleling religious building functions (Chuang, 2020), illustrating how in post-secular society, sacred moves from traditional religious spaces into consumption spaces.

Brand rituals like daily Starbucks visits, Nike Run Club runs and Apple technology updates acquire the signs of religious practice, structuring everyday life, creating predictability and stability and strengthening identity and community belonging. These rituals often have a collective character: shared viewing of new product presentations, social media discussions and participation in brand events. Religious rhetoric borrowing reflects deep societal transformation where traditional institutions lose influence while the need for meanings, values, rituals and community remains (Efendioğlu, 2024). Brands occupying niche vacated in secularisation process offer ready-made meaning systems and identities, representing "post-secular religiosity" form where sacred doesn't disappear but moves into new spheres, particularly consumption, resonating with Baudrillard's theses (Baudrillard, 1998) on consumption as new mythology. Hepp's mediatization concept (Hepp, 2020) helps understand how media become an environment for these transformations. The parallels between religious institutions and brand marketing are systematically outlined in *Table 3*, which juxtaposes elements of religious discourse with their marketing equivalents and corresponding functions.

Table 3

Signs of religious rhetoric in marketing communications

Element of religious discourse	Marketing equivalent	Example	Function
Faith	Belief in brand, loyalty	"I believe in Apple"	Formation of emotional connection
Apostles	Brand ambassadors, opinion leaders	Nike influencers	Spread of "faith" among new followers
Sacred texts	Brand manifestos	Nike manifesto, Apple manifesto	Formation of value system and guidelines
Temples	Brand stores	Apple store, Starbucks as "third place"	Space for rituals and shared interaction
Religious practices	Brand rituals	Daily Starbucks coffee, Nike Run Club	Structuring everyday life, strengthening identity

Source: compiled by the author.

The systematic adoption of religious rhetoric repositions brands as quasi-religious institutions that provide meaning, identity, and community in a post-secular society (Campbell, 2013; Efendioğlu, 2024). As the table demonstrates, this borrowing is neither accidental nor superficial; rather, it reflects a fundamental restructuring of how meaning is produced and

consumed in the digital age, with significant implications for both marketing practice and social theory.

4. Brand communities as a new form of sociality

Brand communities combine traditional community features (shared values, rituals, identity) with new sociality forms characteristic of the digital age (global character, territorial attachment absence, mediated communication) (Zhang et al., 2022). They function similarly to traditional communities while demonstrating unique features due to their virtual nature. Muniz and O'Guinn (Muniz & O'Guinn, 2001) identify three key markers: shared consciousness – deep connection feeling with other brand followers; rituals and traditions – shared practices reproducing brand history and culture; moral responsibility sense – readiness to help other members and facilitate new follower recruitment. These markers demonstrate that brand communities are not merely marketing constructs but authentic social formations satisfying fundamental human needs for belonging and identity.

Brand community structure often has a hierarchical character resembling traditional social group organisation. At the top of the hierarchy are brand ambassadors – selected representatives who officially represent the brand, participate in special events and receive exclusive offers. Next are opinion leaders (influencers) shaping public opinion about the brand and influencing consumer preferences. Active members regularly interact with the brand and other members, creating content and participating in discussions. Peripheral members consume content, occasionally interact but aren't active community members. This hierarchy creates social dynamics stimulating more active interaction and status raising, interpreted through Bourdieu's social capital concept (Bourdieu, 1986) (Sohaib, 2025).

The value system ensures community unity and identity. The brand formulates basic values that community members share. For the Apple community, values are creativity, innovation, simplicity, and design. For the Nike community – sport, overcoming, achievement, self-improvement. The Starbucks community unites around values of community, cosiness and coffee quality. These values aren't merely declared but constantly reproduced in communications, rituals, events, creating shared purpose and identity sense, resonating with Anderson's "imagined communities" (Anderson, 2006), where shared ideas and values create a sense of belonging.

Language and symbolism function as belonging markers, allowing members to recognise each other and demonstrate identity. Recognisable logos, slogans, hashtags, jokes and memes become community culture elements. Knowledge of this language and symbolism confirms "insider" status and provides access to internal community communication, especially noticeable in brand-dedicated online forums using specific vocabulary understandable only to members, demonstrating how new cultural codes form in "network society" (Castells, 2010; Zhu, 2025).

Brand rituals strengthen social ties and confirm shared identity. Collective new product presentation viewing, post-purchase impression sharing, joint challenge participation, brand event celebration – all rituals creating shared experience and strengthening community. Brand communities provide members with a sense of belonging, support and shared identity. In conditions of traditional social ties fragmentation, individualisation, and anomie described by Bauman (Bauman, 2000), brand communities offer ready-made identity and social network, especially important for youth seeking meanings and communities. Shared consumption becomes a basis for social capital formation and mutual assistance networks beyond purely consumer relations (Khan et al., 2025).

5. Consumption as identity construction in the digital age

Consumption increasingly becomes key tool for constructing and demonstrating identity. This phenomenon has deep roots in the social nature of consumption, which has always served not only utilitarian but also symbolic functions. As Baudrillard notes (1998), consumption in the modern world is not merely the satisfaction of needs but a sign system that structures social relations and hierarchies. In the social media age, where self-presentation has become a central element of social interaction, the role of consumption in identity construction takes on particular significance (Efendioğlu, 2024).

Brand choice becomes a means of self-presentation and identity communication. Consumers choose brands that align with their self-image and how they wish to be perceived by others. Brands offer not just products but ready-made identities consumers can "try on" and present to others. Choosing Apple may signal creativity and innovation, selecting Nike indicates athletic spirit and determination, and driving a Tesla reflects environmental concern and technological progressiveness. On social media, this connection becomes more obvious as consumers regularly demonstrate purchases, forming a visual identity image, representing "imaginary" self-construction through consumer signs (Sohaib, 2025).

Lifestyle becomes an important marker of social differentiation. Food preferences (veganism, organic products), leisure activities (travel, fitness, yoga), fashion attitudes (vintage, sustainable fashion) – all lifestyle elements that shape identity and determine social group belonging. Social media creates space for lifestyle demonstration where consumption practices become a visual self-presentation basis, illustrating Bauman's "liquid modernity" (Bauman, 2000) where identity becomes a project constantly reviewed and reconstructed through consumer choices (Zamora, 2025).

Search for like-minded people through shared consumer preferences becomes an important social tie formation mechanism. Communities of fans of certain brands, musical groups, series and hobbies unite people with no other contact points. Shared consumption becomes the basis for communication, experience exchange, and friendship formation, especially

important for youth seeking communities where they can be understood and accepted, demonstrating how new sociality forms based on shared consumer interests emerge in "network society" (Castells, 2010; Chuang, 2020).

Bourdieu (1986) explains how symbolic capital acquired through consumption converts into social status and identity. Brands become symbolic capital that consumers can accumulate, demonstrate, and exchange in social space. In the digital age, social media creates a platform for this conversion where likes, comments, and shares serve as a social recognition form, creating a new symbolic exchange economy where consumption practices directly affect social status (Zhang et al., 2022).

Identity construction through consumption has risks: excessive dependence on consumer markers, identity fragmentation and social norm pressure. Social media creates a space where consumption practices are constantly under audience scrutiny, potentially causing anxiety, insecurity, envy. Ritzer (2019) warns against "irrationality of the rational" – dehumanisation and authenticity loss from excessive rationalisation and standardisation. Baudrillard's critique (1998) acquires new relevance where simulacra and signs play an increasing role and genuine social ties may be replaced by consumer simulations.

Conclusions

The research confirmed the hypothesis that brand communication strategies evolve from instrumental to sacred, borrowing religious discourse elements to form a deep emotional connection, leading to brand communities as a qualitatively new form of sociality in the digital age. The analysis yields the following original conclusions, which constitute the author's independent scientific contribution to understanding digital consumerism.

First, the study identifies four key communicative strategies that brands employ to transform consumer relationships: storytelling, which constructs emotional narratives that transcend product functionality; gamification, which leverages interactive engagement to deepen participation; unique symbolism, which functions as a marker of belonging and identity; and co-creation, which repositions consumers from passive recipients to active participants in brand meaning production. These strategies do not operate in isolation but form an integrated ecosystem that systematically shifts consumer-brand interaction from transactional exchange to participatory cultural experience. The effectiveness of this integrated approach lies in its capacity to appeal not to rational economic choice but to fundamental human needs for meaning, belonging, and recognition – needs that traditional institutions increasingly fail to satisfy in the contemporary digital environment.

Second, the investigation of consumption rituals reveals that practices such as unboxing, purchase demonstrations, and collective brand event participation have evolved from individual consumer behaviours into culturally significant social performances. These rituals serve multiple

functions: they create shared experiences that bind community members together, confirm individual status within the community hierarchy, facilitate social exchange and recognition, and provide a sense of predictability and stability in conditions of social fragmentation. The ritualisation of consumption represents a compensatory mechanism whereby individuals counter anomie and identity uncertainty by embedding their consumer choices within meaningful, socially validated practices. This transformation elevates consumption from a utilitarian act of need satisfaction to a symbolic practice that structures everyday life and reinforces social belonging.

Third, the analysis of religious rhetoric in marketing communications demonstrates that brands systematically borrow not only isolated elements but the entire semiotic apparatus of religious discourse – faith language, manifestos as sacred texts, stores as temples, rituals as religious practices, and followers as apostles. This borrowing is neither incidental nor merely metaphorical; it reflects a profound cultural shift wherein brands increasingly assume functions traditionally performed by religious institutions, including the provision of meaning systems, moral frameworks, collective identity, and a sense of community belonging. In the context of post-secular society, where traditional religious authority has waned, but the human need for transcendence and meaning persists, brands have occupied this cultural vacuum by offering secular forms of religiosity organised around consumption. This process of sacralization represents a fundamental transformation in how contemporary societies produce and consume meaning.

Fourth, the characterisation of brand communities as a new form of sociality reveals that these formations exhibit structural and functional features traditionally associated with kinship groups, religious congregations, or territorial communities – including hierarchical organisation, shared value systems, distinctive language and symbolism, collective rituals, and moral responsibility among members. However, brand communities simultaneously demonstrate unique characteristics that distinguish them from traditional social formations: they are globally dispersed, digitally mediated, voluntarily chosen rather than ascribed, and organised around shared consumption practices rather than inherited identities. This combination of traditional community functions with novel organisational forms makes brand communities particularly effective at satisfying the need for belonging and identity in conditions where traditional social structures have fragmented. They represent not merely marketing constructs but authentic social formations that address fundamental human needs in the digital age.

Fifth, the examination of consumption's role in identity construction establishes that brand choice, lifestyle expression, and consumption practices have become primary tools for self-presentation, identity communication, and the search for like-minded others in the digital environment. Consumers use brands as symbolic resources to construct and project identities, signal social status, and navigate complex social landscapes. Social media platforms amplify this function by providing spaces where consumption practices become publicly

visible and socially validated through likes, comments, and shares. While this process empowers individuals with unprecedented opportunities for creative self-expression and community formation, it also entails significant risks: excessive dependence on consumer markers may lead to identity fragmentation, social anxiety, and the substitution of genuine social ties with consumer simulations. The line between authentic community and manufactured consumer experience becomes increasingly blurred, raising ethical questions about the manipulation of human needs for commercial purposes.

The scientific novelty of this research lies in its comprehensive analysis of digital consumerism as a socio-cultural practice that extends beyond economic exchange into the realms of meaning production, identity construction, and community formation. The identification of religious rhetoric borrowing mechanisms in marketing, the characterisation of brand communities as a distinct form of post-secular sociality, and the application of an interdisciplinary theoretical framework combining sociological, anthropological, and communication perspectives collectively constitute an original contribution to understanding contemporary consumer culture.

The practical value of these findings extends to multiple domains. For marketers and brand managers, understanding the mechanisms of ritualisation and sacralization enables more conscious and ethically responsible approaches to communication strategy development, moving beyond manipulative practices toward authentic dialogue and meaningful consumer engagement. For researchers, this study provides a theoretical foundation for further investigation of social relations transformation under digitalisation, particularly regarding the intersection of consumption, identity, and community. For policymakers and educators, the findings highlight the need for critical media literacy that enables consumers to recognise and evaluate the quasi-religious dimensions of brand communication.

Future research prospects include comparative analysis of brand communities across different cultural contexts – particularly between Ukraine and Western countries – to identify culturally specific patterns of consumption sacralization; investigation of emerging technologies' impact, including virtual reality and augmented reality, on consumer communication and community formation; examination of the ethical dimensions and psychological consequences of consumption sacralization for consumer well-being; and exploration of brand communities' potential as sites for social capital formation and civic engagement beyond purely commercial relationships.

REFERENCES

-
- Anderson, B. (2006). *Imagined communities: Reflections on the origin and spread of nationalism* (Rev. ed.). Verso, ISBN: 978-1-84467-086-4
-
- Baudrillard, J. (1998). *The consumer society: Myths and structures*. Sage Publications, ISBN: 0-7619-5692-1
-
- Bauman, Z. (2000). *Liquid modernity*. Polity Press, ISBN: 978-0-7456-2410-5
-
- Bourdieu, P. (1986). The forms of capital. In J. Richardson (Ed.). *Handbook of theory and research for the sociology of education*, 241–258. Greenwood Press. ISBN: 978-0-313-23529-0
-

-
- Campbell, H. A. (2013). Digital religion: Understanding religious practice in new media worlds. *Routledge*. ISBN: 978-0-415-67610-6
-
- Castells, M. (2010). The rise of the network society (2nd ed.). *Wiley-Blackwell*. ISBN: 978-1-4051-9686-4
-
- Chuang, Y.-W. (2020). Promoting consumer engagement in online communities through virtual experience and social identity. *Sustainability*, 12(3), 855. <https://doi.org/10.3390/su12030855>
-
- Efendioğlu, İ. H. (2024). Digital consumer behavior: A systematic literature review. *Prizren social science journal*, 8(1), 5–20. <https://doi.org/10.32936/pssj.v8i1.479>
-
- Hepp, A. (2020). Deep mediatization. *Routledge*, ISBN: 978-1-138-02498-4
-
- Khan, M., Gulzar, M. M., Ahmed, I., & Khalid, M. (2025). The impact of cultural factors on digital marketing strategies in global markets. *Cogent Business & Management*, 12(1), Article 2486590. <https://doi.org/10.1080/23311975.2025.2486590>
-
- Muniz, A. M., & O'Guinn, T. C. (2001). Brand community. *Journal of consumer research*, 27(4), 412–432. <https://doi.org/10.1086/319618>
-
- Oldenburg, R. (1999). The great good place: Cafés, coffee shops, bookstores, bars, hair salons, and other hangouts at the heart of a community. *Da Capo Press*, ISBN: 978-1-56924-681-8
-
- Ritzer, G. (2019). The McDonaldization of society (9th ed.). *Sage Publications*, ISBN: 978-1-5063-4855-1
-
- Sohaib, M. (2025). Social media marketing drives brand love and customer behavioral engagement: Gender as a moderator. *Journal of theoretical and applied electronic commerce research*, 20(4), Article 344. <https://doi.org/10.3390/jtaer20040344>
-
- Zamora, N. L. (2025). Virtual communities: Koze Krew – Friendship in virtual spaces. *Berkeley journal of sociology*. <https://berkeleyjournal.org/2025/06/11/virtual-communities/> (accessed 30 June 2026)
-
- Zhang, J., Yang, L., & Lyu, B. (2022). Social capital and knowledge sharing among consumers in virtual communities: Psychological ownership's mediating effect. *Electronic commerce research*, (24), 2803–2829. <https://doi.org/10.1007/s10660-022-09625-w>
-
- Zhu, X. (2025). The impact of social media on brand digital marketing. *SHS Web of Conferences*, (220), Article 03017. <https://doi.org/10.1051/shsconf/202522003017>
-

Conflict of interest. The author certifies that she doesn't have financial or non-financial interest in the subject matter or materials discussed in this manuscript; the authors have no association with state bodies, any organisations, or commercial entities having a financial interest in or financial conflict with the subject matter or research presented in the manuscript. Given that the author is affiliated with the institution that publishes this journal, which may cause potential conflict or suspicion of bias and therefore the final decision to publish this article (including the reviewers and editors) is made by the members of the Editorial Board who are not the employees of this institution.

The author received no direct funding for this study.

Dobrodum, O. (2026). Digital consumerism in the development of virtual communities. *Scientia fructuosa*, 4(168), 52–66. [http://doi.org/10.31617/1.2026\(168\)04](http://doi.org/10.31617/1.2026(168)04)

Received by the editorial office 15.03.2026.

The article has been revised 23.04.2026.

Accepted for printing 25.05.2026.

Published online 07.09.2026.

KONOPLIANNIKOVA Marianna <https://orcid.org/0000-0002-6877-3515>

PhD (Economics), Associate Professor, Associate Professor at the Department of Marketing State University of Trade and Economics 19, Kyoto St., Kyiv, 02156, Ukraine
m.konoplyannikova@knute.edu.ua

QUANTUM MARKETING IN E-COMMERCE

The high rate of business digitalisation has increased the necessity of sophisticated marketing mechanisms capable of shaping intricate, specific and contextual consumer decision-making procedures. The traditional linear marketing models are less effective in accounting for the behavioural dynamics in the algorithmically mediated and information-saturated digital world. The empirical gap addressed in this study concerns the economic and behavioural efficacy of quantum marketing mechanisms in electronic commerce. The hypothesis of the study is that increasing the intensity of quantum marketing in e-commerce has a positive but nonlinear impact on economic performance of companies, which is mediated by changes in consumer behaviour and is amplified in conditions of market uncertainty. The study determines the extent to which the intensity of quantum marketing influences consumer buying behaviour and company performance both in nonlinear and interactive as well as state-dependent ways. The paper uses a multi-country panel model of e-commerce companies from 2020 to 2024. An overall index of Quantum Marketing Intensity is created to reflect the depth of personalisation, adaptivity in real-time, coordination between channels, and intensity of experimentation. They use fixed-effects panel econometric models that include behavioural mediation, nonlinear specifications, and terms of interaction that are used to indicate contextual volatility. The statistical results indicate that the intensity of quantum marketing has a positive and statistically significant effect on conversion rates, revenue per visit, gross margin, and customer lifetime value. The evidence suggests diminishing marginal returns, which confirms the nonlinear nature of advanced marketing

КОНОПЛЯННИКОВА Маріанна <https://orcid.org/0000-0002-6877-3515>

к. е. н., доцент, доцент кафедри маркетингу Державного торговельно-економічного університету вул. Кіото, 19, м. Київ, 02156, Україна
m.konoplyannikova@knute.edu.ua

КВАНТОВИЙ МАРКЕТИНГ В ЕЛЕКТРОННІЙ КОМЕРЦІЇ

Високі темпи цифровізації бізнесу посилюють потребу у складних маркетингових механізмах, здатних формувати виважені, визначені та контекстуальні процедури прийняття рішень споживачами. Традиційні лінійні маркетингові моделі дедалі менш ефективні, враховуючи динаміку поведінки в алгоритмічно опосередкованому та інформаційно насиченому цифровому світі. Емпірична прогалина, яку враховано в цьому дослідженні, пов'язана з економічною та поведінковою ефективністю квантових маркетингових механізмів в електронній комерції. Дослідження ґрунтується на гіпотезі, що підвищення інтенсивності квантового маркетингу в електронній комерції має позитивний, але нелінійний вплив на економічні результати компаній, які опосередковуються змінами споживчої поведінки та посилюються в умовах ринкової невизначеності. Визначено, якою мірою інтенсивність квантового маркетингу впливає на купівельну поведінку споживачів та ефективність компаній як нелінійним, так і інтерактивним, а також залежним від стану способом. Використано багатовимірну панельну модель компаній електронної комерції за 2020 та 2024 рр. Створено загальний індекс інтенсивності квантового маркетингу для відображення глибини персоналізації, адаптивності в режимі реального часу, координації між каналами та інтенсивності експериментів. Вони використовують панельні економетричні моделі з фіксованими ефектами, що включають поведінкове посередництво, нелінійні специфікації та умови взаємодії для позначення контекстуальної волатильності. Статистичні результати показують, що інтенсивність квантового маркетингу має позитивний та статистично значущий вплив на коефіцієнт конверсії, дохід на відвідувача, валовий прибуток та довічну цінність клієнта. Дані свідчать про зниження граничної



mechanisms. The evidence shows that marginal returns are decreasing, which proves the nonlinearity of marketing mechanisms. The economic outcomes are mediated by behavioural variables that explain the effects of specific characteristics, with variables explaining approximately one-quarter to one-third of all effects. The combined effects of digital channels are positive, highlighting the need for synchronised omnichannel strategies. Market volatility enhances the effectiveness of quantum marketing, particularly under increased uncertainty, which supports the contextual dependency hypothesis. The analysis shows that its effectiveness peaked in 2022 and subsequently stabilised as markets matured and consumers became more accustomed to digital interactions. Overall, the study makes a scientific contribution by demonstrating the quantification of marketing as a quantitatively measurable econometric approach and the possibility of its integration with the tools of behavioural economics and panel econometric analysis. The results provide a basis for further research into quantum marketing in e-commerce, particularly for analysing customer data and applying experimental algorithms in digital sales channels.

Keywords: quantum marketing, electronic commerce, consumer behaviour, digital personalisation, nonlinear marketing effects, omnichannel strategy, panel econometric analysis.

прибутковості, що підтверджує нелінійний характер дії передових маркетингових механізмів. Отримані результати також демонструють, що економічні ефекти реалізуються через поведінкові змінні, які відображають вплив певної специфіки та сукупно пояснюють приблизно від чверті до третини всіх ефектів. Синергія ефектів між цифровими каналами є позитивною, і важливо відзначити необхідність синхронізованих омніканальних стратегій. Волатильність ринку підвищує ефективність застосування квантового маркетингу, особливо за умов зростаючої невизначеності, що підтверджує гіпотезу контекстної залежності. Дослідження показує, що його ефективність була максимальною у 2022 р., а згодом стабілізувалася, у міру того як ринки ставали більш зрілими, а споживачі більш адаптованими. Загалом дослідження робить науковий внесок, демонструючи квантифікацію маркетингу як кількісно вимірюваного економічного підходу та можливості його інтеграції з інструментарієм поведінкової економіки і панельного економічного аналізу. Отримані результати створюють основу для подальших досліджень квантового маркетингу в електронній комерції, зокрема для аналізу клієнтських даних, застосування експериментальних алгоритмів у цифрових каналах збуту.

Ключові слова: квантовий маркетинг, електронна комерція, поведінка споживачів, цифрова персоналізація, нелінійні маркетингові ефекти, омніканальна стратегія, панельний економічний аналіз.

JEL Classification: M31, D12, D91, L81.

Introduction

The high growth rate of electronic commerce has increased competition levels and firms are seeking the best new marketing mechanisms that can be used to affect complex and uncertain consumer decision-making processes (Konopliannykova, 2024). Conventional linear marketing frames are becoming less relevant for describing observed consumer behaviour in digitally saturated contexts of information overload, algorithmic mediation and volatile contextuality. In that regard, quantum marketing becomes a promising paradigm with the focus on probabilistic choice, nonlinear effects, contextuality, and interaction among the multiple digital stimuli. Although both conceptual and behavioural interest in quantum marketing mechanisms is increasing, empirical evidence on their economic and behavioural efficiency remains inconsistent and methodologically underdeveloped.

The rapid expansion of digital commerce and data-driven marketing has increasingly exposed the limitations of traditional linear models of consumer choice and firm performance. Recent theoretical advances

emphasise nonlinear and probabilistic perspectives on economic decision-making. Zheng and Bai (2024) demonstrate that market dynamics may exhibit threshold effects and discontinuities that cannot be captured by smooth linear adjustments, a logic that is directly applicable to digital marketing contexts characterised by personalisation and adaptive targeting. Broader research on quantum computing and post-quantum technological systems further supports this departure from deterministic causality, highlighting contextual dependence, uncertainty, and multi-dimensional interaction structures in complex decision environments (Memon et al., 2024; Shamsuddoha et al., 2025; Kuka et al., 2026). These studies provide a conceptual foundation for interpreting advanced digital marketing as a probabilistic and nonlinear system.

Empirically, capturing such complexity requires econometric approaches that account for unobserved heterogeneity, indirect effects, and diminishing returns. Applied economic research demonstrates the suitability of panel models with fixed effects and nonlinear specifications for analysing strategic decisions under uncertainty. Mazur et al. (2023) show that firm-level outcomes are governed by structurally nonlinear relationships, while Prokopenko et al. (2024) emphasise that economic effects often materialise through combined direct and mediated channels. In the marketing domain, Kazibudzki and Trojanowski (2024) confirm that marketing effectiveness is best evaluated through integrated quantitative frameworks linking behavioural adjustments to economic performance.

Behavioural studies of digital consumption further reinforce the systemic nature of marketing outcomes. Peer influence, product type, and social context significantly shape online purchase decisions, particularly among younger consumers (Theocharis, 2025). Spatial and location-based factors also moderate the effectiveness of digital marketing, underscoring the importance of contextual variation (Theocharis et al., 2025). Comparative evidence from European e-commerce markets reveals substantial cross-country heterogeneity in online consumer behaviour, suggesting that responses to digital stimuli are neither uniform nor stable across institutional settings (Madlenak et al., 2025). Moreover, integrity- and trust-based interactions function as key behavioural transmission mechanisms through which marketing efforts influence purchase intentions (Florea et al., 2025).

Parallel evidence from the literature on artificial intelligence and data-driven marketing illustrates how adaptive mechanisms operate in practice. AI-driven marketing tools are shown to increase e-commerce sales, yet their effectiveness diminishes as algorithmic complexity intensifies, indicating the presence of decreasing marginal returns (Madanchian, 2024). Systematic reviews of emerging technologies in e-commerce identify personalisation, experimentation, and omnichannel coordination as dominant trends, while also highlighting the growing difficulty of managing their combined effects within linear frameworks (Sandu et al., 2025). Advances in big data analytics,

including the use of synthetic and high-dimensional data, further complicate the marketing-performance relationship by amplifying uncertainty and reinforcing the need for adaptive strategies (Theodorakopoulos et al., 2026).

Foundational studies on digital marketing provide the baseline for understanding these advanced mechanisms. Early research conceptualises digital marketing as an innovative communication and coordination tool that restructures firm–consumer interactions (Holovchuk et al., 2018). Subsequent work positions digital marketing as a central component of modern business strategy, particularly in competitive and technologically dynamic environments (Goriashchenko & Ilchenko, 2020; Pertsova, 2020). Strategic analyses of e-commerce firms further indicate that marketing behaviour reflects adaptive responses to market conditions rather than static optimisation processes (Svobodová & Rajchlová, 2020).

Overall, the literature converges on the conclusion that digital marketing effectiveness is nonlinear, behaviourally mediated, and context-dependent. Economic outcomes are shaped not only by the intensity of marketing mechanisms but also by behavioural transmission channels, interaction effects, and market volatility. These insights directly motivate the empirical framework adopted in this study, which models quantum marketing intensity as a composite construct, incorporates behavioural mediation, and explicitly accounts for nonlinear and context-dependent effects within a multi-country panel setting.

The main research question that has been considered in this study is how little has been done to econometrically validate the linkage between quantum marketing processes and quantifiable behavioural and economic returns in e-commerce. The available literature is mainly centred on single tools, such as personalisation or omnichannel strategies, without paying any attention to the combined, nonlinear, and state-dependent effects of these methods. This void limits theoretical knowledge and managerial advice on how best to use advanced digital marketing processes in terms of both intensity and coordination.

The objective of the study is to empirically evaluate the processes by which quantum marketing impacts e-commerce performance both behaviourally and economically. The aims are to create a composite quantum marketing intensity index, approximate non-linear effects of the same, and the channels of mediation of behaviour. The other aims include describing the effects of interaction between the digital medium and evaluating the impact of market volatility on enhancing the marketing performance. According to the theoretical framework, the hypotheses that were tested in the study are positive direct effects, mediation by behaviour, decreasing returns, and amplification.

The central hypothesis of this research is that quantum marketing, understood as a set of adaptive, personalised, and context-dependent digital mechanisms, exerts a statistically significant influence on consumer

behaviour and the economic performance of e-commerce firms. It is further hypothesised that this influence is nonlinear, characterised by diminishing marginal returns at higher levels of marketing intensity, partially mediated by behavioural variables, and strengthened in periods of elevated market volatility.

The study relies on a multi-country panel econometric model, which will be applied to firm-level data on international e-commerce companies from 2020 to 2024 to test the empirically proposed hypothesis. This methodology is a combination of fixed-effects panel regression, mediation estimation, nonlinear specifications, and interaction terms to estimate the mechanisms of behavioural transmission and context-specific effects. Due to the intricacy of the econometric design and the development of the composite indices, the methodological design is described in detail in a dedicated section.

The novelty of this study is the combination of quantum marketing theory and econometric panel modelling using secondary multi-country data. Unlike previous work, the analysis of non-linearities, interaction effects and time-varying dynamics are captured in a unified empirical framework. The study contributes to the marketing and digital economics literature through the operationalisation of quantum marketing as an economic concept. From a practical point of view, the results give evidence-based information on how to strategically calibrate advanced marketing mechanisms in electronic commerce.

The paper is organised in the following way. In section 1, the research methodology, including the conceptual framework, sample construction, and econometric model specification are demonstrated. Section 2 presents the econometric evaluation of quantum marketing strength in e-commerce firms. Section 3 examines the mediation of behaviour and contextual effects, and Section 4 addresses the empirical findings and implications. The last part is a conclusion of the key findings, limitations, and future research directions.

1. Investigation of the quantum marketing mechanism considering behavioural and economic aspects

1.1. Justification of the research methodology

The methodological framework is a structured, multi-stage process designed to ensure the theoretical consistency, empirical validity, and replicability of the results. The research design integrates conceptual development, data construction, econometric modelling, and interpretative analysis within a coherent analytical framework. This approach enables a systematic study of the quantum marketing mechanism from both behavioural and economic perspectives. The overall process is summarised in *Table 1* in order to improve transparency and methodological clarity.

Table 1

Research methodology process

Stage	Description	Purpose
1	Conceptualisation of quantum marketing mechanisms	Theoretical grounding and hypothesis development
2	Construction of indicators and dataset	Operationalisation of behavioural and economic variables
3	Econometric modelling and estimation	Identification of direct, indirect, and nonlinear effects
4	Interpretation and validation of results	Comparative analysis and robustness assessment

Source: authors' development.

The first stage lays the theoretical basis by synthesising the literature on quantum marketing, behavioural economics and digital commerce. The second stage involves the translation of theoretical constructs into measurable indicators using aggregated secondary data sources. The third stage uses the panel econometric methods to estimate nonlinear, interactive, and mediated relationships. The last stage is the assessment of temporal dynamics, comparative effects, and consistency with existing empirical evidence. Together, these stages help to assure a logical coherence of research objectives, methods and empirical findings.

1.2. Formation of the sample of international e-commerce companies

The study uses an unbalanced panel sample of medium- and large-sized e-commerce companies operating across multiple international digital markets. This sample design guarantees adequate heterogeneity in marketing practices, consumer behaviour and levels of technological adoption.

The companies represented in the sample originate from five regions (North America, Western Europe, Central and Eastern Europe, East Asia, and Southeast Asia), reflecting different levels of digital market maturity. Geographically the dataset includes firms that operate in the United States, Canada, Germany, France, the United Kingdom, Poland, Ukraine, China, South Korea and Singapore. The sample comprises firms in key e-commerce segments, including consumer electronics, fashion and apparel, household goods, health and beauty, and digital services.

The dataset combines secondary data sourced from public information such as information available on platforms, financial disclosures, digital traffic estimators, and marketing technology databases. Behavioural indicators are based on web analytics, marketplace dashboards and consumer interaction metrics, and economic outcomes are based on reported sales and transactions statistics. Marketing intensity measures are created using information on personalisation tools, omnichannel marketing activity, experimentation frequency, and adaptive pricing signals.

The countries and firms selected offer variation in the regulatory environments, consumer digital behaviour, and technological adoption. This heterogeneity is a strength for external validity and enables the identification of context-dependent quantum marketing effects. The multi-country design is especially appropriate to capture the amplification mechanisms based on volatility favoured in the conceptual framework.

The chosen firms operate in different regulatory, cultural, and economic settings, strengthening external validity. The period 2020–2024 reflects extraordinary volatility in the markets, accelerated digitalisation, and rapid developments in algorithmic marketing mechanisms. This time frame allows one to measure both short-term shocks and medium-term adaptation processes. Monthly aggregation strikes a balance between data availability and sensitivity to behavioural and marketing dynamics.

1.3. Construction of a fixed-effects model to control for unobserved heterogeneity

The empirical analysis uses a fixed-effects panel regression model to address unobserved heterogeneous characteristics of firms. Time fixed effects are included to absorb common macroeconomic shocks and seasonal patterns. Quantum Marketing Intensity is modelled as a composite explanatory variable integrated with digital marketing mechanisms. Behavioural indicators are introduced as mediating variables to establish the relationship between marketing intensity and economic outcomes. Nonlinear effects are captured by including squared terms which make it possible to identify diminishing marginal returns. Channel interference and contextual amplification of the channel in market volatility are measured using interaction terms. This specification allows testing direct, indirect and state-dependent effects at the same time.

Model 1. FE baseline:

$$Y_{it} = \beta_1 QMI_{it} + \beta_2 X_{it} + \mu_i + \tau_t + u_{it}, \quad (1)$$

where: Y_{it} – denotes the economic performance outcome of firm i at time t , including conversion rate, revenue per visit, margin, or CLV proxy;

QMI_{it} – represents Quantum Marketing Intensity, a composite index capturing personalisation, adaptivity, omnichannel coordination, and experimentation intensity;

β_1 – measures the average marginal effect of quantum marketing intensity on economic performance;

X_{it} – is a vector of control variables such as price level, discount depth, product ratings, delivery time, assortment size, and advertising activity;

β_2 – is the corresponding vector of coefficients for control variables;

μ_i – captures firm fixed effects controlling for time-invariant firm-specific characteristics;

τ_t – denotes time fixed effects accounting for macroeconomic shocks and seasonality;

u_{it} – is the idiosyncratic error term.

Model 2. Mediation (two-step):

I. Estimate Eq. A for B_{it} (Behavioural response):

$$B_{it} = \alpha_1 QMI_{it} + \alpha_2 X_{it} + \mu_i + \tau_t + \varepsilon_{it}, \quad (2)$$

where: B_{it} – represents consumer behavioural responses, including click-through rates, add-to-cart activity, repeat visits, or engagement indices;
 α_1 – captures the effect of quantum marketing intensity on consumer behaviour;
 ε_{it} – is the error term of the behavioural equation.

II. Estimate Eq. B: for Y_{it} with B_{it} (Economic outcome with mediation):

$$Y_{it} = \beta_1 QMI_{it} + \beta_2 B_{it} + \beta_3 X_{it} + \mu_i + \tau_t + u_{it}, \quad (3)$$

where: β_2 – measures the mediating effect of behavioural responses on economic performance;
the indirect effect is computed as $\alpha_1 \cdot \beta_2$, representing the behavioural transmission channel;
the direct effect is captured by β_1 , reflecting the influence of quantum marketing independent of behavioural mediation.

Model 3. Quantum nonlinearity + interference:

$$Y_{it} = \beta_1 QMI_{it} + \beta_2 QMI_{it}^2 + \delta_3 (S_{it} \times E_{it}) + \beta_3 X_{it} + \mu_i + \tau_t + u_{it}, \quad (4)$$

where: QMI_{it}^2 – captures nonlinear effects and diminishing marginal returns to quantum marketing intensity;
 β_2 – indicates whether higher levels of marketing complexity reduce incremental effectiveness;
 S_{it} – measures the intensity of social-based marketing channels such as reviews, user-generated content, and influencer activity;
 E_{it} – measures the intensity of email, push notifications, and retargeting campaigns;
 $S_{it} \cdot E_{it}$ – represents channel interaction or interference effects;
 δ_3 – indicates whether channel coordination generates complementarity or cannibalisation.

Model 4. Regime/context model:

$$Y_{it} = \theta_1 QMI_{it} + \theta_2 (QMI_{it} \cdot Volatility_t) + \beta X_{it} + \mu_i + \tau_t + u_{it}, \quad (5)$$

where: $Volatility$ – is an index capturing market or macroeconomic uncertainty, including demand volatility or supply disruptions;
 $QMI_{it} \cdot Volatility$ – reflects the context-dependent effectiveness of quantum marketing;
 θ_1 – measures the baseline effect of quantum marketing under stable market conditions;
 θ_2 – captures the amplification effect of quantum marketing during periods of heightened uncertainty.

Together, these models identify direct, indirect, nonlinear, and context-dependent effects of quantum marketing mechanisms in electronic commerce. Their combined use provides a comprehensive econometric assessment of the behavioural–economic transmission process.

1.4. Justification of the index construction methodology

Econometric estimation is performed with fixed-effects panel econometric estimators (robust standard errors are clustered at the firm level). The effects of mediation are assessed using sequential regression and indirect effect breakdown. Index construction utilises standardisation and principal component techniques to ensure scale consistency. Volatility and context indicators are included to capture state-dependent consumer responses. All the tools are chosen to achieve the greatest degree of interpretability, methodological rigour, and conformity to empirical standards of digital marketing research.

The dataset is built on aggregated secondary indicators consistent with those reported by popular digital analytics and e-commerce intelligence platforms. Key behavioural and traffic data points equate to structures that are commonly found in Google Analytics, Adobe Analytics and platform-level seller dashboards. Marketing intensity components align with information available from MarTech stack databases, A/B testing platforms, and public disclosures on the adoption of personalisation and automation. Revenue, conversion, and margin measures are calibrated against those commonly reported in annual reports, industry benchmarks, and market intelligence summaries. Traffic and engagement dynamics are in line with estimates provided by Similarweb, Statista, as well as marketplace analytics aggregators.

2. Econometric assessment of quantum marketing intensity

The empirical analysis is based on a panel fixed-effects model that investigates the relationship between quantum marketing mechanisms, behavioural responses, and economic performance in e-commerce during 2020–2024. Quantum Marketing Intensity is operationalised as a composite index that captures levels of personalisation depth and height in adapting to two real-time, omnichannel coordination intensities of experimentation across digital platforms.

The model uses behavioural variables to mediate consumer decision-making in digital environments, reflecting the probabilistic and context-dependent behaviour of consumer decision-making. Firm and time fixed effects control for unobserved heterogeneity and macroeconomic shocks that affect all market participants simultaneously. Nonlinear and interaction terms are added to account for diminishing returns, channel interference, and contextual amplification in volatile market conditions.

The results show a statistically significant positive relationship between Quantum Marketing Intensity and conversion rates, revenue per visit, gross margin, and customer lifetime value (*Table 2*).

Table 2

Econometric results: Quantum Marketing mechanisms and E-commerce performance (2020–2024)

Variable	Model (1) Conversion Rate	Model (2) Revenue per Visit	Model (3) Gross Margin	Model (4) CLV Proxy
Quantum Marketing Intensity (QMI)	0.184*** (0.031)	0.267*** (0.044)	0.121** (0.052)	0.298*** (0.061)
QMI ²	−0.046** (0.019)	−0.071** (0.028)	−0.033* (0.018)	−0.084** (0.034)
Behavioural Index (B)	0.392*** (0.057)	0.418*** (0.069)	0.205** (0.091)	0.476*** (0.083)
Social × Email Interaction	0.063** (0.025)	0.091** (0.041)	0.058* (0.031)	0.104** (0.047)
QMI × Market Volatility	0.112** (0.049)	0.146*** (0.055)	0.081* (0.043)	0.169*** (0.062)
Price Index	−0.214*** (0.038)	−0.327*** (0.051)	−0.141** (0.064)	−0.289*** (0.058)
Discount Depth	0.176*** (0.033)	0.221*** (0.047)	−0.097* (0.054)	0.084 (0.061)
Product Rating	0.129*** (0.029)	0.198*** (0.042)	0.164** (0.067)	0.213*** (0.059)
Delivery Time	−0.087** (0.035)	−0.133** (0.052)	−0.074* (0.041)	−0.118** (0.049)
Constant	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Observations	4.860	4.860	4.860	4.860
R ² (within)	0.41	0.46	0.33	0.48

Notes: Robust standard errors clustered at the firm level in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Source: authors' development using econometric model and data from Google LLC (n. d.); Adobe Inc. (2025); Similarweb Ltd. (n. d.); Statista GmbH (2025); World Bank (n.d.); OECD (n. d); BuiltWith Pty Ltd. (n. d.).

The squared Quantum Marketing Intensity term is negative and significant, indicating decreasing marginal returns to increasing levels of marketing complexity. Behavioural indicators have very good explanatory power, confirming their mediating role between marketing mechanisms and economic outcomes. Cross-channel interaction effects show positive complementarity, indicating greater benefits of coordinated digital touchpoints than of separate channels.

3. Behavioural mediation and contextual effects of quantum marketing

In 2020, the quantum marketing effects remain moderate due to high uncertainty and behavioural adaptation during the pandemic-induced changes in online consumption (Table 3). In 2021, the strength of this impact

is enhanced by the way that firms optimise personalisation algorithms, and consumers are more responsive in this field of adaptive digital communications. In 2022, the estimated coefficients are at their highest, which is combined with an increase in market volatility and an over-reliance on data-driven decision making for marketing. In 2023, effects normalise, implying that the market is saturating, but also that there is a point of diminishing behavioural sensitivity to over-personalisation. In 2024, quantum marketing shows continued effectiveness, but less impressive improvements appear, indicating a transition towards an effort to optimise efficiency.

Table 3

Indirect (behavioural) and direct effects of Quantum Marketing

Effect Type	Conversion Rate	Revenue per Visit	Gross Margin	CLV Proxy
Direct QMI Effect	0.184***	0.267***	0.121**	0.298***
Indirect Effect via Behaviour	0.072***	0.081***	0.042**	0.142***
Total Effect	0.256***	0.348***	0.163***	0.440***
Share of Behavioural Channel (%)	28.1%	23.3%	25.8%	32.3%

Source: authors' development using econometric model and data from Google LLC (n. d.); Adobe Inc. (2025); Similarweb Ltd. (n. d.); Statista GmbH (2025); World Bank (n. d.); OECD (n. d.); BuiltWith Pty Ltd. (n. d.).

Table 4 presents the estimated coefficients of Quantum Marketing Intensity across annual subsamples, capturing time-varying effects on e-commerce revenue performance. The results demonstrate a strengthening impact from 2020 to 2022, reflecting the increasing effectiveness of adaptive and personalised marketing mechanisms.

Table 4

Temporal dynamics of Quantum Marketing effects (2020–2024)

Period	QMI Coefficient (Revenue Model)	Interpretation
2020	0.198*** (0.062)	Moderate effectiveness under pandemic-driven uncertainty
2021	0.231*** (0.057)	Strengthening behavioural response to personalisation
2022	0.286*** (0.051)	Peak impact amid heightened market volatility
2023	0.274*** (0.049)	Stabilisation with diminishing marginal returns
2024	0.259*** (0.046)	Mature phase with optimised quantum mechanisms

Source: authors' development using econometric model and data from Google LLC (n. d.); Adobe Inc. (2025); Similarweb Ltd. (n. d.); Statista GmbH (2025); World Bank (n. d.); OECD (n. d.); BuiltWith Pty Ltd. (n. d.).

The peak coefficient observed in 2022 dates to heightened market uncertainty and accelerating digital consumption patterns. In 2023, the impact is estimated to stabilise, indicating partial consumer adaptation and

saturation of advanced personalisation approaches. The slightly declining 2024 number seems to indicate decreasing marginal returns, with quantum marketing practices at a mature implementation stage. Overall, the temporal pattern confirms that the effectiveness of quantum marketing is dynamic and context-dependent rather than constant over time. These results are in favour of the inclusion of nonlinear and volatility interaction terms in the econometric specification.

Across all specifications, the economic impact of quantum marketing's behavioural channels is about one-quarter to one-third of total economic effects. The indirect pathway is especially powerful for customer lifetime value where value is more about the long-term relational benefits than short-term transactional benefits. Revenue-based results demonstrate greater sensitivity to contextual volatility; that is, there is at least a state dependency in quantum marketing mechanisms. Margin effects are positive but reduced, indicating trade-offs between the benefits of personalisation and the cost of personalisation (note the reduced margin profit for both product spectrums).

4. Empirical results and discussion

Table 5 presents marginal effects of an annual increase in Quantum Marketing Intensity, for about one standard deviation, on key performance outcomes from 2020 to 2024.

Table 5

Annual marginal effects of Quantum Marketing intensity
by outcome (2020–2024)

Year	ΔConversion Rate (pp)	ΔRevenue per Visit (%)	ΔGross Margin (pp)	ΔCLV Proxy (%)	Volatility Index (0–1)
2020	0.92	2.8	0.41	3.1	0.74
2021	1.06	3.3	0.47	3.8	0.61
2022	1.24	4.1	0.55	4.6	0.83
2023	1.15	3.7	0.51	4.1	0.67
2024	1.09	3.4	0.49	3.9	0.58

Notes: (1) Δ values represent the annual marginal effect of a one-standard-deviation increase in QMI, holding controls constant. (2) Conversion and margin are reported in percentage points (pp), while revenue per visit and CLV are reported in percent changes (%).

Source: authors' development using econometric model and data from Google LLC (n. d.); Adobe Inc. (2025); Similarweb Ltd. (n. d.); Statista GmbH (2025); World Bank (n. d.); OECD (n. d.); BuiltWith Pty Ltd. (n. d.).

In 2020, conversion effects increase and continue to strengthen, reaching a peak in 2022. After this peak, marginal conversion gains gradually decline in 2023 and in 2024, indicating saturation and diminishing returns. This trend suggests that gains will increase rapidly in the high-uncertainty state, after which they will partially plateau as customers become accustomed

to customised experiences. Revenue per visit is projected to grow the most in 2022 and clean up in 2024. The trend indicates that quantum processes outcompete conventional targeting in markets where decision-making is supported by adaptability and opportune offers.

The effects of gross margin are also positive but smaller, increasing from 2020 to 2022. The fact that this is further decreasing in 2024 means that optimisation is shifting more towards retention and experience rather than price-driven extraction. The effects of the customer lifetime value increase in 2020 and in 2022. This stability implies that quantum marketing can maintain long-term stable relational value as short-term conversion impacts begin to decline. The greatest volatility index is 2022, when there were the most robust marginal effects of all outcomes.

This correspondence aids the contextual amplification mechanism, as summarised by the interaction factor between quantum intensity and market volatility. In 2021, the effects are fortified even though the volatility decreases, which is indicative of learning-by-doing and multi-channel and experimentation-cycle orchestration. In 2023, medium volatility is observed, along with a small reduction in marginal effects, which is consistent with the hypothesis of diminishing returns at high intensity levels. In 2024, decreased volatility is linked to predictable though less significant incremental returns, suggesting that experienced quantum marketing must be recalibrated to be efficient.

Table 5 supports the fact that quantum marketing effectiveness is context-dependent, time-varying, and nonlinear. The findings confirm their orientation toward the strategic management of adaptive intensity, rather than pursuing the ever-growing complexity of personalisation.

Generally, the discovery supports the conclusion that quantum marketing is a nonlinear, behaviourally mediated system rather than a promotional tool. The findings indicate that effectiveness is contingent on contextual uncertainty, a channel interaction, and the regulated intensity of an algorithmic intervention. Overcomplicated marketing can reduce efficiency, underscoring the importance of calibrating strategies rather than excessive personalisation. Economically, quantum marketing improves not only the performance in the short term but also the customer value building process in the long term. These findings locate quantum marketing as a structurally different paradigm between behavioural economics and digital management performance in electronic commerce.

Conclusions

The study achieves the identified goal through an empirical assessment of the effects of quantum marketing mechanisms on the performance of e-commerce, mediated by behavioural and economic factors. The proposed goals are achieved by building a composite Quantum Marketing Intensity index, and approximating its complex, interactive, and context-dependent effects. The econometric findings indicate that the effects

on the 2020–2024 conversion and revenue per visit, the gross margins, and customer lifetime value are statistically significant and positive. This is confirmation of behavioural mediation: indirect effects account for a significant share of the overall economic results, underscoring the importance of the behavioural-economic transmission mechanism.

The results show that quantum marketing performance is nonlinear: at some level of intensity, marginal returns diminish. The interplay between digital channels shows positive complementarity, underscoring the need for coordinated omnichannel strategies rather than individualised marketing interventions. Contextual volatility enhances the efficacy of marketing, especially in situations that mark a period of increased uncertainty and in the context of volatile consumer decision-making. There are empirical studies that prove that long-term value is created through adaptive personalisation and experimentation, which is more powerful than short-term optimisation through transactions.

The empirical findings confirm the proposed research hypothesis. The results demonstrate that quantum marketing intensity has a positive and statistically significant effect on key economic outcomes in e-commerce, including conversion rates, revenue per visit, gross margins, and customer lifetime value. At the same time, the estimated nonlinear specifications reveal diminishing marginal returns at higher levels of marketing intensity. Behavioural indicators play a substantial mediating role, accounting for approximately one-quarter to one-third of the total economic effect, thereby confirming the behavioural-economic transmission mechanism. Moreover, the interaction with market volatility indicates that the effectiveness of quantum marketing is context-dependent and increases under heightened uncertainty. Overall, the hypothesis of a nonlinear, behaviourally mediated, and context-dependent impact of quantum marketing on e-commerce performance is empirically supported.

In terms of limitations, the study is based on secondary information; thus, the author has no control over the consistency of measures and may include platform-specific reporting effects across firms and over time. The diverse mechanisms captured by the built Quantum Marketing Intensity index may confound the distinct mechanisms of individual personalisation or orchestration units. With fixed effects and robustness tests, the remaining endogeneity, based on the quality of Six Sigma and unobserved strategic capabilities, cannot be completely ruled out. The outcomes analysed are at the aggregate firm level, which limits the possibility of observing the process of individual consumer decision-making underlying the behavioural mediation. Lastly, the 2020–2024 period is unique due to market conditions that may limit the extrapolation of findings to more stable digital commerce settings.

In terms of recommendations, quantum marketing intensity should be carefully balanced by companies, and more effort should focus on adapting personalisation and experimentation rather than going all-in on algorithms. Behavioural metrics should be incorporated in performance measures as

marketing strategies to include indirect impacts that lead to long-term customer value. It seems that coordinating digital channels across various dimensions is recommended to capture interaction effects conducive to digital positioning and to ensure that messages are not lost or cannibalised by others. In periods of market uncertainty, establishments should temporarily become more responsive to adaptive marketing to capitalise on the effects of contextual amplifications. Further applications should focus on efficiency optimisation, and personalisation costs and opportunities should be balanced to guarantee sustainable revenues and profit margins.

The study as a whole is able to make contributions to the literature on quantum marketing as a measurable and economically relevant construct. The findings will offer managers a practical perspective on how to achieve optimal calibration, efficiency-based implementation, and strategic coordination of superior marketing mechanisms. Future studies can build upon this framework using consumer-level microdata, experimental methods, or fruitful industry-specific implementations. Other directions for future research can include ethical, regulatory, and artificial intelligence aspects that define the future of quantum marketing in the digital ecosystem.

REFERENCES / СПИСОК ВИКОРИСТАНИХ ДЖЕРЕЛ

-
- Adobe Inc. (2025). *Adobe Analytics overview*. <https://experienceleague.adobe.com/en/docs/analytics/analyze/admin-overview/analytics-overview>
-
- BuiltWith Pty Ltd. (2024). *Analytics and Tracking Web Usage Distribution*. <https://trends.builtwith.com/analytics>
-
- Florea, N.-V., Croitoru, G., & Diaconeasa, A.-A. (2025). The Impact of Integrity-Related Factors on Consumer Shopping Intention—An Interactive Marketing Approach Based on Digital Integrity Model. *Journal of Theoretical and Applied Electronic Commerce Research*, 20(4), 262. <https://doi.org/10.3390/jtaer20040262>
-
- Google LLC. (n. d.). *Benchmarking*. <https://support.google.com/analytics/answer/16388466?hl=en>
-
- | | |
|---|---|
| Goryashchenko, Y. H., & Ilchenko, V. M. (2020). Digital marketing as the foundation of modern business. <i>Scientific View: Economics and Management</i> , (2), 115–120. http://nbuv.gov.ua/UJRN/vamsue_2020_2_22 | Горященко, Ю. Г., & Ильченко, В. М. (2020). Цифровий маркетинг як основа сучасного бізнесу. <i>Науковий погляд: економіка та управління</i> , (2), 115–120. http://nbuv.gov.ua/UJRN/vamsue_2020_2_22 |
| Holovchuk, Y. O., Melnyk, Y. V., & Kozub, M. V. (2018). Digital marketing as an innovative communication tool. <i>Economy and Society</i> , (19). https://economyandsociety.in.ua/journals/19_ukr/51.pdf | Головчук, Ю. А., Мельник, Ю. В., & Козуб, М. В. (2018). Цифровий маркетинг як інноваційний інструмент комунікацій. <i>Економіка і суспільство</i> , (19). https://economyandsociety.in.ua/journals/19_ukr/51.pdf |
-
- Kazibudzki, P. T., & Trojanowski, T. W. (2024). Quantitative evaluation of sustainable marketing effectiveness: a polish case study. *Sustainability*, 16(9), 3877. <https://doi.org/10.3390/su16093877>
-
- | | |
|---|---|
| Konopliannykova, M. (2024). Influencer marketing in social networks. <i>Scientia fructuosa</i> , 2(154), 118–144. https://doi.org/10.31617/1.2024(154)07 | Конопляникова, М. (2024). Інфлюенсер-маркетинг у соціальних мережах. <i>Scientia fructuosa</i> , 2(154), 118–144. https://doi.org/10.31617/1.2024(154)07 |
|---|---|
-
- Kuka, C., Muhyaddin, S., Lee Teh, P., & Davies, L. (2026). Global roadmaps for post-quantum era in finance: policies, timelines, and a pragmatic playbook for migration. *FinTech*, 5(1), 16. <https://doi.org/10.3390/fintech5010016>
-
- Madanchian, M. (2024). The Impact of Artificial Intelligence Marketing on E-Commerce Sales. *Systems*, 12(10), 429. <https://doi.org/10.3390/systems12100429>
-
- Madlenak, R., Chinoracky, R., Stalmasekova, N., & Madlenakova, L. (2025). Differences in Online Consumer Behavior: A Multi-Dimensional Comparative Study in the Context of European Digital Commerce. *Behavioral Sciences*, 15(10), 1384. <https://doi.org/10.3390/bs15101384>
-

- Mazur, V., Koldovskiy, A., Ryabushka, L., & Yakubovska, N. (2023). The formation of a rational model of management of the construction company's capital structure. *Financial and credit activity: problems of theory and practice*, 6(53), 128–144. <https://doi.org/10.55643/fcaptp.6.53.2023.4223>
- Memon, Q. A., Al Ahmad, M., & Pecht, M. (2024). Quantum computing: navigating the future of computation, challenges, and technological breakthroughs. *Quantum reports*, 6(4), 627–663. <https://doi.org/10.3390/quantum6040039>
- OECD. (n.d.). *Digital*. <https://www.oecd.org/digital>
- | | |
|---|---|
| Pertsova, A. R. (2020). Digital marketing as a tool for enterprise development. <i>International Scientific Journal "Internauka"</i> , 8(2), 44–47. http://nbuv.gov.ua/UJRN/mnj_2020_8(2)_8 | Перцова, А. Р. (2020). Цифровий маркетинг як інструмент розвитку підприємства. <i>Міжнародний науковий журнал "Інтернаука"</i> , 8(2), 44–47. http://nbuv.gov.ua/UJRN/mnj_2020_8(2)_8 |
|---|---|
- Prokopenko, O., Chechel, A., Koldovskiy, A., & Kldiashvili, M. (2024). Innovative models of green entrepreneurship: Social impact on sustainable development of local economies. *Economics Ecology Socium*, (8), 89–111. <https://doi.org/10.61954/2616-7107/2024.8.1-8>
- Sandu, A., Cotfas, L.-A., Ioanăș, C., Cișmașu, I.-D., & Delcea, C. (2025). E-Commerce Meets Emerging Technologies: An Overview of Research Characteristics, Themes, and Trends. *Journal of Theoretical and Applied Electronic Commerce Research*, 20(4), 320. <https://doi.org/10.3390/jtaer20040320>
- Shamsuddoha, M., Kashem, M. A., Nasir, T., Hossain, A. I., & Ahmed, M. F. (2025). Quantum Computing Applications in Supply Chain Information and Optimization: *Future Scenarios and Opportunities*. *Information*, 16(8), 693. <https://doi.org/10.3390/info16080693>
- Similarweb Ltd. (n. d.). *Website Traffic Checker*. <https://www.similarweb.com/website/>
- Statista GmbH. (2025). *E-commerce worldwide – statistics & facts*. https://www.statista.com/topics/871/online-shopping/?srsltid=AfmBOorIahXSjTh65nhx1vsA-lqH_ldMg7hyi3xt1-eMUgiuHmD02OUe
- Svobodová, Z., & Rajchlová, J. (2020). Strategic Behavior of E-Commerce Businesses in Online Industry of Electronics from a Customer Perspective. *Administrative Sciences*, 10(4), 78. <https://doi.org/10.3390/admsci10040078>
- Theocharis, D. (2025). Peer dynamics in digital marketing: how product type shapes the path to purchase among gen z consumers. *Businesses*, 5(3), 43. <https://doi.org/10.3390/businesses5030043>
- Theocharis, D., Tsekouropoulos, G., Hoxha, G., & Simeli, I. (2025). Location-Based moderation in digital marketing and e-commerce: understanding gen z's online buying behavior for emerging tech products. *Journal of theoretical and applied electronic commerce research*, 20(3), 161. <https://doi.org/10.3390/jtaer20030161>
- Theodorakopoulos, L., Theodoropoulou, A., & Klavdianos, C. (2026). Big data analytics and ai for consumer behavior in digital marketing: applications, synthetic and dark data, and future directions. *Big data and cognitive computing*, 10(2), 46. <https://doi.org/10.3390/bdcc10020046>
- World Bank. (n. d.). *World Development Indicators database*. <https://databank.worldbank.org/source/world-development-indicators>
- Zheng, H., & Bai, J. (2024). Quantum leap: a price leap mechanism in financial markets. *Mathematics*, 12(2), 315. <https://doi.org/10.3390/math12020315>

Conflict of interest. The author certifies that she doesn't have financial or non-financial interest in the subject matter or materials discussed in this manuscript; the authors have no association with state bodies, any organisations, or commercial entities having a financial interest in or financial conflict with the subject matter or research presented in the manuscript. Given that the author is affiliated with the institution that publishes this journal, which may cause potential conflict or suspicion of bias and therefore the final decision to publish this article (including the reviewers and editors) is made by the members of the Editorial Board who are not the employees of this institution.

The author received no direct funding for this study.

Konopliannykova, M. (2026). Quantum marketing in e-commerce. *Scientia fructuosa*, 4(168), 67–82. [http://doi.org/10.31617/1.2026\(168\)05](http://doi.org/10.31617/1.2026(168)05)

Received by the editorial office 29.01.2026.

The article has been revised 02.03.2026.

Accepted for printing 05.04.2026.

Published online 07.09.2026.

DOI: [http://doi.org/10.31617/1.2026\(168\)06](http://doi.org/10.31617/1.2026(168)06)
UDC 004:504:659.126=111

**IANKOVETS Tetiana**

<https://orcid.org/0000-0002-8159-3826>

Doctor of Sciences (Economic),
Associate Professor,
Professor of the Department of Marketing
State University of Trade and Economics
19, Kyoto St., Kyiv, 02156, Ukraine

t.yankovets@knute.edu.ua

KOSTENKO Anna

<https://orcid.org/0009-0003-5740-6669>

Brand Manager, Chumak Ukraine LLC
19, Mykola Mikhnovsky Boulevard,
Kyiv, 01042, Ukraine

anyutakosenko@gmail.com

VYSHNEVSKA Maryna

<https://orcid.org/0000-0003-1536-9102>

Associate Professor of the Philology and Translation
Department, Kyiv National University of
Technologies and Design
2, Mala Shyianovska St., Kyiv, 01011, Ukraine

vishnevskaya.mo@kntud.com.ua

DIGITAL ECO-BRANDING OF FMCG COMPANIES

The study examines the formation of eco-brands of FMCG companies in the context of implementing Sustainable Development Goals and digital marketing. The relevance of the research is driven by the growing importance of corporate environmental responsibility, the mass production of fast-moving consumer goods, and the need to integrate sustainable development principles into the marketing activities of FMCG companies. The study hypothesises that integrating sustainable development principles into the activities of FMCG companies and applying digital marketing tools contribute to the effective formation, promotion, and development of eco-brands, enhance consumer trust, and strengthen companies' competitiveness. The methodological framework combines general scientific and specialised research methods, including analysis and synthesis, systems analysis, structural and logical analysis, comparative analysis, and modelling. The study is based on scientific publications, materials of the United Nations Global

ЯНКОВЕЦЬ Тетяна

<https://orcid.org/0000-0002-8159-3826>

д. е. н., доцент,
професор кафедри маркетингу
Державного торговельно-економічного
університету
вул. Кіото, 19, м. Київ, 02156, Україна

t.yankovets@knute.edu.ua

КОСТЕНКО Анна

<https://orcid.org/0009-0003-5740-6669>

бренд-менеджер, ТОВ "Чумак Україна"
бульвар Миколи Міхновського, 19,
м. Київ, 01042, Україна

anyutakosenko@gmail.com

ВИШНЕВСЬКА Марина

<https://orcid.org/0000-0003-1536-9102>

доцент кафедри філології та перекладу
Київського національного університету
технологій та дизайну
вул. Мала Шияновська, 2, м. Київ, 01011, Україна

vishnevskaya.mo@kntud.com.ua

ЦИФРОВИЙ ЕКО-БРЕНДИНГ FMCG ПІДПРИЄМСТВ

Досліджено формування еко-брендів FMCG підприємств у контексті реалізації цілей сталого розвитку та цифрового маркетингу. Актуальність теми зумовлена зростанням ролі екологічної відповідальності бізнесу, масовим виробництвом товарів повсякденного попиту та необхідністю інтеграції принципів сталого розвитку у маркетингову діяльність FMCG підприємств. Внесено гіпотезу, що інтеграція принципів сталого розвитку у діяльність FMCG підприємств та використання інструментів цифрового маркетингу сприяють ефективному формуванню, просуванню та розвитку еко-брендів, підвищенню довіри споживачів і конкурентоспроможності підприємств. Методологічною основою дослідження є комплекс загальнонаукових і спеціальних методів: аналізу та узагальнення, системний і структурно-логічний аналіз, порівняльний аналіз та моделювання. Інформаційну базу дослідження становили наукові джерела, матеріали ініціативи United Nations Global Compact, а також



Copyright © 2026. The Author(s). This is an open access article distributed under the terms of the [Creative Commons Attribution License 4.0 International License \(CC-BY\)](https://creativecommons.org/licenses/by/4.0/).

Compact initiative, and data from the official websites and management reports of the companies under study. The study substantiates the concept of eco-branding for FMCG companies in the digital environment, identifies the essential characteristics of an eco-brand, and proposes the author's definition of the concept. A conceptual model of eco-branding has been developed that covers the factors, stages, and outcomes of eco-brand formation in the digital environment. Digital marketing tools have been systematised according to the stages of the digital consumer journey: Awareness, Consideration, Conversion, Loyalty, and Advocacy. Based on the analysis of international and Ukrainian experience, the study demonstrates that digital marketing communications transform environmental value into added consumer value, contribute to the development of a positive environmental image, increase consumer loyalty, and create long-term competitive advantages for FMCG companies.

Keywords: sustainable development, eco-brand, eco-branding, FMCG companies, digital environment, digital marketing, digital eco-branding.

JEL Classification: M31, M37, Q01, L67.

дані офіційних сайтів і управлінської звітності досліджуваних компаній. Обґрунтовано концепцію еко-брендингу FMCG підприємств у цифровому середовищі, визначено сутнісні ознаки еко-бренду та запропоновано авторське визначення дефініції "еко-бренд". Розроблено концептуальну модель еко-брендингу, що охоплює чинники, етапи та результати формування еко-бренду у цифровому середовищі. Систематизовано інструменти цифрового маркетингу відповідно до етапів цифрового шляху споживача Awareness, Consideration, Conversion, Loyalty, Advocacy. На основі аналізу закордонного та вітчизняного досвіду доведено, що цифрові маркетингові комунікації забезпечують трансформацію екологічної цінності у додаткову споживчу вартість бренду, сприяють формуванню позитивного екологічного іміджу, підвищенню лояльності споживачів і створенню довгострокових конкурентних переваг FMCG підприємств.

Ключові слова: сталий розвиток, еко-бренд, еко-брендинг, FMCG підприємства, цифрове середовище, цифровий маркетинг, цифровий еко-брендинг.

Introduction

Growing attention to corporate environmental responsibility and the need to integrate sustainable development principles into companies' activities have increased the relevance of this research. These processes are particularly important for FMCG companies, whose operations involve the mass production of fast-moving consumer goods, intensive use of natural resources, and a significant influence on consumer experience. Under these conditions, eco-branding has become an important instrument for implementing marketing and branding strategies that enhance companies' competitiveness. At the same time, the rapid development of digital technologies, communication channels, and sales platforms has expanded opportunities to promote environmental values and build consumer trust in the digital environment. This creates the need to explore the theoretical and practical foundations of digital eco-branding for FMCG companies.

The existing literature demonstrates growing scholarly interest in sustainable development, environmental marketing, and the formation and development of eco-brands. The theoretical foundations of sustainable development and its key principles are discussed in the works of both Ukrainian and international researchers, as well as in the materials of the United Nations Global Compact initiative, which outlines the 17 Sustainable Development Goals and the principles of responsible business conduct. Issues related to the development and promotion of eco-brands, as well as the influence of brands' environmental characteristics on consumer behaviour, have been examined

by international scholars, including Afifa et al. (2025), Hegde et al. (2025), and Davidenko et al. (2025), who explore the relationship between environmental brand values, consumer perceptions, and the development of sustainable marketing. Ukrainian researchers, including Blazhei (2016), Bondarenko and Syazin (2024), and Chygrin and Usova (2025), focus on green marketing, eco-branding, and the application of marketing tools to develop the environmental image of companies. However, the systematic conceptualisation of eco-branding for FMCG companies, which integrates the Sustainable Development Goals with the opportunities offered by digital marketing, remains underexplored, underscoring the need for further research.

The aim of this article is to substantiate the theoretical foundations of eco-branding for FMCG companies in the context of implementing the Sustainable Development Goals and to develop a conceptual model of eco-branding in the digital environment. To achieve this aim, the study pursues the following objectives: to examine the concept of sustainable development and identify the main directions for achieving the Sustainable Development Goals by FMCG companies; to review scientific approaches to the interpretation of the concept of an eco-brand, identify its essential characteristics, and propose the author's definition of the concept of an eco-brand; to develop a conceptual model of eco-branding for FMCG companies in the digital environment; and to analyse international and Ukrainian experience in eco-branding for FMCG companies and validate the proposed model.

The study is based on the hypothesis that integrating sustainable development principles into the activities of FMCG companies and applying digital marketing tools contribute to the effective development of eco-brands, enhance consumer trust, and create additional competitive advantages for companies.

To test the hypothesis and achieve the research aim, a combination of general scientific and specialised research methods was applied. Analysis and synthesis were applied to examine scientific approaches to the interpretation of the concepts of "eco-brand" and "eco-branding". Systems analysis and structural-logical analysis were applied to identify the essential characteristics of an eco-brand and to systematise digital marketing tools for the promotion and development of eco-brands. Modelling was applied to develop a conceptual model of eco-branding for FMCG companies in the digital environment. Comparative analysis was applied to investigate international and Ukrainian experience in the digital eco-branding of FMCG companies.

The study draws on Ukrainian and international scholarly sources, including publications indexed in the Scopus database, materials of the United Nations Global Compact initiative available on the official website of Global Compact Network Ukraine, information from the official websites of Unilever and Chumak, as well as management reports of Unilever Ukraine LLC and Chumak Ukraine LLC.

The first section substantiates the concept of eco-branding in the context of sustainable development and identifies the directions for implementing the 17 Sustainable Development Goals in FMCG companies. It also defines the essential characteristics of an eco-brand and proposes the author's definition of this concept. Furthermore, a conceptual model of eco-branding for FMCG companies is developed, encompassing the key factors, stages, and expected outcomes of eco-brand development in the digital environment.

The second section presents the validation of the proposed model based on the analysis of international and Ukrainian practices of FMCG companies. It highlights the practical aspects of implementing digital eco-branding and emphasises its role in creating added consumer value and enhancing companies' competitiveness.

1. Eco-branding of FMCG companies in the context of sustainable development

1.1. The concept of sustainable development: goals and their implementation by FMCG companies

The concept of sustainable development began to emerge in the late 1960s as a response to the global crisis. During this period, members of the non-governmental organisation the Club of Rome developed approaches to analysing the crisis and identified the major socio-economic challenges facing humanity (Zaitseva, 2019). For the following three decades, the programs and initiatives associated with this concept were implemented primarily at the global and national levels. The possibility of integrating sustainable development principles into business activities at the micro level was first discussed at the World Economic Forum in 1999 during the presentation of the Global Compact initiative. In 2000, the United Nations Secretary-General Kofi Annan launched the United Nations Global Compact as a platform for cooperation between the United Nations and the business community, based on ten principles covering human rights, labour, the environment, and anti-corruption (Global Compact Network Ukraine, 2025b). In September 2015, all 193 United Nations Member States adopted the 2030 Agenda for Sustainable Development, committing to the achievement of the 17 Sustainable Development Goals.

In recent years, the concept of sustainable development has gained prominence due to the growing environmental, social, and economic challenges affecting societies worldwide, as well as individual countries, regions, industries, and enterprises that are structural components of national economies. For FMCG companies, the implementation of sustainable development principles involves not only corporate social responsibility but also the adoption of environmental initiatives and cooperation with public institutions and civil society organisations (*Table 1*). This approach supports the development of an eco-brand, which directly contributes to stronger customer loyalty and greater support from key stakeholder groups, thereby enhancing the company's economic performance.

Table 1

**The 17 sustainable development goals for implementation
by FMCG companies**

№	Sustainable development goals	Global Directions for implementation by 2030	Implementation directions for FMCG companies
1	No poverty	Eradicate poverty in all its forms by reducing extreme deprivation, expanding social protection, ensuring equal access to resources and services, strengthening the resilience of vulnerable groups, and reinforcing financial and institutional support mechanisms	Implement fair wage and employee social protection programs, ensure equal access to professional development opportunities, and support vulnerable groups through social partnership initiatives. These measures contribute to reducing employee poverty while strengthening the brand's positive social impact
2	Zero hunger	End hunger and all forms of malnutrition by ensuring access to safe and nutritious food, increasing the productivity and incomes of small-scale producers, promoting sustainable agricultural ecosystems, preserving genetic diversity, and fostering fair and resilient food markets	Adopt sustainable production practices, support small-scale suppliers, and provide consumers with affordable, high-quality products. These efforts contribute to reducing hunger and malnutrition while strengthening the brand's contribution to sustainable development
3	Good health and well-being	Ensure healthy lives and promote well-being for all by reducing mortality, combating communicable and non-communicable diseases, expanding access to quality healthcare services and essential medicines, strengthening disease prevention, supporting mental health, and minimizing the impact of environmental hazards	Ensure product safety, implement environmentally responsible solutions, support employee health and well-being, provide consumer education programs, and responsibly manage environmental impacts. These efforts contribute to improving the quality of life and promoting people's well-being while strengthening the brand's social value
4	Quality education	Ensure inclusive, equitable, and high-quality education for all by reducing inequalities, developing relevant skills, supporting inclusive and safe learning environments, and fostering the competencies required for sustainable development	Invest in employee training and professional development, support educational initiatives for young people and vulnerable groups, provide equal opportunities for career advancement, and foster a culture of lifelong learning. These efforts strengthen the brand's intellectual capital and support its long-term competitiveness
5	Gender equality	Achieve gender equality and empower all women and girls by eliminating discrimination and violence, promoting participation in decision-making, ensuring equal access to resources and services, and creating conditions for the full realisation of their rights and opportunities	Ensure equal opportunities for women at all organisational levels, prevent discrimination and violence, implement diversity, equity, and gender equality policies, and support leadership development and equal access to resources. These efforts strengthen the brand's social responsibility and reputation

Continued from the Table 1

№	Sustainable development goals	Global directions for implementation by 2030	Implementation directions for FMCG companies
6	Clean water and sanitation	Ensure universal access to safe drinking water and adequate sanitation, improve water-use efficiency, enhance water quality, restore water-related ecosystems, and strengthen water resources management at all levels	Implement efficient water resource management, introduce water treatment and reuse practices in production processes, support water conservation initiatives, and engage local communities. These efforts enhance operational resilience and strengthen the brand's social responsibility
7	Affordable and clean energy	Ensure universal access to affordable, reliable, and modern energy, significantly increase the share of renewable energy sources, improve energy efficiency, and promote the development of clean technologies and sustainable energy systems	Adopt renewable energy sources, improve the energy efficiency of production processes, modernise equipment, and support the implementation of clean technologies. These efforts reduce the company's carbon footprint and reinforce the brand's commitment to sustainable development
8	Decent work and economic growth	Promote sustained economic growth, increase productivity, foster decent employment and entrepreneurship, ensure the efficient use of resources, and protect labour rights for all, including young people and vulnerable populations	Create decent jobs, invest in employee skills development, support innovation, and promote the efficient use of resources. These efforts contribute to sustainable business growth and strengthen the brand's social responsibility
9	Industry, innovation and infrastructure	Build resilient, inclusive, and sustainable infrastructure, promote sustainable industrialisation, enhance productivity, and improve access to financial and technological resources, with particular emphasis on developing vulnerable and less-developed regions	Modernize production infrastructure, improve resource efficiency, adopt clean technologies, and promote innovation and digital transformation. These efforts support sustainable manufacturing and enhance the brand's competitiveness
10	Reduced inequalities	Reduce inequalities within and among countries by increasing the incomes of disadvantaged populations, ensuring equal opportunities, protecting human rights through effective legislation, promoting inclusive participation in society, and supporting fair financial and migration policies	Ensure equal opportunities for all employees, provide fair compensation, implement inclusive policies, and support programs for vulnerable groups. These efforts contribute to reducing social inequalities and strengthening the brand's social responsibility
12	Responsible consumption and production	Ensure sustainable consumption and production through the efficient use of resources, the reduction of waste and food loss, the environmentally sound management of chemicals, and increased public environmental awareness	Adopt sustainable production practices, reduce waste and product losses, promote efficient use of resources, and ensure transparent reporting on environmental practices. These efforts improve business efficiency and strengthen the brand's reputation as a responsible business

End of Table 1

№	Sustainable development goals	Global directions for implementation by 2030	Implementation directions for FMCG companies
13	Climate action	Strengthen resilience to climate change and natural disasters, integrate climate adaptation measures into policies and strategies, and enhance public awareness and capacity to mitigate the impacts of climate change, particularly among vulnerable populations	Implement climate adaptation measures, reduce the company's carbon footprint, adopt environmentally responsible production processes, and provide educational programs for employees and consumers. These efforts enhance business resilience and reinforce the brand's commitment to environmental responsibility
14	Life below water	Conserve and sustainably use marine resources by protecting the marine environment and restoring marine and coastal ecosystems	Introduce environmentally responsible packaging, minimise waste discharge into aquatic ecosystems, support the sustainable sourcing of marine resources, and participate in projects to restore coastal and marine ecosystems. These efforts contribute to protecting marine biodiversity and strengthening the brand's environmental responsibility
15	Life on land	Protect, restore, and promote the sustainable use of forests, mountains, wetlands, and other terrestrial and freshwater ecosystems, prevent land degradation, and combat poaching and illegal wildlife trade	Promote environmentally responsible land use and sustainable raw material sourcing, support the restoration of degraded lands and reforestation, avoid sourcing materials from illegal sources, and conduct environmental awareness campaigns for employees and local communities. These efforts contribute to biodiversity conservation and strengthen the brand's environmental responsibility
16	Peace, justice and strong institutions	Promote peaceful and inclusive societies by reducing violence, protecting human rights, upholding the rule of law, strengthening transparency, accountability, and the effectiveness of public institutions, and combating corruption and illicit financial flows	Foster a safe working environment, ensure compliance with legal and ethical standards, implement zero-tolerance policies toward violence, discrimination, and corruption, provide employee training, and promote social responsibility and community engagement. These efforts strengthen corporate integrity and reinforce the brand's reputation
17	Partnerships for the goals	Strengthen global partnerships by mobilising financial, technological, and human resources, promoting international trade, facilitating knowledge sharing, and building capacity to achieve all Sustainable Development Goals	Foster strategic partnerships, leverage resources and innovation, invest in employee development, ensure transparency, and integrate sustainable development principles into all business processes. These efforts strengthen long-term collaboration and support the achievement of sustainable development objectives

Source: developed by the authors based on (Global Compact Network Ukraine, n. d. a, n. d. b).

Promoting awareness of the implementation of sustainable development principles by FMCG companies involves positioning them as eco-brands, employer brands, and other socially responsible brands. The application of branding enables companies to enhance their value for target audiences and society as a whole by creating a consistent customer experience, ultimately supporting the achievement of their strategic business objectives.

1.2. Eco-branding of FMCG companies in the digital environment

Within the concept of sustainable development, considerable attention is devoted to environmental issues, providing a foundation for the implementation of environmental initiatives by FMCG companies. This involves integrating the principles of resource efficiency, waste reduction, and energy efficiency into all business processes. As contemporary consumers increasingly prefer environmentally responsible companies, the adoption of sustainable development practices by FMCG companies contributes to building consumer trust and strengthening customer loyalty. In this context, the development of eco-brands has become a strategic necessity for FMCG companies, as it enables them to systematically demonstrate their environmental responsibility, reflect it in their products and marketing communications, and thereby strengthen consumer trust and loyalty while creating a sustainable competitive advantage.

Against this background, it is important to establish clear conceptual definitions of the terms eco-brand and eco-branding in order to clarify their essence and identify the key stages in the development, promotion, and growth of an eco-brand for FMCG companies.

The analysis of the scientific literature indicates that the concepts of "eco-brand" ("ecological brand") (Deynega et al., 2025) and "green brand" (Loučanová et al., 2021; Zinchenko et al., 2023) are used interchangeably, as both describe brands that offer products with minimal environmental impact and implement environmental initiatives based on sustainable development principles. For the purposes of this study, the term "eco-brand" has been adopted to ensure conceptual consistency, owing to its conciseness, terminological neutrality, and widespread use in both contemporary academic literature and business practice. Unlike the term "green brand", which often carries metaphorical or predominantly communication-oriented connotations, the term "eco-brand" is more universal and better suited to academic analysis because it encompasses not only the environmental characteristics of products but also the value-based and strategic dimensions of brand management.

Based on a content analysis of the scientific literature (Blazhei, 2016; Loučanová et al., 2021; Zinchenko et al., 2023; Lopes et al., 2024; Hegde et al., 2025; Deynega et al., 2025; Chygrin & Usova, 2025), the essential characteristics of the "eco-brand" concept were identified:

- *integration of sustainable development principles into business activities*, combining environmental, social, and economic dimensions;

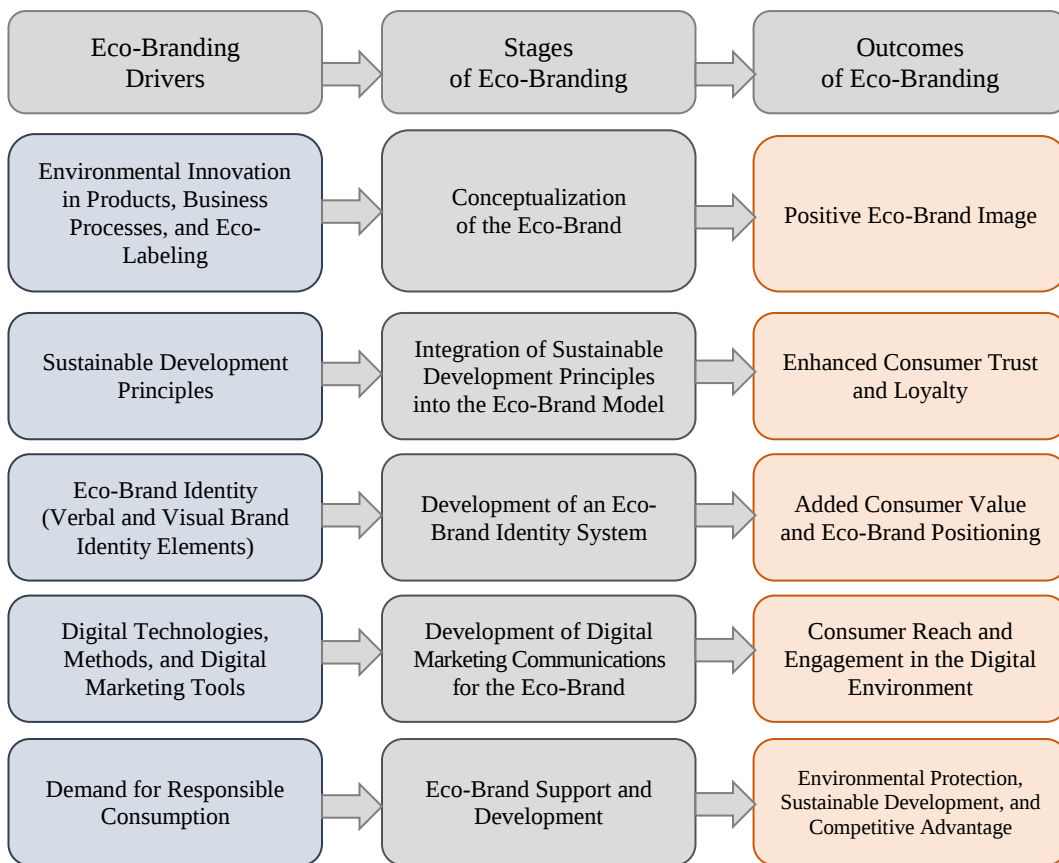
- *environmental orientation of business operations*, aimed at minimising environmental impacts through environmentally responsible products, technologies, and business processes;
- *a system of environmental values and brand identity*, including eco-brand positioning, a corresponding creative concept, and a coherent system of eco-brand identity elements;
- *environmentally oriented communication through eco-labelling*, transparent communication, and socially responsible promotion that informs stakeholders about the company's environmental initiatives;
- *the development of positive consumer perceptions* by creating an environmental brand image that fosters trust, evokes positive emotions, and influences consumer attitudes and behaviour;
- *consumer engagement in environmental practices* through the development of communities and encouragement of participation in environmental initiatives;
- *the creation of added consumer value and competitive advantages* derived from the environmental attributes of the brand.

The identification of these essential characteristics enabled the authors to formulate their interpretation of the concept under study. An eco-brand is a brand built upon a company's environmental and social responsibility and the environmental characteristics of its products and business processes. It integrates sustainable development principles into the brand's values, identity, and communications, thereby creating a positive environmental brand image and added consumer value.

The scientific novelty of the proposed definition lies in broadening the concept of an eco-brand by considering it not merely as a carrier of environmentally friendly product characteristics or a tool for green positioning, but as the outcome of integrating a company's environmentally and socially responsible activities with the environmental characteristics of its products and business processes. Unlike existing approaches, the proposed definition emphasises the integration of sustainable development principles into the brand's values, identity, and communications. It also highlights the role of an eco-brand in creating a positive environmental brand image and enhancing consumer value.

The application of the eco-brand concept by FMCG companies involves integrating environmental principles into product policy, production processes, packaging, and brand communications, thereby creating added consumer value and strengthening consumer trust. Taking these features into account not only helps reduce environmental impacts but also creates long-term competitive advantages for brands in the fast-moving consumer goods market. In this context, digital marketing tools play a pivotal role by enabling the effective promotion of the brand's environmental values in the digital environment and further strengthening the positive image of an eco-brand through the creation of added consumer value.

To better understand the essence of an eco-brand, it is necessary to examine the process of its creation, promotion, and development within the operations of FMCG companies in today's digital environment. In this context, an eco-brand is viewed as the outcome of purposeful managerial and marketing activities aimed at integrating environmental values into the brand system. Accordingly, further attention should be given to the concept of eco-branding as a process of creating, promoting, and developing brands based on the principles of environmental responsibility and sustainable development. A content analysis of the literature on eco-branding (Boyenko, 2019; Gavrylets et al., 2022; Bondarenko & Syazin, 2024; Davidenko et al., 2025; Hegde et al., 2025; Chygrin & Usova, 2025) made it possible to identify the key drivers, stages, and outcomes of eco-branding and to adapt them for application by FMCG companies in the digital environment (*Figure*).



Conceptual model of eco-branding in the digital environment

Source: developed by the authors.

The drivers of eco-branding influence the development of an eco-brand. The systematic implementation of the stages of eco-branding ensures its effective market positioning. The key outcomes of the proposed conceptual model reflect both consumer and environmental value. The effectiveness of the model is enhanced through the application of digital

technologies, methods, and digital marketing tools to support the promotion and development of the eco-brand in today's digital environment. Consideration of the essential characteristics of an eco-brand, together with the drivers, stages, and outcomes of eco-branding, contributes to enhancing the competitiveness of FMCG companies.

2. Validation of the eco-branding model in the digital environment

2.1. International experience in eco-branding: the case of unilever

To demonstrate the practical applicability of the proposed conceptual model of eco-branding in the digital environment (see *Figure*), the model was validated using the example of *Unilever*, one of the world's leading FMCG companies operating in the food, personal care, and home care markets. Over several decades, the company has systematically developed its brand as environmentally and socially responsible, guided by the principles of sustainable development and committed to ambitious goals to improve environmental sustainability and quality of life. *Unilever* introduced its Sustainable Living Plan in 2010 (Unilever, 2010). Since then, the company's approach to sustainable development has continuously evolved in response to emerging environmental, social, and economic challenges, requiring ongoing adaptation of its business model to the changing global environment. At the core of this strategy is the integration of sustainable development principles into every aspect of the company's operations, which serves as a key driver of its competitiveness.

As Rebecca Marmot, Chief Sustainability Officer at *Unilever*, stated: "We've made deliberate strategic choices about where to focus and have achieved encouraging early progress toward our goals. At the same time, we are increasing our focus on systemic sustainability challenges to drive changes that benefit both our business and society" (Darley, 2025).

To enhance business performance while expanding its positive impact on society and the environment, *Unilever* is implementing a comprehensive business transformation centred on four strategic priorities: addressing climate change, protecting natural ecosystems, reducing plastic pollution, and improving livelihoods. These priorities form the foundation of the company's environmental and social responsibility strategy and demonstrate its commitment to combining economic performance with long-term environmental and societal value.

The analysis of *Unilever*'s activities demonstrates a high level of corporate responsibility reflected in the systematic integration of the environmental, social, and economic dimensions of sustainable development into all business processes. The company effectively implements the full eco-branding cycle in accordance with the conceptual model presented in *Figure* (Table 2).

Table 2

Systematisation of unilever's practices according to the eco-branding Model in the digital environment

Elements of the Model	Implementation in unilever's activities
<i>Eco-branding drivers</i>	
Environmental Innovation in Products, Business Processes, and Eco-Labeling	<i>Unilever</i> systematically integrates environmental innovation into its product policy and business operations, including reducing the use of virgin plastic (by approximately 20–25% since 2019), transitioning to reusable, recyclable, or compostable packaging (targeting 100% by 2030–2035), increasing the share of recycled plastic (to approximately 20–25% across its global portfolio), developing alternative packaging formats (refill and reuse), implementing regenerative agricultural practices to improve soil health and reduce carbon emissions, and exploring alternatives to fossil-based raw materials in chemical products
Sustainable Development Principles	<i>Unilever</i> integrates sustainable development principles into its strategic management through its ESG approach and the <i>Sustainable Living Plan</i> . Key priorities include achieving net zero emissions, transitioning to sustainably sourced raw materials (approximately 75–80% of key agricultural commodities are already sustainably certified), combating plastic pollution, and ensuring living wages and livelihoods across its supply chains. The company's activities are aligned with the United Nations Sustainable Development Goals, particularly Goals 12, 13, and 15
Eco-Brand Identity	The company's eco-brand identity is shaped through the consistent communication of sustainable development values, including the publication of sustainability reports, the integration of environmental messages across its brand portfolio (e.g., <i>Dove</i> and <i>Hellmann's</i>), the use of eco-labelling, and a strong emphasis on social responsibility and transparency. A key element of <i>Unilever's</i> positioning is its identity as a purpose-driven business, where environmental and social commitments are embedded in the brand architecture
Digital Technologies	The company actively leverages digital technologies to enhance the transparency and effectiveness of its environmental initiatives, including digital supplier management platforms, the use of Big Data to monitor emissions and resource consumption, digital traceability tools for sustainably sourced raw materials, satellite data for monitoring agricultural practices, and interactive ESG reports and online dashboards
Demand for Responsible Consumption	The company actively responds to the global trend of rising consumer environmental awareness, particularly among Generation Z and Millennials, who are more willing to pay a premium for environmentally responsible products. In response, <i>Unilever</i> continues to expand its portfolio of sustainable brands, which consistently achieve higher growth rates than the company's other product categories
<i>Eco-branding stages</i>	
Conceptualisation of the Eco-Brand	The conceptual foundation of <i>Unilever's</i> eco-brand was established through the <i>Sustainable Living Plan</i> (2010), which defined the company's strategic commitment to combining business growth with reducing environmental impacts and enhancing the social value of its operations
Integration of Sustainable Development Principles into the Eco-Brand Model	Environmental and social objectives are integrated throughout the entire value chain, from raw material sourcing (eliminating deforestation and implementing supplier certification) to manufacturing (transitioning to renewable energy) and logistics (reducing transportation-related carbon emissions)
Development of an Eco-Brand Identity System	A global identity of a responsible brand is developed through a unified system of visual and semantic markers, including eco-packaging, labelling, communication style, and corporate reports. The brand is associated with innovation, transparency, and responsibility
Development of Digital Marketing Communications for the Eco-Brand	The company implements large-scale digital campaigns to promote sustainable consumption, making extensive use of social media, video content, interactive platforms, ESG communications, and storytelling. Particular emphasis is placed on educational content, including campaigns focused on reducing food waste and conserving water

Elements of the Model	Implementation in unilever's activities
Eco-Brand Support and Development	The company continuously updates its sustainability objectives in response to emerging global challenges, publishes regular non-financial (management) reports, participates in international initiatives, and develops partnerships with governments and businesses to maximise the impact of its sustainability efforts
<i>Eco-Branding Outcomes</i>	The implementation of eco-branding contributes to a high level of brand trust, strong global consumer loyalty, increased sales of sustainable brands, the development of a strong eco-brand image, and long-term competitive advantage. It also enhances the company's investment attractiveness and reputational capital

Source: systematised by the authors based on (Unilever, n.d.; Darley, 2025).

An important aspect of validating the proposed conceptual model of eco-branding in the digital environment is the analysis of digital marketing tools and digital marketing communications used to support the eco-brand. Unilever actively employs official digital platforms (corporate websites and sustainability dashboards), social media to promote environmental initiatives, data-driven marketing to personalise communications, and digital reporting supported by publicly available ESG data. The use of these tools enhances transparency, expands consumer reach, and strengthens engagement in the digital environment. Thus, Unilever's experience demonstrates that effective eco-branding requires the comprehensive integration of environmental initiatives and digital marketing tools throughout every stage of eco-brand development.

The scientific value of Unilever's experience lies in its practical implementation of the triple-bottom-line approach to sustainable development (economy, society, and the environment) (Unilever, 2010; Unilever, n. d.). The company demonstrates that integrating environmental performance, social equity, and economic performance creates a synergistic effect that strengthens the competitiveness of its eco-brand. A particularly innovative aspect of Unilever's approach is its commitment to developing a circular eco-brand economy, in which products, business processes, and brand communications are designed according to the principles of circular resource use, digital transparency, and collaborative ecosystems. This approach enables the company not only to minimise its environmental impact but also to transform sustainability into a source of innovation, reputational capital, and long-term consumer loyalty. Overall, Unilever's experience shows that the strategic integration of sustainable development principles into business practice can generate mutual reinforcement between environmental responsibility, social responsibility, and commercial performance, transforming the company into a globally recognised eco-brand that sets new standards for corporate culture and responsible consumption.

2.2. Digital marketing toolkit for FMCG companies

To further enhance the practical applicability of the proposed eco-branding model in the digital environment, digital marketing tools were systematized according to the stages of eco-branding using the digital consumer journey model consisting of Awareness, Consideration, Conversion, Loyalty, and Advocacy (Chukurna & Kofman, 2023; Iankovets, 2025; Tatarintseva, 2025) (*Table 3*). This approach establishes a clear relationship between the stages of eco-branding and the corresponding digital marketing tools, thereby ensuring effective brand interaction with target audiences. In addition, it supports the achievement of the intended outcomes of eco-branding for FMCG companies, particularly the transformation of environmental value into added consumer value.

At *Unilever*, the application of digital marketing tools follows a systematic approach consistent with the proposed model. During the *Awareness* stage, the company implements global digital marketing campaigns to promote sustainable lifestyles through advertising, video content, social media, and partnership initiatives. During the *Consideration* stage, it actively employs corporate sustainability platforms, educational content, and interactive transparency tools. At the *Conversion* stage, the company utilises targeted advertising, the promotion of products with environmental attributes, and e-commerce integration. During the *Loyalty* and *Advocacy* stages, social media, communication through the company's brand portfolio, and consumer engagement in environmental initiatives (campaign engagement) play a central role. Together, these digital marketing communications ensure a complete consumer engagement cycle and serve as a key driver of effective eco-branding.

The proposed eco-branding model in the digital environment was also validated using the example of the Ukrainian company Chumak PrJSC, founded in 1996. The company was originally engaged in vegetable cultivation and the production of food products based on agricultural raw materials. Following the outbreak of the full-scale war in Ukraine, the company's manufacturing facility located in the city of Kakhovka, Kherson region, came under occupation. As a result, Chumak transitioned to contract manufacturing through the production facilities of its partner companies.

Chumak positions itself as a producer of natural, healthy, and high-quality food products, as evidenced by the "100% Natural" label displayed on its product packaging. At the same time, the company does not publicly report adherence to sustainable development principles or the integration of environmental initiatives into its corporate strategy. The company's official website contains only limited references to environmental innovation. In particular, in 1999, Chumak introduced the environmentally friendly Ekolin packaging, which combines natural calcium carbonate with plastic. The company also launched Chumak sunflower oil, which rapidly strengthened its market position and enabled it to become the second-largest producer in Ukraine's bottled sunflower oil market.

Table 3

Systematisation of digital marketing tools for eco-brands of FMCG companies

Eco-branding stage	Consumer journey stage	Objective	Digital marketing tools	Communication content	Eco-branding outcome
Conceptualisation of the Eco-Brand	Awareness	Build Awareness of the Brand's Environmental Mission and Values	Advertising: Google Ads, YouTube video advertising, Facebook and Instagram Ads, media advertising, PR campaigns, influencer marketing, brand collaborations, and special projects	Communicating Sustainable Development Values and Shaping Initial Brand Perceptions	Building a Positive Eco-Brand Image
Integration of Sustainable Development Principles into the Eco-Brand Model	Consideration	Build Trust and Interest in the Eco-Brand	Blogs, podcasts, online video reviews, Meta (Facebook/Instagram) Ads and content, Google Ads, online forums (comments, discussions, and reviews), ESG pages on corporate websites, search engine marketing (SEM), and interactive sustainability reporting	Explaining environmental initiatives and ensuring transparency	Increased Consumer Trust and Loyalty
Development of an Eco-Brand Identity System	Conversion	Encourage Brand Choice	Targeted advertising, performance marketing, search engine marketing (SEM), affiliate marketing, customer onboarding, email marketing, marketplaces, and e-commerce integrations	Demonstrating the advantages of eco-products and communicating their value proposition	Added Consumer Value and Eco-Brand Positioning
Development of Digital Marketing Communications for the Eco-Brand	Loyalty	Build Customer Loyalty	CRM systems, remarketing, email marketing, personalised offers, social media marketing, positive customer reviews, and mobile applications	Strengthening emotional connections and building trust	Expanded Reach and Consumer Engagement in the Digital Environment
Eco-Brand Support and Development	Advocacy	Foster Brand Advocacy	User-generated content (UGC), online communities, value-added customer support, responsive customer service, and promotional gifting	Encouraging consumers to advocate for the brand	Environmental Protection, Sustainable Development, and Competitive Advantage

Source: developed by the authors.

A significant contribution to the development of Ukraine's agricultural sector was the introduction of a drip irrigation system. Irrigation pipes were imported from Sweden to irrigate 20 hectares of agricultural land, where the company had leased farmland. The results were remarkable: local farmers harvested approximately 80 tons of tomatoes per hectare, five times higher than the yields typically achieved with conventional cultivation methods prior to the introduction of drip irrigation (Chumak, n. d.).

These initiatives partially correspond to Sustainable Development Goal 9 (Industry, Innovation and Infrastructure). However, due to the loss of access to its production facilities and agricultural land in the occupied territory, the company is currently unable to continue using this environmentally friendly packaging.

Since the Chumak brand is associated by consumers with natural quality, developing it as an eco-brand would strengthen consumer loyalty, enhance the company's brand image and reputation, and ultimately contribute to increased sales, improved business performance, and greater competitiveness.

From the perspective of environmental sustainability and in line with the 17 United Nations Sustainable Development Goals (Global Compact Network Ukraine, n. d. a), the following strategic initiatives are recommended for Chumak PrJSC:

- Supporting the development of the agricultural sector in Ukraine and globally (SDG 2. Zero Hunger; SDG 9. Industry, Innovation and Infrastructure). Given the company's extensive experience in agriculture and its track record of implementing innovative solutions, Chumak should strengthen its innovation-driven approach to agricultural production by scaling sustainable practices and expanding partnerships with research institutions, technology companies, and agricultural producers while considering stakeholder interests to enhance food security.

- Increasing consumers' environmental awareness through systematic educational brand communications (blogs, news, and information campaigns) aimed at fostering a culture of responsible consumption and improving understanding of the environmental consequences of pollution while considering stakeholder interests (SDG 4. Quality Education; SDG 12. Responsible Consumption and Production; SDG 13. Climate Action).

- Promoting gender equality through consistent corporate policies and communications that reflect equal opportunities, equal pay, and the equitable distribution of responsibilities while considering stakeholder interests (SDG 5. Gender Equality).

- Reducing plastic use (SDG 14. Life Below Water; SDG 15. Life on Land). Chumak should transition to biodegradable, environmentally friendly packaging and implement recycling and reusable packaging practices, while considering stakeholder interests to support the protection of marine and terrestrial ecosystems.

- Strengthening environmental and social responsibility through the implementation of systematic environmental initiatives and charitable programs, including participation in environmental restoration projects,

support for volunteer environmental initiatives, funding for agroecological research, and the development of the company's own environmental philanthropy initiatives while considering stakeholder interests to restore damaged ecosystems and strengthen consumer trust (SDG 12. Responsible Consumption and Production; SDG 13. Climate Action; SDG 15. Life on Land; SDG 17. Partnerships for the Goals).

In addition, Chumak PrJSC is encouraged to introduce its own environmental philanthropy program, the "1% for Nature" initiative, under which a portion of the revenue generated from the sale of each product would be allocated to the restoration of ecosystems in southern Ukraine affected by the war and the destruction of the Kakhovka Hydroelectric Power Plant. This initiative combines environmental responsibility with social support for affected communities and is fully aligned with the United Nations Sustainable Development Goals.

Table 4 presents the potential applications of digital marketing tools to promote and develop the Chumak eco-brand.

Table 4

Digital marketing tools for the chumak eco-brand

Digital marketing tools	Application	Core message and role in promoting and developing the eco-brand
SMM (Instagram, Facebook, TikTok, YouTube)	Developing a systematic content strategy (eco-themed content series, farmers' stories, operational transparency, charitable initiatives, and sustainability reporting)	Visualises the eco-brand identity through the consistent communication of values related to natural quality, local sourcing, environmental and social responsibility, while fostering an emotional connection with consumers
PR and Content Marketing (Blog and Media)	Educational content focused on sustainable consumption, local production, and environmental initiatives	Builds the brand's image as a trusted advocate of environmental values and increases consumer trust through education and informative communication
Email Marketing	Personalised email campaigns featuring environmental initiatives, new products, and social projects	Supports long-term engagement with consumers and reinforces the brand's values through personalised communication
Influencer Marketing	Collaboration with environmental bloggers, sustainability and food influencers, and chefs	Strengthens trust in the brand through third-party validation and positions it as modern, environmentally conscious, and relevant
Video Marketing (YouTube, Reels, TikTok)	"From Farm to Table" videos, behind-the-scenes production content, and farmers' stories	Enhances transparency by showcasing the authentic product creation process, which serves as a key driver of trust in the eco-brand
SEO and Paid Search Advertising	Promotion for eco-related search queries	Reinforces the eco-brand's positioning in the digital information space as a producer of natural, high-quality products
Community Marketing	Building online communities and engaging with consumers	Builds a community around the eco-brand and fosters the transformation of consumers into loyal supporters and brand advocates
Interactive Digital Activations	Eco-challenges, gamification, and participation in social initiatives	Increases consumer engagement and fosters the behavioural dimension of the eco-brand
ESG Platforms and Corporate Website	Publishing sustainability reports and environmental performance indicators	Ensures transparency and strengthens the rational foundation of trust in the eco-brand

Source: developed by the authors.

Digital marketing tools play a pivotal role in validating the proposed eco-branding model in the digital environment by facilitating the development of the eco-brand identity. Rather than merely communicating environmental commitments, digital marketing communications translate sustainability principles into values, meanings, and brand associations that are meaningful and understandable to consumers. In this context, particular importance is attached to the fourth stage of the proposed digital eco-branding model – the development of digital marketing communications for the eco-brand – which represents the core mechanism for transforming the product's functional attributes (natural quality and product quality) into the brand's intangible assets, including trust, loyalty, and emotional attachment.

Given that the Chumak brand currently lacks a systematic environmental communication strategy, the proposed digital marketing tools should be regarded not only as promotional channels but also as mechanisms for developing an eco-brand identity grounded in the principles of sustainable development. Accordingly, integrating digital marketing tools into the company's activities would enable it to: (1) develop a coherent eco-brand identity; (2) align the brand with contemporary consumer trends; and (3) increase consumer trust and audience engagement.

Conclusions

The concept of sustainable development provides a strategic framework for integrating environmental, social, and economic priorities into the operations of FMCG enterprises.

International and Ukrainian experience in eco-branding demonstrates the effectiveness of integrating sustainable development principles with digital marketing tools to build, promote, and develop eco-brands while simultaneously creating added consumer value. Digital brand communications foster consumer trust and contribute to the development of long-term competitive advantages for FMCG enterprises in the digital environment.

The findings of this study confirm the proposed hypothesis that integrating sustainable development principles into the operations of FMCG enterprises, together with the application of digital marketing tools, facilitates the effective creation, promotion, and development of eco-brands. This made it possible to develop and substantiate a conceptual model of eco-branding for FMCG enterprises in the digital environment, along with a corresponding system of digital marketing tools that enhances consumer trust and strengthens business competitiveness.

Future research should focus on further developing theoretical and methodological approaches to evaluating the effectiveness of eco-branding for FMCG enterprises in the digital environment, particularly by designing a system of indicators that captures the impact of digital marketing communications on consumers' environmental behaviour. Another promising direction is the investigation of the role of innovative digital technologies, particularly Big Data and artificial intelligence (AI), in developing

personalised, environmentally oriented communications. Further attention should also be devoted to examining the risks of greenwashing and developing mechanisms to enhance the transparency of eco-brands in the digital environment.

REFERENCES / СПИСОК ВИКОРИСТАНИХ ДЖЕРЕЛ

- Afifa, K. S., Haider, S. W., Issa, A., Raza, A., & Altaf, F. (2025). Pathway to Green Consumerism: Decoding the Interplay of Affective and Cognitive Green Brand Factors. *Journal of Sustainable Marketing*, 6(1), 265–284. <https://doi.org/10.51300/JSM-2025-132>.
- Blázej, I. (2016). Model of ecologically oriented brand. *European journal of economics and management*, 2(4), 17–22. https://eujem.cz/wp-content/uploads/2016/eujem_2016_2_4/05.pdf
- Bondarenko, O., & Syazin, S. (2024). Greenwashing in eco-branding of FMCG enterprises. *Scientia Fructuosa*, 6(158), 31–50. [https://doi.org/10.31617/1.2024\(158\)03](https://doi.org/10.31617/1.2024(158)03)
- Boyenko, O., & Yu. (2019). Use of eco-branding by domestic producers. *Scientific works of DonNTU. Series: economic*, 2(21), 40–47. <https://r.donnu.edu.ua/bitstream/123456789/2827/1/Boyenko2.pdf>
- Chukurna, O., Kofman, V. (2023). Marketing tools for promoting ecological brands in the paradigm of sustainable development. *Economy and Society*, (48). <https://doi.org/10.32782/2524-0072/2023-48-45>
- Chumak. History. (n. d.). *Official website*. <https://chumak.com/history>
- Chygrin, O. Yu., & Usova, S. O. (2025). Green branding as a tool for increasing environmental responsibility and competitiveness of companies. *Bulletin of Economy*, (3), 9–23. <https://doi.org/10.35774/visnyk2025.03.009>
- Darley, J. (2025, March 26). Meet Rebecca Marmot, Unilever's Chief Sustainability Officer. *Sustainability MAGAZINE*. <https://sustainabilitymag.com/articles/meet-rebecca-marmot-unilevers-chief-sustainability-officer>
- Davidenko, L., Titkov, A., Sherimova, N., & Beisembina, A. (2025). Economic Aspects of Sustainable Development: Eco-Branding in Manufacturing Enterprises from Kazakhstan. *Sustainability*, 17(1), 36. <https://doi.org/10.3390/su17010036>
- Deynega, I. O., Pyrtko, S. A., & Pyrtko, M. S. (2025). The essence and tools of forming an ecological brand of enterprises. *Scientific notes of the National University "Ostroh Academy". Series "Economy": scientific journal*. Ostroh. NaUOA, 38(66), 39–46. [https://doi.org/10.25264/2311-5149-2025-38\(66\)-39-46](https://doi.org/10.25264/2311-5149-2025-38(66)-39-46)
- Gavrylets, O., Dochynets, N., & Campo, G. (2022). Green marketing – a promising concept of market positioning as a response to today's challenges. *Mechanism of an Economic Regulation*, 3–4(97–98), 118–123. <https://doi.org/10.32782/mer.2022.97-98.19>
- Блажей, І. (2016). Модель екологічно спрямованого бренду. *European journal of economics and management*, 2(4), 17–22. https://eujem.cz/wp-content/uploads/2016/eujem_2016_2_4/05.pdf
- Бондаренко, О., & Сязін, С. (2024). Грінвошинг в екобрендингу FMCG підприємств. *Scientia Fructuosa*, 6(158), 31–50. [https://doi.org/10.31617/1.2024\(158\)03](https://doi.org/10.31617/1.2024(158)03)
- Босенко, О. Ю. (2019). Використання еко-брендингу вітчизняними товаровиробниками. *Наукові праці ДонНТУ. Серія: економічна*, 2(21), 40–47. <https://r.donnu.edu.ua/bitstream/123456789/2827/1/Босенко2.pdf>
- Чукурна, О., & Кофман, В. (2023). Маркетингові інструменти просування екологічних брендів в парадигмі сталого розвитку. *Економіка та суспільство*, (48). <https://doi.org/10.32782/2524-0072/2023-48-45>
- Чумак. Історія. (б. д.). *Офіційний сайт*. <https://chumak.com/history>
- Чигрин, О. Ю., & Усова, С. О. (2025). Зелений брендинг як інструмент підвищення екологічної відповідальності та конкурентоспроможності компаній. *Вісник економіки*, (3), 9–23. <https://doi.org/10.35774/visnyk2025.03.009>
- Дейнега, І. О., Пиртко, С. А., & Пиртко, М. С. (2025). Суть та інструменти формування екологічного бренду підприємств. *Наукові записки Національного університету "Острозька академія". Серія "Економіка": науковий журнал*. Острог. НаУОА, 38(66), 39–46. [https://doi.org/10.25264/2311-5149-2025-38\(66\)-39-46](https://doi.org/10.25264/2311-5149-2025-38(66)-39-46)
- Гаврилець, О., Дочинець, Н., & Кампо, Г. (2022). Зелений маркетинг – перспективна концепція ринкового позиціонування як реакція на виклики сьогодення. *Mechanism of an Economic Regulation*, 3–4(97–98), 118–123. <https://doi.org/10.32782/mer.2022.97-98.19>

Global Compact Network Ukraine. (n. d. a). <i>17 Sustainable Development Goals</i> . https://globalcompact.org.ua/tsili-stijkogo-rozvytku/	
Global Compact Network Ukraine. (n. d. b). <i>Ten Principles of the UN Global Compact</i> . https://globalcompact.org.ua/desjat-principiv-gd-oon/	
Hegde, S., Gupta, R. K., Rath, A., Kulkarni, N., & Khadse, A. (2025). Eco-Branding: Consumer Response to Sustainability Claims in Marketing. <i>Advances in Consumer Research</i> , 2(3), 1111–1119. https://acr-journal.com/search?q=Eco-Branding%20Consumer%20Response%20to%20Sustainability%20Claims%20in%20Marketing	
Iankovets, T. M. (2025). <i>Digital Marketing and Impression Design</i> . Monograph. Kyiv: DTEU, 392 p.	Янковець, Т. М. (2025). <i>Цифровий маркетинг та дизайн вражень</i> . Монографія. Київ: ДТЕУ, 392 с.
Lopes, P. R., Rosário, A.T., & Rosário, F. S. (2024). Sustainable Brand Advertising – The Green Advertising for Generation Z, a Qualitative LRSB Analyze. <i>Platforms</i> , 2(2), 84–100. https://doi.org/10.3390/platforms2020006	
Loučanová, E., Šupín, M., Čorejová, T., Repková-Štofková, K., Šupínová, M., Štofková, Z., & Olšáková, M. (2021). Sustainability and Branding: An Integrated Perspective of Eco-innovation and Brand. <i>Sustainability</i> , 13(2), 732. https://doi.org/10.3390/su13020732	
Tatarintseva, Y. (2025). Marketing and communication policy of startups: budget marketing tools for digital promotion in the experience economy. <i>Collection of scientific papers "Scientific notes"</i> , 41(4), 366–375. http://doi.org/10.33111/vz_kneu.41.25.04.25.175.181	Татаринцева, Ю. (2025). Маркетингова та комунікаційна політика стартапів: бюджетні маркетингові інструменти цифрового просування в економіці вражень. <i>Збірник наукових праць "Наукові нотатки"</i> , 41(4), 366–375. http://doi.org/10.33111/vz_kneu.41.25.04.25.175.181
Unilever. (2010, November). <i>Unilever sustainable living plan Small Actions. Big Difference</i> . https://www.unilever.com/files/origin/9752ff2d82b8afabb507eb92c47b5dad795801d5.pdf/unilever-sustainable-living-plan.pdf	
Unilever. (n. d.). <i>A new era of corporate sustainability: building resilience through action</i> . https://www.unilever.com/sustainability/	
Zaitseva L. O. (2019). Components of the concept of sustainable development. <i>Effective economy</i> , (11). https://doi.org/10.32702/2307-2105-2019.11.55	Зайцева, Л. О. (2019). Складові концепції сталого розвитку. <i>Ефективна економіка</i> , (11). https://doi.org/10.32702/2307-2105-2019.11.55
Zinchenko, O. A., Meshko, N. P., & Mishustina, T. S. (2023). "Green" branding in the context of the image of a socially responsible company. <i>International scientific journal "Internauka". Series: "Economic Sciences"</i> , (11). https://doi.org/10.25313/2520-2294-2023-11-9434	Зінченко, О. А., Мешко, Н. П., & Мішустіна, Т. С. (2023). "Зелений" брендинг в контексті іміджу соціально-відповідальної компанії. <i>Міжнародний науковий журнал "Інтернаука". Серія: "Економічні науки"</i> , (11). https://doi.org/10.25313/2520-2294-2023-11-9434

Conflict of interest. The authors certify that they don't have financial or non-financial interest in the subject matter or materials discussed in this manuscript; the authors have no association with state bodies, any organisations, or commercial entities having a financial interest in or financial conflict with the subject matter or research presented in the manuscript. Given that the authors are affiliated with the institution that publishes this journal, which may cause potential conflict or suspicion of bias and therefore the final decision to publish this article (including the reviewers and editors) is made by the members of the Editorial Board who are not the employees of this institution.

The authors received no direct funding for this study.

Iankovets, T., Kostenko, A., & Vyshnevskaya, M. (2026). Digital eco-branding of FMCG companies. *Scientia fructuosa*, 4(168), 83–102. [https://doi.org/10.31617/1.2026\(168\)06](https://doi.org/10.31617/1.2026(168)06)

Received by the editorial office 30.03.2026.

The article has been revised 25.05.2026.

Accepted for printing 01.06.2026.

Published online 07.09.2026.

ROZHDESTVENSKYY Vladyslav

 <http://orcid.org/0009-0006-1924-4875>Postgraduate Student
at of the Department of Marketing
State University of Trade and Economics
19, Kyoto St., Kyiv, 02156, Ukrainev.rozhdestvenskyy@knute.edu.ua

GAMIFICATION IN DIGITAL BRANDING

The article examines the impact of gamification on the formation of digital consumer loyalty within digital branding. It demonstrates that gamification is no longer merely a tactical tool for attracting attention but is becoming a strategic mechanism for managing users' behavioural activity and emotional interaction with a brand. In conditions of intense competition, digital saturation, and information overload, gamified interactions contribute to increased engagement, stimulation of repeated actions, and the development of long-term relationships between consumers and a brand's digital platform. The study hypothesises that the systematic use of gamification mechanics in digital branding increases consumers' behavioural loyalty by enhancing emotional engagement, interactivity, and the depth of interaction with the brand. The methodology combines a content analysis of mobile applications and digital platforms of six brands across three industries with a quantitative analysis of download metrics, review structures, average ratings, category rankings, and website traffic. To assess the impact, a system of proxy indicators is proposed: Download Index (DI), Positive Review Rate (PRR), Web Interaction Index (WII), and the integrated electronic Net Promoter Score (eNPS). The results reveal a positive relationship between the level of gamification implementation and integrated digital loyalty metrics, allowing gamification to be formalised as a structural element of digital brand strategy and substantiating the feasibility of its systematic implementation in marketing communications practice.

Keywords: gamification, consumer loyalty, digital branding, behavioural loyalty, mobile applications, digital metrics, digital loyalty.

JEL Classification: M30, M31, M37, O33.

РОЖДЕСТВЕНСЬКИЙ Владислав

 <http://orcid.org/0009-0006-1924-4875>аспірант кафедри маркетингу
Державного торговельно-економічного
університету
вул. Кіото, 19, м. Київ, 02156, Українаv.rozhdestvenskyy@knute.edu.ua

ГЕЙМІФІКАЦІЯ У ЦИФРОВОМУ БРЕНДІНГУ

Розглянуто вплив гейміфікації на формування цифрової лояльності споживачів у межах цифрового брендингу. Обґрунтовано, що гейміфікація перестає бути суто тактичним інструментом залучення уваги та трансформується у стратегічний механізм управління поведінковою активністю й емоційною взаємодією користувачів із брендом. В умовах високої конкуренції, цифрової насиченості та інформаційного перевантаження гейміфікація сприяє залученості, стимулюванню повторних дій і формуванню довготривалих взаємин між споживачем і цифровою платформою бренду. Висунуто гіпотезу, що системне застосування гейміфікаційних механік у цифровому брендингу підвищує поведінкову лояльність споживачів через посилення емоційної залученості, інтерактивності та глибини взаємодії з брендом. Методологія поєднує контент-аналіз мобільних застосунків та цифрових платформ шести брендів трьох індустрій з кількісним аналізом показників завантажень, структури відгуків, середніх оцінок, рейтингових позицій та вебтрафіку. Для оцінювання впливу запропоновано систему проксі-індикаторів: Download Index (DI), Positive Review Rate (PRR), Web Interaction Index (WII) та інтегральний показник electronic Net Promoter Score (eNPS). Результати дослідження засвідчили наявність позитивного взаємозв'язку між рівнем застосування гейміфікаційних механік та інтегральними показниками цифрової лояльності, що дозволяє формалізувати гейміфікацію як структурний елемент цифрової бренд-стратегії та обґрунтувати доцільність її системного впровадження у практиці маркетингових комунікацій.

Ключові слова: гейміфікація, споживча лояльність, цифровий брендинг, поведінкова лояльність, мобільні додатки, диджитал-метрики, цифрова лояльність.



Copyright © 2026. The Author(s). This is an open access article distributed under the terms of the [Creative Commons Attribution License 4.0. International License \(CC-BY\)](https://creativecommons.org/licenses/by/4.0/).

Introduction

In the current context of digital transformation, consumer loyalty is no longer an automatic consequence of satisfaction with a product or service. Intense competition, customer awareness, and the availability of alternatives require brands to adopt new approaches to building long-term relationships with their target audiences. One of the most dynamic tools demonstrating high effectiveness in the digital environment is gamification – the application of game mechanics in non-game contexts in order to increase engagement and stimulate repeated behaviour (Saleem et al., 2022).

Despite growing interest in gamification across educational, economic, and social spheres (Novák, 2025; Staling & Juanjo, 2020), the scholarly understanding of its role in the strategic management of loyalty in digital branding remains fragmented. Recent studies indicate that gamification is increasingly viewed as a marketing tool capable of strengthening consumer engagement, emotional experience, and repeated interaction with a brand. In particular, the study by Santos et al. (2024) demonstrates the intensive growth of scholarly interest in gamification in marketing while also revealing a lack of consistent approaches to explaining its impact on consumers' behavioural outcomes. Jacobides et al. (2024) regard gamification as a tool for achieving strategic business goals, primarily customer retention and the acquisition of new users. At the same time, Ukrainian scholars focus on related mechanisms of digital loyalty: personalisation as a loyalty strategy in e-commerce (Konoplyannykova, 2024) and digital brand marketing in social media as a prerequisite for building a loyal audience (Iankovets, 2024). Thus, the existing research provides an important theoretical foundation; however, the systemic impact of gamification mechanics on behavioural loyalty in digital branding requires further clarification. In these studies, gamification is considered as an element of UX or as a short-term marketing technique, whereas its potential as a tool for building stable behavioural brand loyalty remains insufficiently theorised and empirically studied.

Given the integrative nature of digital branding, which encompasses social networks, mobile applications, CRM platforms, and other channels, there is a need to study gamification specifically within a systemic approach to loyalty management. In particular, the effectiveness of the applied gamification mechanics and their impact on the formation of consumer loyalty in the digital space are pressing issues.

The aim of the study is to substantiate the role of gamification as a strategic tool of digital branding aimed at increasing consumers' behavioural loyalty, as well as to identify effective mechanics for its implementation in a multichannel environment.

To achieve this aim, the following objectives were set:

- to analyse conceptual approaches to gamification in marketing and branding;
- to systematise the game mechanics used in the digital environment to engage consumers;

- to examine the relationship between gamification and key digital loyalty metrics;
- to substantiate the practical advantage of applying gamification mechanics in digital branding.

The main hypothesis is that the systematic use of gamification mechanics in digital branding increases consumers' behavioural loyalty by enhancing emotional engagement, interactivity, and the depth of interaction with the brand.

To test the hypothesis, a mixed approach was applied: the qualitative analysis covers a content analysis of brand cases and an analysis of the UX interfaces of mobile applications. The quantitative component includes a comparison of loyalty metrics using open data, industry reports, and empirical findings from previous studies.

The main part of the article is structured into three sections. The first summarises theoretical approaches to the interpretation of gamification in digital branding and systematises the key game mechanics that influence consumer loyalty. The second section proposes the analytical framework of the study and substantiates the methodology for comparing brands based on the level of integration of gamification elements and on digital metrics. The third presents the results of the empirical analysis, the calculation of proxy indicators of digital loyalty, and the interpretation of the obtained results.

1. Theoretical foundations of gamification in digital branding

A review of publications from 2024–2025 demonstrates the deep integration of behavioural economics into branding. Dos Santos et al. (2025) emphasise that gamification strengthens emotional and cognitive engagement. Maranchak M. and Maranchak N. (2023) focus on gamification as a driving force of consumer-generated content creation, which is one of the indicators of digital loyalty. However, as noted by Zafar et al. (2024), the literature lacks a unified model that would link psychological drivers to financial metrics and behavioural factors.

In the context of branding, gamification acts as a catalyst that links the emotional perception of a brand to practical interaction. The modern consumer expects an interactive experience that simultaneously entertains, stimulates, and informs. Gamification provides this level of interaction by combining the "reward for action" logic with elements of social communication. Empirical models demonstrate that consumer experience and brand engagement often act as mediators between gamification elements and loyalty (Singh & Milan, 2024).

The transformation of gamification from a tactical technique into a strategic tool is driven by a number of key factors:

- the growth of competition in the online environment;
- the saturation of the digital consumer experience;
- the development of analytics and personalisation, which make it possible to tailor gamified elements to a specific user.

Consumers expect personalised and digitally oriented loyalty programs, while for younger generations, a high-quality digital experience becomes a critical condition of a program's value, as stated by 75% of Generation Z representatives and millennials (Deloitte, 2024).

In the context of digital branding, gamification is increasingly viewed not as an engagement tool for entertainment but as a mechanism for strategic loyalty management that enables building stable, mutually beneficial relationships between a brand and a consumer. The modern concept of loyalty goes beyond repeated purchases or favourable reviews and includes emotional attachment, community participation, and a willingness to promote the brand organically. Empirical studies indicate that gamification elements (achievements, social interaction, leaderboards) can strengthen consumer engagement. PLS-SEM analysis (Rukshar et al., 2025) revealed a significant positive relationship between gamification and brand loyalty ($\beta=0.792$).

Thus, gamification in marketing today is regarded as part of a comprehensive customer experience management (CEM) system, rather than an isolated element of UX design. Research highlights its role as a mechanism for shaping the gamification-enabled customer experience, with a subsequent impact on continuance intentions through other engagement factors (Liu et al., 2024).

Classic loyalty programs based solely on point accumulation and discounts are losing their differentiating power in the digital era: the Deloitte report emphasises that rewards remain important but are insufficient to retain attention and build lasting program value, especially against the backdrop of growing expectations regarding personalisation and digital experience (Deloitte, 2024).

The main drivers of gamification for the consumer in digital branding are scarcity and limitation, loss aversion, the desire for self-expression and social recognition, motivation and engagement, and competition (Tan et al., 2023; Hsu, 2022). These drivers make it possible to implement the following mechanics:

- point systems;
- fortune wheels and random rewards;
- progress bars and task completion indicators;
- personalised quests and missions;
- leaderboards;
- quizzes and challenges;
- recurring continuous streaks;
- virtual goods, skins, and avatars;
- interactive onboarding;
- level systems and progression.

To illustrate the use of each of the described mechanics and their impact on the consumer, a tabular systematisation with descriptions of the impact based on real brands is appropriate (*Table 1*).

Table 1

Examples and impact of the use of gamification mechanics in digital branding

Mechanic	Brand	Implementation	Impact
Point systems	Starbucks	Awarding "stars" for each purchase, which can be exchanged for free drinks or food through the loyalty program	Program users made 300% more purchases compared with other customers. In 2023, 30% of the chain's purchases were made via mobile devices
Fortune wheels and random rewards	Sephora SEA	Introduction of the game elements DAILY ANGPAO and Spin to win in the mobile application	A 132% increase in the volume of purchases by participants of the gamification mechanic over a 30-day observation period
Progress bars and task completion indicators	ScanVault	A progress bar for completing an online order aimed at confirming the correctness of the consumer's actions	An increase in the conversion rate by 46%
Personalised quests and missions	Starbucks	Individual challenges in the app, for example: "buy a latte three times a week to receive 50 bonus stars"	An increase in the number of daily active users (DAU) and customer retention by 25% and 10%, respectively
Leaderboards	Nike Run Club	Global and local runner rankings where users compete by distance or pace	69% of surveyed consumers responded positively to the presence of leaderboards, which significantly contributes to brand perception
Quizzes and challenges	Nike Run Club	Time-limited competitions that activate FOMO triggers	400,000 new app downloads at the beginning of 2026
Recurring continuous streaks	Duolingo	A visual counter of consecutive learning days ("Daily Streak") with push notifications about the risk of losing progress	An increase in DAU by 36% over the first 9 months of 2025, exceeding 50 million users
Virtual goods, skins, and avatars	Fortnite	Purchase of digital copies of clothing and accessories with in-game currency and avatar customisation in the virtual space	58% of the company's 2025 revenue comes from purchases of in-game currency and player personalisation elements
Interactive onboarding	Hubspot	Replacement of static instructions with a game-like interface tour featuring instant micro-rewards for the first steps	A reduction in the churn rate of new users at the initial stage and an increase in satisfaction with the product
Level systems and progression	Flipkart	Users' transition between status levels depending on accumulated SuperCoins	49% of Plus-level participants confirmed that they began making purchases more frequently thanks to gamified progression. A strong positive relationship was established between satisfaction with the SuperCoins program and overall loyalty to the brand ecosystem (correlation coefficient = 0.603)

Source: systematised by the author based on (Maijala, 2025; Braze, 2025; Azarian, 2023; Ovaisi, 2025; Rodrigues et al., 2021; Koninck, 2026; Duolingo, 2025; Younus & Mahmood, 2026; Meshram et al., 2025).

Thus, the analysed studies and brand cases confirm a statistically significant relationship between gamification mechanics and indicators of engagement, brand attitude, and consumer purchasing behaviour. At the same time, the scholarly literature lacks an analysis of recent examples, which makes it impossible to trace a direct link between individual mechanics and brands' open behavioural metrics. This necessitates an empirical verification of the impact of gamification through quantitative digital indicators.

2. Analytical framework for measuring the impact of gamification

To trace the impact of gamification mechanics in practical examples, it is proposed to conduct a study of brand cases, followed by a comparison of the criteria for companies' marketing performance. Accordingly, it is appropriate to select both well-known companies that widely apply the previously described mechanics and their competitors in similar markets with a low or limited level of gamification.

In general, the methodology for selecting brands for comparison is based on belonging to the same industry, a similar business model, the presence of a mobile application as the main channel of communication with the consumer, data availability, and differentiation in the use of gamification mechanics.

Based on these criteria, a sample of six brands was formed:

- Temu – e-commerce industry, extensively gamified;
- eBay – e-commerce industry, non-gamified;
- Duolingo – EdTech industry (online learning), extensively gamified;
- Rosetta Stone – EdTech industry, non-gamified;
- Monobank – online banking, extensively gamified;
- Oschadbank – online banking, non-gamified.

To illustrate the extent of a brand's use of gamification mechanics, an analysis of applications and websites was conducted, and a table was compiled that demonstrates the use of each described mechanic (*Table 2*). The logic of the description is to fill the corresponding cells with values in the range of 0–1, where 0 indicates the absence of the described mechanic and 1 indicates its presence.

Table 2

Audit of the application of gamification mechanics by brands

Mechanics	Temu	eBay	Duolingo	Rosetta Stone	Monobank	Oschadbank
Point systems	1	0	1	1	1	0
Fortune wheels and random rewards	1	0	1	0	0	0
Progress bars and task completion indicators	1	0	1	1	1	0
Personalised quests and missions	1	0	1	0	1	0
Leaderboards	0	0	1	0	0	0
Quizzes and challenges	1	0	1	0	1	0
Recurring continuous streaks	0	0	1	0	0	0
Virtual goods, skins, and avatars	0	0	1	0	1	0
Interactive onboarding	1	0	1	0	1	0
Level systems and progression	1	0	1	1	1	0

Source: compiled by the author based on (Temu (App Store, Version 4.30.0), n. d.; Temu: Shop like a billionaire, Version 4.29.1, n. d.; eBay – buy and save, n. d.; eBay (Version 6.245.1), n. d.; Duolingo – languages and chess, n. d.; Duolingo: foreign language lessons (Version 7.110.0), n. d.; Rosetta Stone: Learn Languages (Version 8.35.0), n. d.; Rosetta Stone: Learn Languages (Version 8.43.5), n. d.; monobank - digital mobile bank (Version 7.18), n. d.; monobank – bank in smartphone (Version 7.18.0), n. d.; Oschad (Version 1.1.2571), n. d.; Oschad (Version 1.0.2571), n. d.).

The results of the brand application audit indicate a substantial differentiation in the level of gamification use in communication with consumers, which creates a practical basis for formulating additional hypotheses:

H1. Brands with deeper integration of gamification mechanics demonstrate higher user engagement indicators in mobile applications within their industry.

H2. Gamified brands are characterised by a larger number of positive reviews.

H3. The level of a brand's gamification is related to integrated indicators of digital loyalty.

To test the formulated hypotheses, open digital data on the studied brands were collected and systematised. In particular, mobile application indicators (number of downloads, number of reviews, average rating, position in the category ranking) and web analytics (monthly visit volume and average session duration) were analysed. The obtained data serve as an empirical basis for calculating integrated indicators of the impact of game mechanics on consumers' digital loyalty.

Table 3

Analysis of brands' digital activity metrics

Indicator	Temu	eBay	Duolingo	Rosetta Stone	Monobank	Oschadbank
App downloads, AppStore	10 M	1 M	5 M	80 K	60 K	30 K
App downloads, PlayMarket	24 M	1 M	14 M	60 K	100 K	100 K
Number of reviews, AppStore	2 M	5 M	4.94 M	235 K	895 K	24.49 K
Number of reviews, PlayMarket	11 M	4.99 M	43 M	404 K	1.11 M	160.79 K
Average rating on AppStore	4.6/5	4.8/5	4.7/5	4.8/5	4.9/5	4.4/5
Reviews rated 4 and above, AppStore	1.89 M	4.78 M	4.66 M	225 K	871.94 K	21.05 K
Average rating on PlayMarket	4.5/5	4.6/5	4.7/5	4.6/5	4.9/5	4.5/5
Reviews rated 4 and above, PlayMarket	9.49 M	4.57 M	40 M	371 K	1.08 M	143.4 K
Category ranking on AppStore	1	11	1	39	1	7
Category ranking on PlayMarket	1	9	1	30	1	3
Monthly website visits	1.53 B	666 M	56.37 M	2.21 M	6.51 M	3.96 M

Source: compiled by the author based on data as of February 2026 (Sensor tower, n. d.; SimilarWeb PRO, n. d.).

The data in Table 3 indicate noticeable differences in digital indicators between brands with different levels of integration of gamification mechanics. Gamified brands generally demonstrate higher indicators of downloads, numbers of reviews, and positions in category rankings, which may point to a higher level of digital engagement and user activity. At the same time, differences in web traffic and session duration require additional

interpretation in the context of industry specifics. To systematically generalise the results obtained, the next section calculates integrated indicators and analyses their relationship with the brands' level of gamification.

3. Implementation of the analysis results in practice

For the quantitative testing of the formulated research hypotheses, a system of proxy indicators is proposed to transform open digital metrics into measurable indicators of digital loyalty. Given the limited access to internal marketing performance indicators (NPS, CLV, retention rate), four aggregated indicators were introduced:

- DI (Download Index) – download index;
- PRR (Positive Review Rate) – index of positive user experience;
- Web Interaction Index (WII) – an indicator of the depth and intensity of digital interaction;
- eNPS (electronic Net Promoter Score) – an integrated indicator of digital loyalty.

These models enable assessment of the impact of gamification level on a brand's behavioural and perceptual digital indicators.

The download index reflects the relative level of installations for a brand's mobile application within its industry. The calculation of this index involves:

1. Calculation of the total number of downloads:

$$TotalDownloads_i = Downloads_{AppStore} + Downloads_{PlayMarket}$$

2. Normalisation of the indicator within the industry:

$$DI_i = \frac{TotalDownloads_i}{\max(TotalDownloads_{industry})}$$

This approach eliminates scale differences across industries and enables accurate comparisons between gamified and non-gamified brands.

PRR reflects the share of positive ratings among all reviews and serves as a proxy for user satisfaction and emotional experience. Reviews reflecting 80 per cent or more of consumer satisfaction, i.e., a rating of 4 points and above, are considered positive.

The indicator is calculated using the following algorithm:

1. Total number of positive reviews:

$$PositiveReviews_i = Reviews_{4*} + Reviews_{5*}$$

2. PRR index:

$$PRR_i = \frac{PositiveReviews_i}{TotalReviews_i}$$

The calculation of *WII* is performed using the following formula:

$$WII_i = \frac{WebVisits_i}{\max(WebVisits_{industry})}$$

To calculate the *WII* indices, an additional systematization of website visit indicators by industry is required (*Table 4*).

Table 4

Analysis of website metrics of the category leaders of the selected brands

Categories of analysis	Temu	eBay	Duolingo	Rosetta Stone	Monobank	Oschadbank
Industry	Marketplace		Education		Finance	
Industry-leading brand	Amazon		Instructure		Minfin	
Number of website visits of the industry-leading brand	2.719 B		383 M		8.5 M	

Source: compiled by the author based on data as of February 2026 (SimilarWeb PRO, n. d.).

The final indicator of the impact of gamification on digital loyalty is *eNPS*, which enables direct tracking of the influence of all the listed indicators. The calculation formula is based on the sum of weighted average indicators:

$$eNPS = \alpha DI_i + \beta PRR_i + \gamma WII_i$$

$$\alpha = \beta = \gamma = 0.33$$

In *Table 5*, the results of the metric calculations for each of the analysed brands are presented.

Table 5

Proxy indicators of the impact of gamification on digital loyalty

Indicator	Temu	eBay	Duolingo	Rosetta Stone	Monobank	Oschadbank
DI	1	0.0588	1	0.0074	1	0.8125
PRR	0.8754	0.9359	0.9316	0.9327	0.9735	0.8876
WII	0.5627	0.2449	0.1472	0.0058	0.7659	0.4659
eNPS	0.8046	0.4091	0.6860	0.3121	0.9040	0.7148

Source: compiled by the author.

The results of the analysis demonstrate higher *eNPS* values for brands that actively use gamification mechanics to communicate with consumers via mobile applications and websites or online platforms.

Conclusions

The study substantiates the theoretical and applied understanding of the role of gamification as a strategic tool of digital branding. The aim of the study has been achieved, namely, the role of gamification as a strategic tool of digital branding aimed at increasing consumers' behavioural loyalty has been argued, and effective mechanics for its implementation in a multichannel environment have been identified. It has been established that

gamification in the modern digital environment is shifting from a tactical engagement element to a systemic mechanism for managing consumer behavioural loyalty.

Within the first objective, conceptual approaches to gamification in marketing and branding were analysed. It was substantiated that game mechanics in the digital environment influence not only short-term engagement but also deeper behavioural and emotional characteristics of the consumer's interaction with a brand. A synthesis of recent empirical studies confirmed a statistically significant relationship between gamification mechanics and indicators of emotional engagement, brand trust, and repeat interaction intentions.

Within the second objective, the game mechanics used in the digital environment to engage consumers were systematised. It was established that point systems, progression levels, personalized quests, challenges, leaderboards, streak mechanics, random rewards, interactive onboarding, and other mechanics affect the consumer's key psychological drivers – the need for recognition, achievement, social interaction, self-expression, and loss aversion. It is this systemic effect that creates the preconditions for sustainable digital loyalty.

The completion of the third objective enabled an examination of the relationship between gamification and key digital loyalty metrics. In the practical part of the study, an analytical framework was proposed to assess the impact of gamification on digital loyalty by comparing brands with varying levels of game-mechanics integration across three industries: marketplaces, online education, and online banking. The application audit demonstrated clear differences in the level of gamification use, providing an empirical basis for formulating and testing hypotheses.

The practical advantage of applying gamification mechanics in digital branding was substantiated within the fourth objective. The quantitative analysis of open digital metrics (app downloads, the number and structure of reviews, average ratings, category positions, and web traffic) showed that gamified brands, in most cases, exhibit higher levels of digital activity and user interaction. For an integrated assessment of the impact, a system of proxy indicators was introduced: Download Index (DI), Positive Review Rate (PRR), Web Interaction Index (WII) and the aggregated indicator electronic Net Promoter Score (eNPS).

The obtained results indicate a positive relationship between a brand's level of gamification and integrated indicators of digital loyalty. Brands with a higher level of integration of game mechanics demonstrated more significant DI and eNPS values, which provides grounds for confirming the main hypothesis of the study: the systematic use of gamification mechanics in digital branding increases consumers' behavioural loyalty by enhancing emotional engagement, interactivity, and the depth of interaction with the brand.

The additional research hypotheses received varying degrees of confirmation. Hypothesis H1, which states that brands with greater integration of gamification mechanics demonstrate higher mobile application download indicators within their industry, is partially confirmed: this trend is observed across all three studied industries, although the magnitude of the differences varies. Hypothesis H2, stating that gamified brands are characterised by a larger number of positive reviews, was partially reflected in the results: gamified brands demonstrate higher user activity and significant volumes of positive feedback, but do not in all cases have an unconditional advantage in the share of positive ratings. Hypothesis H3, concerning the relationship between a brand's level of gamification and integrated indicators of digital loyalty, received full substantiation, as a higher level of use of gamification mechanics is associated with improved eNPS values and other integrated indicators of digital interaction.

Thus, gamification can be formalised as a structural element of digital brand strategy that affects not only short-term engagement but also consumers' long-term attachment, activity, and willingness to interact repeatedly with a brand. The practical significance of the study lies in the possibility of using the proposed system of indicators to assess the effectiveness of gamification mechanics in digital products across various industries. The proposed approach can be applied both in corporate analytics and in academic research on digital loyalty.

Prospects for further research are related to expanding the sample of brands, conducting an in-depth correlation analysis using Pearson coefficients or regression models, and studying the impact of individual gamification mechanics on specific consumer behavioural indicators in long-term dynamics.

REFERENCES / СПИСОК ВИКОРИСТАНИХ ДЖЕРЕЛ

Azarian, H. (2023, February 7th). *39 CRO case studies to boost conversion rates*. Azarian Growth Agency. <https://azariangrowthagency.com/39-conversion-optimization-case-studies-you-can-learn-and-get-inspired-by/>

Braze Customer Engagement Platform. (2025). *Sephora SEA case study*. <https://www.braze.com/customers/sephora-sea-case-study>

Deloitte. (2024). *2024 consumer loyalty survey* (1). <https://www.deloitte.com/global/en/Industries/consumer/perspectives/consumer-loyalty-survey.html>

Dos Santos, L. F., Oliveira, W., Corrêa de Lima, A., de Castro Junior, A. A., & Hamari, J. (2025). The effects of gamification on learners' engagement according to their gamification user types. *Technology, Knowledge and Learning*. <https://doi.org/10.1007/s10758-025-09866-2>

Duolingo – foreign language lessons (Version 7.110.0). (n. d.). [Mobile application] Duolingo, Inc. <https://apps.apple.com/en/app/duolingo>

Duolingo. (2025). *Shareholder letter Q3 2025* (1). <https://investors.duolingo.com/static-files/c9bf5861-b19d-4396-b060-c0dbeefd34f5>

Duolingo: Languages and Chess. (n. d.). [Mobile application]. Duolingo. <https://play.google.com/store/apps/details?id=com.duolingo&hl=uk>

Duolingo: мови та шахи. (б. д.). [Мобільний застосунок]. Duolingo. <https://play.google.com/store/apps/details?id=com.duolingo&hl=uk>

EBay – buy and save (eBay Mobile). (n. d.). [Mobile application]. <https://play.google.com/store/apps/details?id=com.ebay.mobile>

EBay – купити та заощадити (eBay Mobile). (б. д.). [Мобільний застосунок]. <https://play.google.com/store/apps/details?id=com.ebay.mobile>

eBay (Version 6.245.1). (n. d.). [Mobile application]. eBay Inc. https://apps.apple.com/ua/app/ebay/id282614216	
Hsu, C.-L. (2022). Applying cognitive evaluation theory to analyze the impact of gamification mechanics on user engagement in resource recycling. <i>Information & Management</i> , 59(2), 103602. https://doi.org/10.1016/j.im.2022.103602	
Iankovets, T. (2024). Digital marketing of brands in social media. <i>International Scientific-Practical Journal Commodities and Markets</i> , 49(1), 27–52. https://doi.org/10.31617/2.2024(49)02	Янковець, Т. (2024). Цифровий маркетинг брендів у соціальних медіа. <i>International Scientific-Practical Journal Commodities and Markets</i> , 49(1), 27–52. https://doi.org/10.31617/2.2024(49)02
Jacobides, M. G., Ma, M. D., Trantopoulos, K., & Vassalos, V. (2024). The business value of gamification. <i>California Management Review</i> . https://doi.org/10.1177/00081256231218469	
Koninck, J. D. (2026, February 11). Nike Run Club gamification examples. <i>Case Studies</i> . https://www.strivecloud.io/blog/gamification-examples-nike-run-club	
Konoplyannykova, M. (2024). Personalization as a loyalty strategy in electronic commerce. <i>International Scientific-Practical Journal Commodities and Markets</i> , 49(1), 4–26. https://doi.org/10.31617/2.2024(49)01	Конопляникова, М. (2024). Персоналізація як стратегія лояльності в електронній комерції. <i>International Scientific-Practical Journal Commodities and Markets</i> , 49(1), 4–26. https://doi.org/10.31617/2.2024(49)01
Liu, R., Benitez, J., Zhang, L., Shao, Z., & Mi, J. (2024). Exploring the influence of gamification-enabled customer experience on continuance intention towards digital platforms for e-government: An empirical investigation. <i>Information & Management</i> , 103986. https://doi.org/10.1016/j.im.2024.103986	
Maijala, O. (2025). <i>The growth in the gamification of digital consumer application services: A case analysis of duolingo, fitbit and starbucks</i> [Bachelor's thesis, Aalto University]. Bachelor's Programme in International Business. https://aaltodoc.aalto.fi/items/1ccae18c-14c2-4e50-80ef-b05bfc9b3ab9	
Maranchak, M., & Maranchak, N. (2023). Gamification mechanics usage for UGC promotion in online library marketing. <i>Ukrainian Journal on Library and Information Science</i> , (11), 21–33. https://doi.org/10.31866/2616-7654.11.2023.282652	Маранчак, М., & Маранчак, Н. (2023). Використання гейміфікованих механік для стимулювання UGC в інтернет-маркетингу бібліотек. <i>Український журнал з бібліотекознавства та інформаційних наук</i> , (11), 21–33. https://doi.org/10.31866/2616-7654.11.2023.282652
Meshram, A., Juned, M., & Lakshmi, B. (2025). The role of gamification in enhancing customer loyalty: Analyzing its impact on retention and lifetime value in flipkart plus rewards. <i>International Journal of Engineering Development and Research</i> , 13(4), 313–327. https://rjwave.org/ijedr/papers/IJEDR2504798.pdf	
monobank – digital mobile bank (Version 7.18) (n. d.). [Mobile application]. UNIVERSAL BANK, PRAT. https://apps.apple.com/ua/app/monobank-digital-mobile-bank/id1287005205	
monobank – bank in smartfone (Version 7.18.0). (n. d.). [Mobile application]. Universal bank Monobank. https://play.google.com/store/apps/details?id=com.ftband.mono&hl=ru	monobank – банк у телефоні (Версія 7.18.0). (б. д.). [Мобільний застосунок]. Universal bank Monobank. https://play.google.com/store/apps/details?id=com.ftband.mono&hl=ru
Novák, J. (2025). Gamification in economic education at secondary schools reflecting the value orientation of students. <i>R&e-Source</i> , 253–260. https://doi.org/10.53349/re-source.2025.is1.a1398	
Oschad (Version 1.1.2571). (n. d.). [Mobile application]. JSC "Oschadbank". https://apps.apple.com/ua/app/oschad/id1571479928	
Ovaisi, A. (2025). 10 game-changing digital marketing case studies you need to see in 2025. <i>Performance Marketing & More</i> . https://www.jobaalearnings.com/blog/10-game-changing-digital-marketing-case-studies-you-need-to-see-in-2025	
Rodrigues, I., Lopes, J. M., Borges, A., Oliveira, J., & Oliveira, M. (2021). How can gamified applications drive engagement and brand attitude? The case of nike run club application. <i>Administrative Sciences</i> , 11(3), 92. https://doi.org/10.3390/admsci11030092	
Rosetta Stone: Learn Languages (Version 8.43.5). (n. d.). [Mobile application]. Rosetta Stone, Ltd. https://apps.apple.com/ua/app/rosetta-stone-learn-languages/id435588892?l=uk	
Rosetta Stone: Learn Languages (Version 8.35.0). (n. d.). [Mobile application]. Rosetta Stone Ltd. https://play.google.com/store/apps/details?id=air.com.rosetastone.mobile.CoursePlayer&hl=uk	Rosetta Stone: вивчення мов (Версія 8.35.0). (б. д.). [Мобільний застосунок]. Rosetta Stone Ltd. https://play.google.com/store/apps/details?id=air.com.rosetastone.mobile.CoursePlayer&hl=uk

- Rukshar, R., Khanam, A., Sajjad, M. D., & Nagvanshi, S. (2025). Impact of gamification on brand loyalty: Exploring the mediating role of e-WOM. In book: *Addressing Practical Problems Through the Metaverse and Game-Inspired Mechanics*, 77–96. IGI Global Scientific Publishing. <https://doi.org/10.4018/979-8-3693-8886-0.ch004>
- Saleem, A. N., Noori, N. M., & Ozdamli, F. (2021). Gamification applications in e-learning: A literature review. *Technology, Knowledge and Learning*. <https://doi.org/10.1007/s10758-020-09487-x>
- Santos, P. M., Dias, J. M., & Bairrada, C. M. (2024). Gamification in marketing: Insights on current and future research directions based on a bibliometric and Theories, Contexts, Characteristics and Methodologies analysis. *Heliyon*, e32047. <https://doi.org/10.1016/j.heliyon.2024.e32047>
- Sensor tower. (n. d.). Digital Intelligence & App Data Analysis by Sensor Tower. <https://sensortower.com/>
- SimilarWeb PRO. (n. d.). SimilarWeb. <https://www.similarweb.com/>
- Singh, Y., & Milan, R. (2024). Utilitarian and hedonic values of gamification and their influence on brand engagement, loyalty, trust and WoM. *Entertainment Computing*, 100868. <https://doi.org/10.1016/j.entcom.2024.100868>
- Staling, Cordero-Brito & Juanjo, Mena. (2020). Gamification and its application in the social environment. *Journal of Information Technology Research*, 13(3), 58–79. <https://doi.org/10.4018/JITR.2020070104>
- Tan, C., Devilly, O., Lim, S., Divo, B., Kok, X.-F., Jasin, J., Seaw, K., & Htein, L. (2023). The effect of gamification mechanics on user experiences of adventurelearn: A self-driven learning platform. *Proceedings of the ACM on Human-Computer Interaction*, (7), 416. <https://doi.org/10.1145/3611062>
- Temu (App Store, version 4.30.0). (n. d.). Whaleco Inc. [Mobile application]. <https://apps.apple.com/ua/app/temu>
- Temu: Shop like a billionaire (Version 4.29.1). (n. d.). Temu. [Mobile application]. <https://play.google.com/store/apps/details?id=com.einnovation.temu>
- Younus, M., & Mahmood, R. (2026). *Fortnite revenue breakdown for 2026: Key insights & usage statistics*. TekRevol. <https://www.tekrevel.com/blogs/fortnite-revenue-usage-statistics/>
- Zafar, A. U., Shahzad, M., Shahzad, K., Appolloni, A., & Elgammal, I. (2024). Gamification and sustainable development: Role of gamified learning in sustainable purchasing. *Technological Forecasting and Social Change*, (198), 122968. <https://doi.org/10.1016/j.techfore.2023.122968>
- | | |
|---|---|
| Os Chad. (Version 1.0.2571) [Mobile application]. (n. d.). Os Chadbank. https://play.google.com/store/apps/details?id=ua.oschadbank.flumo | Ошад (Версія 1.0.2571) (б. д.). [Мобільний застосунок]. Ошадбанк. https://play.google.com/store/apps/details?id=ua.oschadbank.flumo |
|---|---|

Conflict of interest. The author declares no financial or non-financial conflicts of interest related to this publication and has no relationships with state bodies, commercial or non-profit organisations that could have an interest in the presentation of this point of view. Given that the author is affiliated with the institution that publishes the journal, which may give rise to a potential conflict of interest or suspicion of bias, the final decision to publish this article (including the selection of reviewers and editors) was made by those members of the Editorial Board who are not associated with this institution.

The author received no direct funding for this study.

Rozhdestvensky, V. (2026). Gamification in digital branding. *Scientia fructuosa*, 4(168), 103–115. [http://doi.org/10.31617/1.2026\(168\)07](http://doi.org/10.31617/1.2026(168)07)

Received by the editorial office 23.02.2026.

The article has been revised 26.03.2026.

Accepted for printing 20.05.2026.

Published online 07.09.2026.

CHUNIKHINA Tetyana

 <https://orcid.org/0000-0002-1386-6706>

PhD (Economics), Associate Professor,
Associate Professor of the Department of Marketing
State University of Trade and Economics
19, Kyoto St., Kyiv, 02156, Ukraine

t.chunihina@knute.edu.ua

CHISTIAKOVA Sofiia

 <https://orcid.org/0009-0002-2088-8564>

Social Media Manager
and Graphic Designer,
Lama Academy (USA)
10625, Penny Rd., Cary,
NC, 27518, USA

sofichi26@gmail.com

AI-ADVERTISING IN JEWELRY RETAIL

The rapid growth of the artificial intelligence (AI) market in e-commerce and the simultaneous inability of most companies to move from localized experiments to the systematic integration of AI solutions underscore the relevance of this study. For jewellery retail, this contradiction takes on particular significance due to the specifics of the premium segment—high buyer emotional engagement, the critical role of visual aesthetics, and the brand's reputational vulnerability—which significantly limit the possibilities for full automation of marketing processes. The study is based on the hypothesis that the maximum marketing effect in jewellery retail is achieved not through total algorithmizing, but through a strategically structured division of functions between humans and artificial intelligence (AI) in accordance with the nature of the specific task. The methodological foundation of this work consists of a systematic analysis and synthesis of the results of field experiments and industry analytical reports by McKinsey and Gartner, as well as publications in peer-reviewed international journals from 2021 to 2026. The study found that the effectiveness of AI in marketing is asymmetrical: algorithms consistently outperform humans in generating text content and performing analytical tasks but fall short when it comes to creating visually appealing materials,

ЧУНІХІНА Тетяна

 <https://orcid.org/0000-0002-1386-6706>

к. е. н., доцент, доцент кафедри маркетингу
Державного торговельно-економічного
університету
вул. Кіото, 19, м. Київ, 02156, Україна

t.chunihina@knute.edu.ua

ЧІСТЯКОВА Софія

 <https://orcid.org/0009-0002-2088-8564>

менеджер із соціальних мереж
та графічний дизайнер,
Академія Лама (США)
Пенні Рд., 10625, Кері,
Північна Кароліна, 27518, США

sofichi26@gmail.com

ШІ-РЕКЛАМА В ЮВЕЛІРНОМУ РИТЕЙЛІ

Стрімке зростання ринку штучного інтелекту (ШІ) в електронній комерції та одночасна нездатність більшості підприємств перейти від локальних експериментів до системної інтеграції ШІ-рішень визначають актуальність дослідження. Для ювелірного ритейлу ця суперечність набуває особливого значення через специфіку преміального сегмента, високу емоційну залученість покупця, критичну роль візуальної естетики та репутаційну вразливість бренду, що суттєво обмежує можливості повної автоматизації маркетингових процесів. Висунуто гіпотезу, що максимальний маркетинговий ефект у ювелірному ритейлі досягається не через тотальну алгоритмізацію, а через стратегічно структурований розподіл функцій між людиною та штучним інтелектом відповідно до природи конкретного завдання. Методологічну основу дослідження становлять системний аналіз і синтез результатів польових експериментів та галузевих аналітичних звітів McKinsey та Gartner, а також публікації у рецензованих міжнародних виданнях за 2021–2026 рр. У ході дослідження встановлено, що ефективність ШІ в маркетингу є асиметричною: алгоритми стабільно перевершують людину у генерації текстового контенту та аналітичних завданнях, проте поступаються їй у створенні візуально-естетичних



Copyright © 2026. The Author(s). This is an open access article distributed under the terms of the [Creative Commons Attribution License 4.0 International License \(CC-BY\)](https://creativecommons.org/licenses/by/4.0/)

which is a decisive factor in jewellery advertising. Specific threats to the industry were also identified: content homogenization, risks of personal data leaks, algorithmic "hallucinations", and legal uncertainty in the field of intellectual property. Based on the study's findings, the author developed the Intelligent Symbiosis Marketing Framework (ISMF), a conceptual model that operationalises the "Human-in-the-loop" principles and the "Centaur" behavioural pattern in the context of jewellery retail. The model defines criteria for task distribution between humans and algorithms and provides for the institutionalisation of validation protocols to preserve the brand's unique identity.

Keywords: artificial intelligence, jewellery retail, digitalisation of advertising, technological inflexion point, hybrid model, marketing.

матеріалів, що є визначальним чинником для ювелірної реклами. Виявлено також специфічні загрози галузі: гомогенізація контенту, ризики витоку персональних даних, алгоритмічні "галюцинації" та правова невизначеність у сфері інтелектуальної власності. За результатами дослідження розроблено авторську концептуальну модель Intelligent Symbiosis Marketing Framework (ISMF), що операціоналізує принципи "Human-in-the-loop" та поведінкового патерну "Кентавра" стосовно специфіки ювелірного ритейлу. Модель визначає критерії розподілу завдань між людиною та алгоритмом і передбачає інституціоналізацію валідаційних протоколів для збереження унікальної ідентичності бренду.

Ключові слова: штучний інтелект, ювелірний ритейл, цифровізація реклами, зубчастий технологічний рубіж, гібридна модель, маркетинг.

JEL Classification: M37, M31, O33.

Introduction

The digital transformation of retail, which has intensified over the past decade, is acquiring a qualitatively new dimension with the proliferation of artificial intelligence (AI) technologies. While earlier digitalisation in retail primarily focused on migrating traditional business processes to the online environment, today the focus has shifted toward a fundamental reconfiguration of the very logic of value creation. Jewellery retail, as a segment characterised by high levels of emotional consumer involvement and the critical role of brand trust, finds itself at the epicentre of these shifts. AI technologies simultaneously offer significant opportunities for this sector while generating specific risks not inherent to the mass consumer market.

The relevance of this study is driven by the contradiction between the rapid growth of the AI market in e-commerce, from USD 9.01 billion in 2025 to a projected USD 74.93 billion by 2035 Zoting (2026) and the systemic inability of most enterprises to transition from localised experiments to the full integration of intelligent systems into the corporate operating model. According to Khandabattu (2025) data, generative AI is currently in the "Trough of Disillusionment" phase, where initial enthusiasm gives way to difficulties in justifying real return on investment (ROI). For the jewellery industry, this issue is particularly acute: any algorithmic error in the factual description of a product or its visualisation can cause irreversible reputational damage, making the issue of deliberate and structured AI integration critical for this specific segment.

The scholarly discussion regarding AI effectiveness in marketing processes is evolving along several lines. Singla et al. (2025) demonstrates that high-performing organisations achieve economic impact from AI not through point automation but via a fundamental redesign of workflows, viewing the technology as a new operating core rather than an add-on to an

existing model. Ju and Aral (2026), in large-scale field experiments, quantitatively investigated the impact of autonomous AI agents on marketer productivity and the structure of intra-team interaction. Dell'Acqua et al. (2026) proposed the concept of the "jagged technological frontier," describing the asymmetric nature of current AI system competence, which allows for predicting tasks where algorithms outperform humans and those where they fall short. The risks of content homogenization stemming from the excessive delegation of creative functions to algorithms were explored by Padmakumar and He (2024). The legal and ethical dimensions of using generative models in commercial communications were analysed by Singla et al. (2025) and Romanchuk et al. (2024). The specifics of visual marketing in the jewellery industry and its impact on behavioural metrics of advertising campaigns were examined by Kobets (2021). Nevertheless, the existing literature lacks an integrated model that systematically combines these aspects specific to jewellery retail and proposes an operationalised mechanism for the distribution of functions between humans and algorithms. Addressing this gap constitutes the scholarly problem that the present study aims to resolve.

The objective of this article is to develop a conceptual hybrid model to organise the marketing activities of a jewellery enterprise, based on the principles of intelligent symbiosis between humans and artificial intelligence. To achieve this goal, the following tasks are addressed: analysing the current state and challenges of AI scaling in e-commerce and outlining the specifics of its application in jewellery marketing; evaluating AI effectiveness in creating various types of advertising content through the lens of the "jagged frontier" concept; systematizing the specific threats of AI utilization in jewellery retail marketing; and justifying and describing the original "Intelligent Symbiosis Marketing Framework" (ISMF) by defining criteria for the distribution of functions between humans and algorithms.

The study is based on the hypothesis that maximum marketing effect in jewellery retail is achieved not through full automation, but through a strategically structured distribution of functions between humans and algorithms according to the nature of the specific task, its creative complexity, the risk of error, and the degree of emotional weight for the consumer. The information base of the study includes field experiment results, industry analytical reports from leading consulting firms such as McKinsey and Gartner, and peer-reviewed international journal publications from 2021 to 2026. The methodological foundation comprises systems analysis, synthesis of existing empirical data, and conceptual modelling. A limitation of the study is its theoretical and conceptual nature: the proposed ISMF model requires further empirical verification on a representative sample of jewellery enterprises.

The article is structured as follows. The first section analyses the current state of the AI market in e-commerce, the challenges of its scaling, and the specifics of its application in jewellery retail marketing. The second

section is devoted to evaluating AI's impact on marketer productivity and analysing the "jagged frontier" concept in the context of the visual specifics of jewellery advertising. The third section systematises the threats and challenges of AI implementation characteristic of the premium segment. The fourth section describes the original ISMF hybrid model, outlines the criteria for task distribution between humans and algorithms, and discusses the proposed approach's limitations.

1. The current state and challenges of scaling AI in the e-commerce market

E-commerce in general, and jewellery retail in particular, are currently undergoing a stage of profound transformation driven by the widespread implementation of artificial intelligence (AI) technologies. Market dynamics confirm the scale of this shift. According to global estimates by Zoting (2026), the AI market volume in e-commerce stood at USD 9.01 billion in 2025 and is projected to reach USD 74.93 billion by 2035, representing a compound annual growth rate (CAGR) of 23.59% (Figure 1).

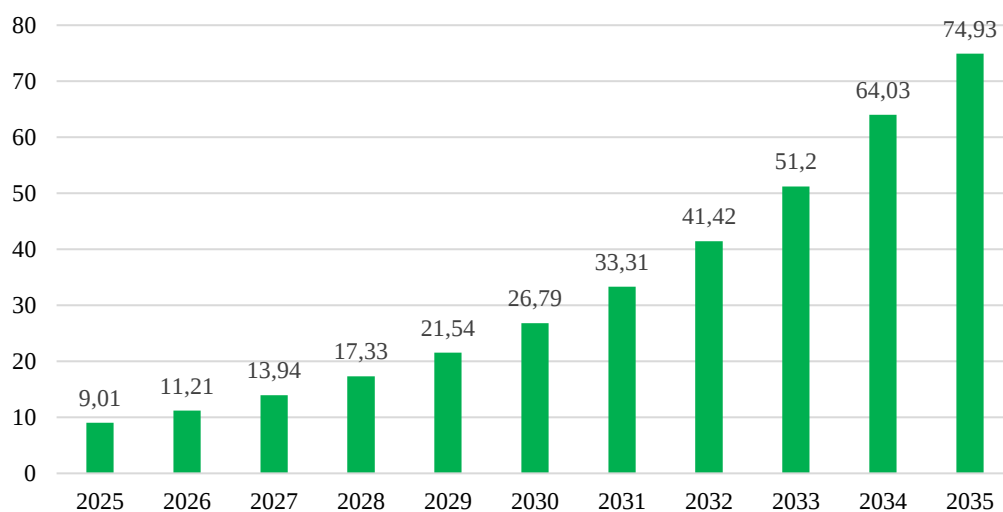


Figure 1. Artificial Intelligence in the e-commerce market size 2025 to 2035 (USD billion)

Source: compiled by the authors based on (Zoting, 2026).

Such dynamics demonstrate a qualitative shift in the role of AI, moving from the category of niche experimental tools to a primary driver of digital commerce capable of radically restructuring value chains. The level of business adoption also shows unprecedented growth. According to Singla et al. (2025), as shown in Figure 2, 88% of organisations already regularly use AI in at least one of their business functions, compared to 78% in 2024. Concurrently, a shift in focus is observed from basic generative models to more complex autonomous systems: over 60% of market participants are

integrating AI agent systems based on foundational models that can independently plan and execute multi-stage workflows in real-world operating environments (Singla et al., 2025).

Reported use of AI in at least one business function continues to increase.

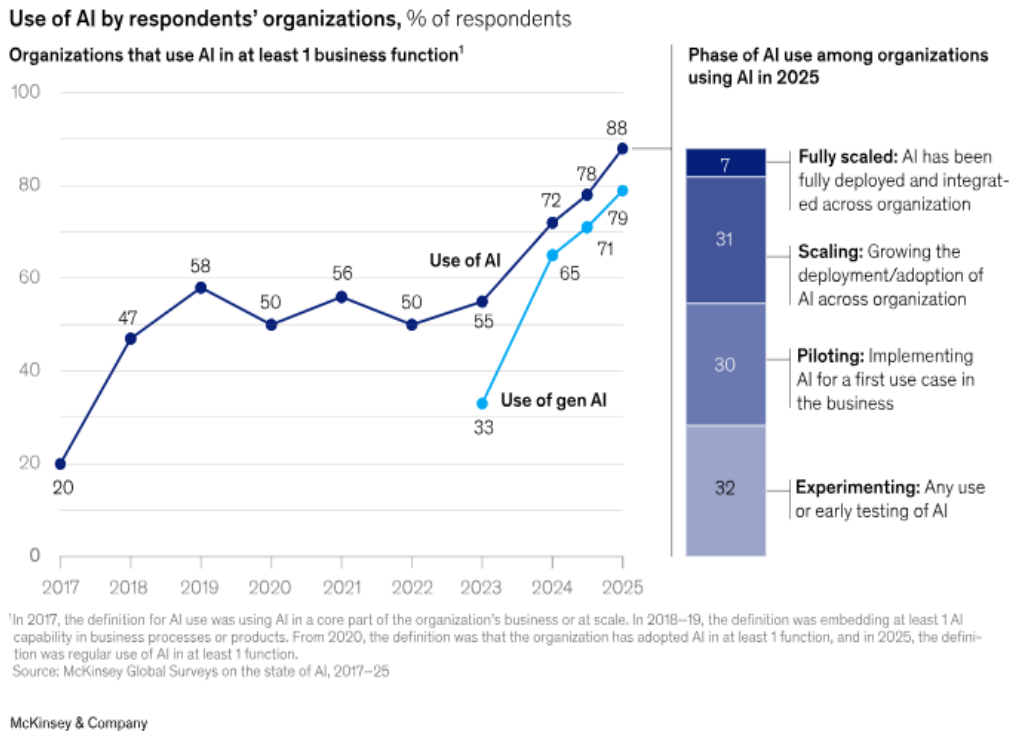


Figure 2. Trends in the use of AI and generative AI in organisations (2017–2025)

Source: (Singla et al., 2025).

However, behind the positive adoption statistics lies a systemic challenge regarding scalability. The critical hurdle remains the transition from localised pilot projects to full-scale deployment of digital initiatives across the entire organisation. Analytical data from McKinsey (2025) suggests that nearly two-thirds of enterprises are still in the experimental pilot phase, unable to integrate AI solutions into a unified corporate operating model. This problem is primarily rooted in the structural unreadiness of traditional retail to implement self-learning algorithms into closed business cycles.

The position of generative AI on the technology maturity curve is indicative in this context. According to the Khandabattu (2025) report, the technology is currently in the "Trough of Disillusionment" phase, characterised by difficulties in justifying the return on investment (ROI). Specifically, fewer than 30% of AI leaders report that their CEOs are satisfied with the returns on these investments. Organisations with low digital maturity

typically hold unrealistic expectations about technology and fail to overcome barriers in risk management, including model hallucinations, algorithmic bias, and a shortage of qualified specialists. For the jewellery industry, these risks are particularly acute; any factual AI error in describing gemstones or incorrect product visualisation can cause irreparable damage to a brand's reputation.

A study of market leaders' practices allows for the identification of an alternative model for successful implementation. According to Singla et al. (2025), high-performing organisations achieve significant economic impact not through point AI applications for cost reduction, but through a fundamental reimagining of workflows. Such companies view AI not as an add-on to existing operating models, but as their new structural core, and are three times more likely to use the technology as a catalyst for transformational change, focusing on stimulating innovation and ensuring sustainable growth rather than mere resource optimisation.

Systemic AI integration acquires particular importance in the marketing strategies of the premium segment. Given the specific nature of jewellery retail marketing, these global trends require a tailored approach. One of the most effective strategies for the jewellery industry is the 4C marketing mix (Customer, Cost, Convenience, Communication), in which the customer's opinion and individual psychological needs serve as the core value. AI becomes a tool that enables the realisation of the 4C concept at the level of the individual consumer rather than an averaged segment (Yanchuk & Sharko, 2025). Accordingly, the primary directions for AI application in jewellery retail marketing encompass three key vectors.

First, hyper-personalisation and deep behavioural analytics: machine learning and semantic analysis methods enable the processing of vast datasets on search activity, demographic profiles, and purchasing preferences. This enables the formation of personalised recommendations and a transition from "product offering" to "life event support," significantly increasing the customer's long-term lifetime value (LTV).

Second, intelligent content generation and communication: modern Large Language Models (LLMs) can automate the creation of marketing materials while maintaining the "elite" communicative style characteristic of luxury brands, providing a level of service previously attainable only through highly qualified consultants.

Third, dynamic pricing: AI algorithms allow for real-time price adjustments based on demand fluctuations, commodity market quotes for precious metals, and user behavioural patterns, ensuring an optimal balance between profitability and customer loyalty. The systematisation of these processes is presented in *Table 1*, demonstrating the transformation of each marketing mix element under the influence of intelligent systems.

Table 1

Matrix of AI applications in the 4C marketing system for a jewellery enterprise

4C element	AI application area	Process description	Expected result
Customer	Hyper-personalization	Predictive Big Data analytics for generating individualised offers	Increased conversion rates and customer loyalty (LTV)
Cost	Dynamic Pricing	Automated price adjustments based on real-time market quotes and demand fluctuations	Maximisation of marginal profit
Convenience	AI Agents & Virtual Try-on	Implementation of Augmented Reality (AR) and chatbots for online jewellery selection	Shortening of the purchase decision cycle
Communication	Generative Copywriting (NLP)	Automated content creation aligned with the brand's unique Voice and Identity	Reduced content production costs alongside increased reach

Source: compiled by the authors based on (Akbar, et al., 2023; Rauschnabel, et al., 2024; Kudelskyi, 2025).

Thus, the analysis of the current state of AI scaling in e-commerce demonstrates that artificial intelligence is no longer merely an auxiliary technological tool, but a strategic driver of transformation in digital retail. For jewellery enterprises, its value lies not only in improving operational efficiency but also in enabling deeper personalisation, more precise communication, dynamic pricing, and enhanced customer experience. At the same time, the successful implementation of AI depends on the ability of companies to move beyond isolated pilot projects and integrate intelligent systems into their broader marketing and business processes. In this context, particular attention should be paid to the practical effectiveness of AI in one of the most important areas of digital marketing – the creation of advertising content.

2. AI effectiveness in advertising content creation

2.1. The impact of AI on marketer productivity

Despite the growing interest among researchers in the integration of artificial intelligence into marketing processes, quantitative evidence regarding its specific impact on professional productivity remains scarce. Field experiments conducted by Ju and Aral (2026) partially address this gap: their findings indicate that hybrid "human–algorithm" interaction models yield a 50% productivity gain per specialist compared to traditional teams without algorithmic support.

This significant economic effect is driven not only by the purely computational power of neural networks but also by a profound transformation in the logic of labour organisation. The integration of autonomous

systems fundamentally alters the nature of marketing activities; the focus of attention shifts from the manual execution of operations to their strategic delegation and multi-level coordination. There is a conceptual evolution of the professional functional profile: from a direct content creator, the specialist becomes a process architect who formulates prompts and performs expert verification of results. This transformation goes beyond simple adaptation to a new toolkit and constitutes evidence of a structural change in the professional role, as confirmed by specific behavioural metrics.

As Ju and Aral (2026) note, the most indicative marker of this change in the nature of labour is a 62% reduction in direct manual text interventions during the generation of advertising campaigns. Routine processes such as initial copywriting, vocabulary selection, and stylistic polishing, which previously consumed the bulk of working time, are now effectively handled by generative models. Consequently, human cognitive resources are liberated for critical auditing. Concurrently, there is a 17% increase in the volume of tasks delegated to intelligent agents. This metric illustrates not only workload optimisation but also the gradual formation of professional trust in autonomous systems, enabling the transfer of increasingly complex, multi-stage algorithmic workflows.

The transformation of intra-team interaction structure deserves special attention. Research by Ju and Aral (2026) records a 25% increase in the share of task-oriented communication (goal setting, operational planning, and formalising instructions), while the volume of socio-emotional contacts between employees decreases by 18%. The professional discourse becomes more pragmatic and criteria-based, a logical consequence of shifting creative routine to algorithms. However, this decline in the intensity of informal communication poses latent risks; in the long term, it may undermine social cohesion and the originality of collective decisions. For the marketing of premium brands, where the subjective and creative components are paramount, such algorithmic communication could become a point of vulnerability. This phenomenon undoubtedly requires thorough verification in future scientific inquiries.

The fundamental driver of productivity growth is the ability of algorithms to automate routine operations and process large datasets at speeds that fundamentally exceed human capabilities. Accordingly, the role of the specialist evolves toward the position of a strategic coordinator responsible for task setting and quality control of results generated by intelligent systems. At the same time, it must be noted that despite the high efficiency of generative models in linguistic and analytical data processing, their capabilities remain limited when solving complex visual-aesthetic tasks. This limitation necessitates a detailed consideration of the "jagged frontier" phenomenon, which is the focus of the next subsection.

2.2. Visual specifics of jewellery advertising and the "jagged frontier" effect

Despite the positive impact on marketing team productivity, the efficacy of AI utilisation is far from uniform. To analytically describe this inconsistency, scholars employ the concept of the "jagged technological frontier," which characterises the asymmetric nature of modern AI system competence (*Figure 3*). The technology demonstrates a substantial advantage in certain tasks while simultaneously falling short of human performance in others (Dell'Acqua et al., 2026; Ju & Aral, 2026). This specific concept serves as a key analytical tool for assessing the potential and limitations of AI within the context of jewellery retail advertising.

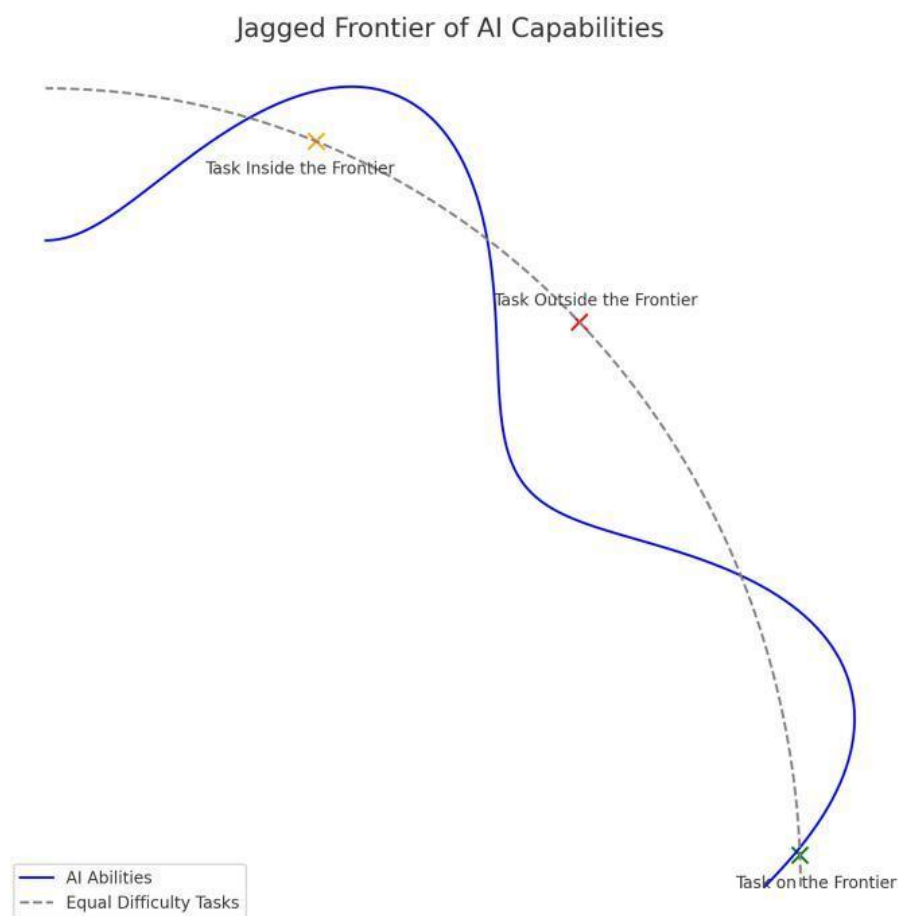


Figure 3. The Jagged AI Frontier

Source: (Dell'Acqua et al., 2026).

Textual content generation tasks fall within the "inside" of the jagged frontier, where AI consistently outperforms humans. Empirical data suggest that advertising copy created with algorithmic support is of higher quality than materials prepared by specialists without AI tools (Ju & Aral, 2026). Practical confirmation of this pattern was obtained through the analysis of

real-world social media advertising campaigns: the superior quality of AI-generated texts statistically correlates with improved click-through rates (CTR) and view-through duration (Ju & Aral, 2026).

A fundamentally different picture is observed in the sphere of visual content creation. The generation of high-quality imagery currently remains "outside" the capabilities of AI systems: teams consisting exclusively of human specialists consistently produce aesthetically superior and more attractive advertising images that surpass the outputs of generative models (Dell'Acqua, F., et al., 2026; Ju, H., & Aral, S., 2026). For the jewellery market, this fact is of critical importance. Visual appeal, the play of light on gemstone facets, the lustre of precious metals, and the precision of detail reproduction—are decisive factors in the purchasing decision and directly translate into behavioural metrics of the advertising campaign (Kobets, 2021). Notably, it is precisely the high quality of human-created and curated visual content that contributes to a significant reduction in cost-per-click (CPC) in advertising campaigns (Ju & Aral, 2026).

Thus, the analysis of AI effectiveness in advertising content creation demonstrates that artificial intelligence can significantly increase marketer productivity and improve the quality of certain types of advertising materials, particularly text-based content. However, the "jagged frontier" effect shows that AI capabilities remain uneven, especially in visually sensitive areas such as jewellery advertising, where aesthetic precision, emotional appeal, and product authenticity are decisive. Therefore, while AI offers considerable opportunities for optimising marketing processes, its application in jewellery retail also presents specific risks and limitations. This makes it necessary to further examine the key threats and challenges associated with the use of AI in jewellery retail marketing.

3. Threats and challenges of AI utilisation in jewellery retail marketing

Despite the significant potential of AI to intensify marketing processes, the implementation of artificial intelligence technologies within the jewellery retail marketing cycle is accompanied by a series of specific threats that require systemic consideration. These challenges can be categorised into three key pillars: creative limitations, ethical and legal risks, and intellectual property issues.

The first and most specific challenge for the creative industry is the phenomenon of "diversity collapse." Empirical evidence suggests that the excessive delegation of creative functions to algorithms leads to progressive homogenization of content: generated advertising materials acquire signs of self-similarity and gradually lose necessary variability (Ju & Aral, 2026; Padmakumar & He, 2024). While intelligent systems are capable of raising the average qualitative level of materials, they simultaneously neutralise original ideas that arise through human cognitive interaction and are rooted

in the unique professional experience of specialists. For a jewellery brand, whose competitive advantage is defined by design authenticity and emotional uniqueness of communication, such homogenization poses a direct threat to differentiation and erodes market positioning.

The second block of challenges encompasses data security and the ethics of algorithmic decision-making. The implementation of hyper-personalisation strategies involves processing vast arrays of sensitive personal information, creating significant risks in the event of non-compliance with cybersecurity protocols. Unauthorised data breaches or misuse can cause irreversible damage to a brand's reputational capital (Romanchuk et al., 2024). Particular attention should be paid to the problem of the factual reliability of generative models. Modern systems remain vulnerable to so-called "hallucinations" the production of content that is convincing in form but false in substance, as well as manifestations of algorithmic bias (Khandabattu, 2025). In the jewellery industry, where the accuracy of product characteristics is critical for consumer trust, such errors can have particularly severe consequences. The use of automated systems also creates a basis for manipulative practices, such as the generation of unreliable consumer reviews or the implementation of non-transparent dynamic pricing mechanisms (Romanchuk, et al., 2024).

The third block is related to legal uncertainty in the field of copyright and intellectual property. The scaling of algorithmically generated content actualises legal risks stemming from the fact that the training datasets of generative models often contain materials protected by copyright (Singla et al., 2025). Business entities integrating AI into the creation of advertising products are forced to consider this factor as part of their compliance strategy.

The sum of these risks indicates that the full autonomy of marketing functions at the current stage is premature. The effective use of AI in jewellery marketing requires not the elimination of the human factor, but its reimagining. Qualified personnel must perform functions of strategic oversight, ethical expertise, and creative control, ensuring the preservation of the brand's corporate identity and compliance with legal norms.

4. Conceptual hybrid model for jewellery retail

Summarising the research findings presented in the previous sections, the logical progression of this work is the development of an applied mechanism to mitigate the identified threats. Given the limitations of the "jagged technological frontier" (Subsection 2.2) and the systemic risks of "diversity collapse" inherent in the full automation of creative processes (Section 3), there is an urgent need to establish a new management architecture.

To overcome these challenges, this study proposes a specialised hybrid model for organising marketing departments—the Intelligent Symbiosis Marketing Framework (ISMF), which is an original conceptual development tailored to the specifics of jewellery retail. The framework is

built upon two complementary principles: the "Human-in-the-loop" strategy, which ensures mandatory human participation at key decision-making stages, and the "Centaur behaviour" pattern. The latter describes an interaction model where humans and algorithms operate in parallel and complementarily rather than sequentially. In this setup, humans undertake tasks requiring creative judgment and emotional intelligence, while algorithms process analytically intensive operations (Dell'Acqua, F., et al., 2026). Unlike the situational application of digital tools, this model provides a clear strategic division of labour based on objective criteria of technological competence.

The conceptual architecture of the proposed ISMF hybrid model is visualised in *Figure 4*.

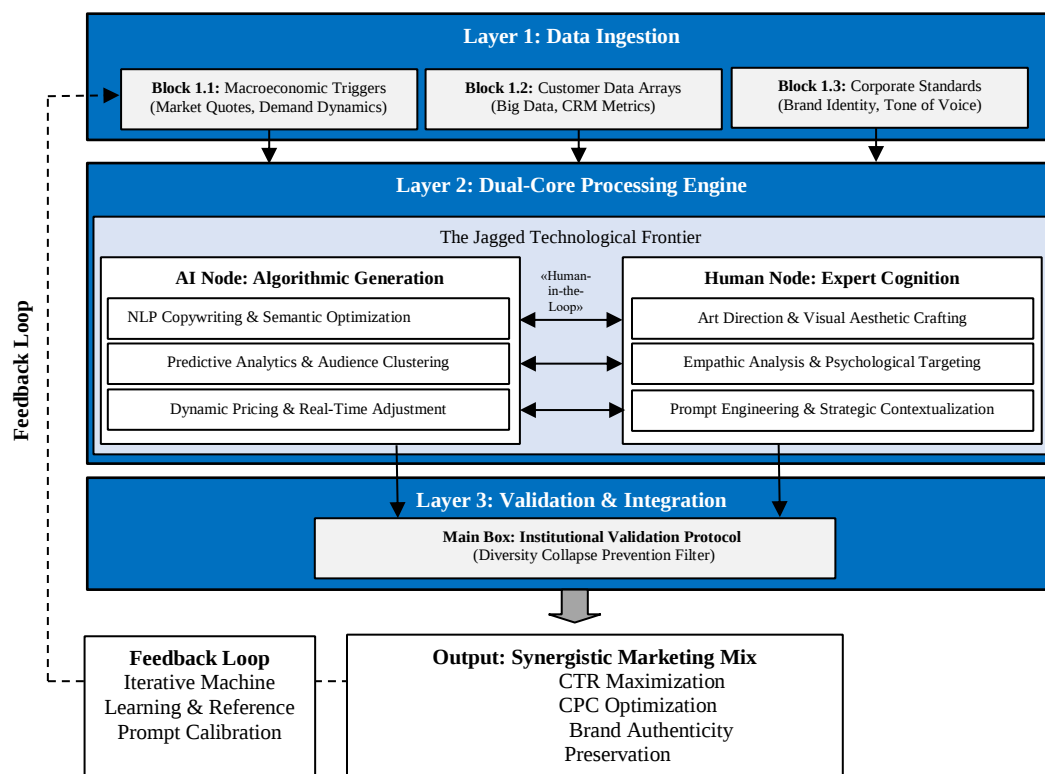


Figure 4. Intelligent symbiosis marketing framework (ISMF)

Source: developed by the authors based on (Dell'Acqua et al., 2026; Ju & Aral, 2026; Kobets, 2021; Romanchuk, et al., 2024).

The practical implementation of the ISMF architecture involves the transformation of marketing operations across three interconnected dimensions.

The first dimension is the algorithmic delegation of linguistic and analytical routines. The functional profile of the marketer is transformed from a direct content generator into a strategic coordinator. Intelligent systems are tasked with developing advertising materials, crafting personalised communications, structuring customer databases, and implementing dynamic pricing, adjusting product costs in real time in response to exchange quotes and shifts in consumer demand.

The second dimension is the preservation of human expertise in visual aesthetics, as the creation of emotionally resonant visual content currently remains outside the technological competence of algorithms. This is due to the fact that the accurate rendering of the optical properties of gemstones (play of light, dispersion, colour depth), as well as the creation of a complementary visual context that conveys status and evokes an empathic response from the consumer, requires refined aesthetic taste and cultural contextualization. These characteristics are highly subjective and currently defy algorithmic formalisation, remaining within the domain of exclusive human competence.

The third dimension is the institutionalisation of validation protocols to neutralise the risk of "diversity collapse." The marketing team develops reference corporate prompts with detailed semantic instructions to preserve the brand's unique "voice." No algorithmically generated material is integrated into the external media space without a final expert audit; this principle ensures the systemic protection of unique brand identity against gradual algorithmic unification.

At the same time, the model has defined limitations regarding its applicability. Its successful implementation assumes a sufficient level of digital maturity within the organisation: enterprises at the early stages of digitalisation may encounter technical and infrastructural barriers. The model also requires investment in developing competencies in prompt engineering and the critical auditing of algorithmic outputs (Relyea, C., et al., 2024), which may serve as a limiting factor for small and medium-sized enterprises.

A clear distribution of tasks between humans and algorithms requires the development of internal regulations, the absence of such guidelines reproduces the very problem of chaotic AI usage that the model is intended to solve. Finally, the boundaries of the "jagged frontier" are dynamic; tasks that are currently beyond the competence of algorithms may be mastered by them in the near future, necessitating a regular review of the criteria for the division of labour.

Conclusions

The conducted research allows for the assertion that digitalisation and the implementation of artificial intelligence technologies in e-commerce constitute an irreversible transformational process. The dynamic growth of the global AI market and the widespread deployment of autonomous AI agents are fundamentally reshaping the workflow architecture. For jewellery retail, where marketing communication has traditionally relied on the 4C strategy and close emotional contact, this transformation opens unprecedented opportunities for hyper-personalisation, dynamic pricing, and the scaling of advertising campaigns.

The results of the study correlate closely with the stated objective and illustrate that the underlying scientific hypothesis has been fully confirmed. It has been proven that the application of generative AI is subject to the "jagged frontier" effect of capabilities (Dell'Acqua et al., 2026). The technology acts as a powerful catalyst for productivity (providing a 50% increase in content generation) and quality in textual tasks; however, it acts

as a destructor in the creation of high-quality visual content, which is critical for jewellery sales (Ju & Aral, 2026).

The effectiveness of a hybrid approach for preserving the uniqueness of jewellery brands has been confirmed. The study revealed that excessive delegation of creative tasks to algorithms inevitably leads to "diversity collapse" and the homogenization of advertising (Ju & Aral, 2026). For jewellery companies, whose value is based on exclusivity and aesthetics, fully autonomous advertisement generation by algorithms poses a threat to the brand's DNA. Therefore, the most effective solution is the proposed hybrid model based on the "Centaur" strategy principles, where AI generates textual content and processes data arrays, while the human marketer exercises strategic control over visual aesthetics and emotional value (Dell'Acqua et al., 2026; Kobets, 2021).

The scientific novelty and contribution of the study lie in the development and justification of a conceptual hybrid model for task distribution in jewellery brand advertising campaigns, which allows for maximising productivity without the risk of losing creative authenticity.

The practical value of the results lies in the formulation of specific recommendations for heads of marketing and e-commerce departments at jewellery enterprises. It has been proven that successful AI transformation requires marketers to transition from the role of executors to the role of managers capable of delegating tasks to algorithms. This necessitates an urgent practical need for companies to invest in staff retraining, particularly in developing skills for effective prompt engineering and critical ethical evaluation of generated outputs to minimise security risks and avoid algorithmic manipulation.

Prospects for further research in this area involve conducting longitudinal studies on the impact of AI-generated visual content (specifically video formats) on consumer trust levels in the luxury segment. Additionally, the economic efficiency of implementing fully autonomous multi-agent AI systems in direct sales processes and omni-channel customer service for jewellery brands requires separate investigation.

REFERENCES / СПИСОК ВИКОРИСТАНИХ ДЖЕРЕЛ

Akbar, M. B., Lawson, A., & Turner, N. (2023). Extending Lauterborn's 4Cs for social marketing. In C. Fourali & J. French (Eds.), *The Palgrave Encyclopedia of Social Marketing*. Springer Nature Switzerland AG. https://doi.org/10.1007/978-3-030-14449-4_12-3

Dell'Acqua, F., McFowland III, E., Mollick, E., Lifshitz-Assaf, H., Kellogg, K. C., Rajendran, S., Kraye, L., Candelon, F., & Lakhani, K. R. (2026). Navigating the jagged technological frontier: Field experimental evidence of the effects of artificial intelligence on knowledge worker productivity and quality. *Organization Science*. <https://doi.org/10.1287/orsc.2025.21838>

Ju, H., & Aral, S. (2026). *Collaborating with AI Agents: A Field Experiment on Teamwork, Productivity, and Performance*. Johns Hopkins Carey Business School, MIT Sloan School of Management. <https://arxiv.org/html/2503.18238v3>

Khandabattu, H. (2025). *The Latest Hype Cycle for Artificial Intelligence Goes Beyond GenAI*. Gartner. <https://www.gartner.com/en/articles/hype-cycle-for-artificial-intelligence>

Kobets, D. L. (2021). Features of marketing strategy in the jewellery industry. <i>Visnyk Khmelnytskoho natsionalnoho universytetu. Ekonomichni nauky</i> , 6(2), 118–123. https://doi.org/10.31891/2307-5740-2021-300-6/2-19	Кобець, Д. Л. (2021). Особливості маркетингової стратегії в ювелірній галузі. <i>Вісник Хмельницького національного університету. Економічні науки</i> , 6(2), 118–123. https://doi.org/10.31891/2307-5740-2021-300-6/2-19
Kudelskyi, V. E. (2025). Artificial intelligence in marketing: Advantages and disadvantages. <i>International Scientific Journal "Grail of Science"</i> , (55), 145–153. https://doi.org/10.36074/grail-of-science.22.08.2025.015	Кудельський, В. Е. (2025). Штучний інтелект в маркетингу: переваги та недоліки. <i>Міжнародний науковий журнал "Грааль науки"</i> , (55), 145–153. https://doi.org/10.36074/grail-of-science.22.08.2025.015
Padmakumar, V., & He, H. (2024). <i>Does writing with language models reduce content diversity</i> . https://doi.org/10.48550/arXiv.2309.05196	
Rauschnabel, P. A., Felix, R., Heller, J., & Hinsch, C. (2024). The 4C framework: Towards a holistic understanding of consumer engagement with augmented reality. <i>Computers in Human Behavior</i> , (154), Article 108105. https://doi.org/10.1016/j.chb.2023.108105	
Relyea, C., Maor, D., Durth, S., & Bouly, J. (2024). <i>Gen AI's next inflection point: From employee experimentation to organizational transformation</i> . McKinsey & Company. https://www.mckinsey.com/capabilities/people-and-organizational-performance/our-insights/gen-ais-next-inflection-point-from-employee-experimentation-to-organizational-transformation	
Romanchuk, L. A., Shchytov, D. M., & Mormul, M. F. (2024). Artificial intelligence in electronic commerce: Key aspects, directions, threats. <i>Naukovi pohliad: ekonomika ta upravlinnia</i> , 4(88), 19–26. https://doi.org/10.32782/2521-666X/2024-88-2	Романчук, Л. А., Щитов, Д. М., & Мормуль, М. Ф. (2024). Штучний інтелект в електронній комерції: ключові аспекти, напрями, загрози. <i>Науковий погляд: економіка та управління</i> , 4(88), 19–26. https://doi.org/10.32782/2521-666X/2024-88-2
Singla, A., Sukharevsky, A., Hall, B., Yee, L., Chui, M., & Balakrishnan, T. (2025). <i>The state of AI in 2025: Agents, innovation, and transformation</i> . McKinsey & Company. https://www.mckinsey.com/capabilities/quantumblack/our-insights/the-state-of-ai#/	
Yanchuk, T., & Sharko, V. (2025). Artificial intelligence in e-commerce: Automation, personalization, efficiency. <i>Osvita/Pedahohika</i> . https://doi.org/10.5281/zenodo.15148589	
Zoting, S. (2026). Artificial Intelligence in E-commerce Market Size, Share, and Trends 2026 to 2035. <i>Precedence Research</i> . https://www.precedenceresearch.com/artificial-intelligence-in-e-commerce-market	

Conflict of interest. The authors certify that they have no financial or non-financial interest in the subject matter or materials discussed in this manuscript; the authors have no association with state bodies, any organisations or commercial entities having a financial interest in or financial conflict with the subject matter or research presented in the manuscript. Given that one of the authors is affiliated with the institution that publishes this journal, which may cause potential conflict or suspicion of bias and therefore the final decision to publish this article (including the reviewers and editors) is made by the members of the Editorial Board who are not the employees of this institution.

The authors received no direct funding for this study.

Chunikhina, T., & Chistiakova, S. (2026). AI-advertising in jewelry retail. *Scientia fructuosa*, 4(168), 116–130. [http://doi.org/10.31617/1.2026\(168\)08](http://doi.org/10.31617/1.2026(168)08)

Received by the editorial office 15.04.2026.

The article has been revised 18.05.2026.

Accepted for printing 25.06.2026.

Published online 07.09.2026.

HUDZENKO Olena

 <https://orcid.org/0000-0003-2028-7697>

PhD (philosophy), Associate Professor,
Associate Professor of the Department of
Psychology Horlivka Institute
of Foreign Languages
Donbas State Pedagogical University
13, Naukova St., Dnipro, 49000, Ukraine
olena.gudzenkooo@gmail.com

THE ECONOMICS OF MANIPULATION: DIGITAL CHOICE ARCHITECTURE AND THE RATIONALITY OF CONSUMER DECISIONS

This research paper thoroughly examines the current phenomenon of the modern digital commercial space functioning as a specific environment for targeted psychological influence on consumers. The relevance of the study is determined by the global digitalisation of markets and the introduction of complex algorithmic systems that effectively replace traditional methods of marketing persuasion with mechanisms of hidden manipulation. This situation poses a threat to an individual's cognitive autonomy and ability to make rational economic decisions. The research is based on the hypothesis that the digital architecture of choice is, by its very nature, a destructive environment in which the interplay between specific design ("dark patterns") and automated psychological triggers is aimed at disabling critical thinking and forcing the subject to take actions that contradict their real needs. To test the stated hypothesis, a comprehensive methodological apparatus was employed, combining terminological analysis, deductive modelling of cognitive reactions, and comparative analysis of e-commerce interface solutions. The results demonstrate a complex hierarchy of methods for exploiting cognitive inertia, automatic thinking, and emotional vulnerabilities of the individual. It has been proven that the digital architecture of choice artificially stimulates fast, subconscious thinking (System 1), while simultaneously blocking the analytical resources of the brain (System 2),

ГУДЗЕНКО Олена

 <https://orcid.org/0000-0003-2028-7697>

к. філос. н., доцент,
доцент кафедри психології
Горлівського інституту іноземних мов
Донбаського державного педагогічного
університету
вул. Наукова, 13, м. Дніпро, 49000, Україна
olena.gudzenkooo@gmail.com

ЕКОНОМІКА МАНІПУЛЯЦІЇ: ЦИФРОВА АРХІТЕКТУРА ВИБОРУ ТА РАЦІОНАЛЬНІСТЬ СПОЖИВЧИХ РІШЕНЬ

Досліджено актуальний феномен функціонування сучасного цифрового торговельного простору як специфічного середовища цілеспрямованого психологічного впливу на споживача. Актуальність дослідження зумовлена глобальною цифровізацією ринків та впровадженням складних алгоритмічних систем, які фактично заміщують традиційні методи маркетингового переконання механізмами прихованої маніпуляції. Такий стан справ створює загрози для збереження когнітивної автономії індивіда та його здатності до раціонального економічного самовизначення. Висунуто гіпотезу, що цифрова архітектура вибору за своєю природою є деструктивним середовищем, де синергія специфічного дизайну ("темних патернів") та автоматизованих психологічних тригерів спрямована на вимкнення критичного мислення та примушування суб'єкта до дій, що суперечать його реальним потребам. Для перевірки гіпотези застосовано комплексний методологічний апарат, що поєднує термінологічний аналіз, дедуктивне моделювання когнітивних реакцій та компаративний аналіз інтерфейсних рішень у сфері електронної комерції. Отримані результати демонструють складну ієрархію методів експлуатації когнітивної інерції, автоматизмів мислення та емоційних вразливостей особистості. Доведено, що цифрова архітектура вибору штучно стимулює швидке, підсвідоме



Copyright © 2026. The Author(s). This is an open access article distributed under the terms of the [Creative Commons Attribution License 4.0. International License \(CC-BY\)](https://creativecommons.org/licenses/by/4.0/)

which leads to the formation of the illusion of voluntary decision-making. This study examines how the digital architecture of choice transforms the traditional model of rational consumer behaviour, creating conditions for unfair competition and inefficient resource allocation. The scientific novelty of the study lies in identifying the connection between the emotional and value aspects of digital interaction and the overall effectiveness of algorithmic manipulation. The practical value of the work lies in the development of the concept of psychological resistance as a strategy for individual self-defence. The authors propose an integrated model for counteracting manipulation that involves the introduction of ethical design standards and the active development of consumers' metacognitive skills. The results of the study can serve as a basis for the creation of educational programmes to improve digital literacy and the development of regulatory acts in the field of consumer protection. This work paves the way for studying the mechanisms of ethical programming of digital interfaces.

Keywords: choice architecture, dark patterns, psychological manipulation, cognitive autonomy, behavioural economics, consumer choice.

мислення (Систему 1), одночасно блокуючи аналітичні ресурси мозку (Систему 2), що призводить до формування ілюзії добровільності прийнятих рішень. Наукова новизна дослідження полягає у виявленні зв'язку між емоційно-ціннісними аспектами цифрової взаємодії та загальною ефективністю алгоритмічного маніпулювання. Практична цінність дослідження втілена у розробці концепції психологічної резистентності як стратегії самозахисту особистості. Запропоновано інтегровану модель протидії маніпуляціям, що передбачає впровадження етичних стандартів дизайну та активний розвиток мета-когнітивних навичок споживачів. Результати дослідження можуть стати підґрунтям для створення освітніх програм з підвищення цифрової грамотності та розробки регуляторних актів у сфері захисту прав споживачів. Дослідження відкриває шлях до вивчення механізмів етичного програмування цифрових інтерфейсів.

Ключові слова: архітектура вибору, темні патерни, психологічна маніпуляція, когнітивна автономія, поведінкова економіка, споживчий вибір.

JEL Classification: D91, M31, D18, D11, Z13.

Introduction

The transformation of the global economy into a digital format has radically changed the mechanisms of interaction between suppliers and consumers. While classical economic theory was based on the postulate of the "rational agent" (Homo Economicus), modern digital markets increasingly exploit the irrational nature of the human psyche. The premise of this study is the rapid development of choice-architecture technologies, in which every element of the interface—from the colour of a button to the recommendation algorithm—is designed to steer user behaviour in ways that benefit the business. In conditions of information overload, consumers lose their ability to think critically, making them vulnerable to hidden psychological influences.

The key problem is the blurring of the line between ethical marketing persuasion and destructive manipulation. The use of so-called "dark patterns" in the digital environment creates a situation in which consumers make economic decisions that are contrary to their own interests, while being under the illusion of complete freedom of choice and voluntary consent (Naimy, 2025; Witte, 2025). This leads not only to individual financial losses but also to a general erosion of trust in the digital ecosystem, which poses a threat to the stable development of the modern economy.

The problem of psychological influence on consumer behaviour has deep roots in academic discourse. The fundamental principles of persuasion laid down by Cialdini (2006) remain the basis for understanding social triggers such as scarcity, authority, and reciprocity, which are now automated in the digital environment. The development of behavioural economics in the context of digital transformation is analysed in detail in the works of Tamilarasi (2025) and Radu et al. (2024), who point to a paradigm shift from "rational choice" to "manipulation" in the era of digital subscriptions.

Of particular value for understanding the architecture of choice are the works of Trzaskowski (2023), who distinguishes between the concepts of persuasion and manipulation through the prism of EU internet law, emphasising the role of cognitive architecture. The issue of destructive interface design ("dark patterns") is explored by Mejtoft et al. (2021), focusing on manipulative forms of obtaining consent for the processing of personal data, which creates a technical basis for further economic pressure.

The psychological dynamics of decision-making in the marketing era of AI and algorithms are examined by Sudirjo et al. (2024) and Nadeem (2022), emphasising that the digital economy creates new cognitive loads that reduce consumer resistance. Witte (2025) made an important contribution to the classification of these phenomena by proposing an integrated framework for defining manipulation, while Arango-Kure and Garz (2025) developed a conceptual framework of unethical influence in marketing, which allows legitimate sales promotion methods to be distinguished from coercive practices.

The legal and ethical aspects of consumer protection in the context of the exploitation of their vulnerabilities are highlighted in the works of Raj et al. (2025) and Mäihäniemi (2024), in which choice manipulation is considered an abuse of a dominant market position. Finally, Naimy (2025) introduces the concept of "digital smoke screens," pointing out that modern consent is often illusory due to the complex architecture of manipulation.

Despite a significant number of developments in the fields of law and marketing, the psychological mechanism of integrating several types of manipulation into a single choice architecture remains insufficiently studied. Most studies focus either on legal protection or on individual types of "dark patterns," while the synergistic cumulative impact of the algorithmic environment on consumer psychological autonomy requires deeper analysis. This article is devoted to this aspect—the combination of psychological traps into a coherent system of digital consumer experience.

The purpose of the article is to provide a theoretical justification and a systematic analysis of the psychological mechanisms underpinning the manipulative architecture of digital consumer choice, and to identify their impact on individual cognitive autonomy in the context of the modern digital economy.

To achieve this goal, the following tasks were identified and solved:

- to clarify the essence of the concept of "digital manipulation" and determine its place in the structure of modern choice architecture based on an interdisciplinary approach;

- to study the psychological tools of "dark patterns" and classify them according to their type of influence on the cognitive and emotional spheres of the consumer;
- analyse the mechanism of transformation of psychological biases (anchoring, scarcity, social proof) into specific instruments of economic pressure in the e-commerce environment;
- identify the consequences of manipulative influence on the process of financial decision-making and justify the need to develop strategies for consumer psychological resistance.

The work is based on the hypothesis that the modern architecture of digital consumer choice is not a neutral platform for decision-making, but functions as an integrated system of psychological manipulation. This system is based on the convergence of "dark patterns" and the exploitation of cognitive biases, which leads to the deformation of consumer autonomy and the adoption of economically inefficient decisions under the illusion of voluntary consent. The source base of the study comprises research by leading experts in behavioural economics, digital law, and cognitive psychology from 2021 to 2025.

The hypothesis was tested using the following algorithm: terminological analysis and systematisation (processing of scientific data to determine the concepts of "manipulation" and "choice architecture," defining the boundary between ethical influence and coercion), deduction (transition from general psychological principles of persuasion to the analysis of specific mechanisms for transforming cognitive errors into profits for digital platforms); comparative analysis (comparison of different "dark patterns" to identify universal psychological triggers); logical generalisation (modelling the impact of identified manipulations on financial stability and consumer mental well-being).

This work is primarily theoretical and methodological and does not include results from our own empirical experiments (laboratory tests or surveys). The analysis is limited to a segment of digital markets (e-commerce and social networks) and does not extend to offline trading practices. The study also does not take into account individual cultural differences in the perception of manipulation, focusing on universal cognitive mechanisms.

During the study, the hypothesis was refined: the initial assumption about the perceived harm of manipulation was adjusted toward a "complex architecture of choice," in which the line between convenience and exploitation is often subjective and depends on the design context.

A logical structure is proposed for the main part of the article, with each section revealing a specific aspect of hypothesis testing. The main part of the article is structured into four interrelated sections. The first section conceptualises the manipulative architecture of choice, defines its psychological essence as a tool for bypassing rational personality filters, and substantiates the impossibility of neutral design in modern digital systems. The second section is devoted to the typology of "dark patterns." It reveals

the mechanisms of exploiting cognitive inertia, automatic thinking, and socio-psychological pressure, which are implemented through interface solutions in e-commerce. The third chapter analyses the economic consequences of manipulation, in particular the distortion of consumer choice towards unstable behaviour patterns and the emergence of consumer financial dependence as a result of the "dopamine loops" of digital marketing. The fourth chapter contains a justification of psychological resistance strategies. It defines the role of psychological literacy and ethical marketing as key factors in protecting consumer cognitive autonomy in the digital age.

1. Conceptualisation of manipulative choice architecture in the digital economy

The transformation of the global market into a digital format has radically changed the mechanisms of interaction between economic actors. While classical economic theory was based on the model of a "rational agent" (Homo Economicus) capable of logically calculating benefits, modern digital infrastructure is increasingly seen as a space for targeted influence on the subconscious cognitive processes of individuals. The digital architecture of choice is no longer a passive backdrop for transactions; it has become an active system of persuasion, where every element of the interface, recommendation algorithm, or navigation structure performs a specific psychological function of directing behaviour (Trzaskowski, 2023).

It is noteworthy that digital platforms manipulate users' time (through "endless feeds" or time constraints), thereby depriving people of the "time sovereignty" necessary for rationally comparing prices and alternatives (Suwan-Achariya, 2026).

The psychological essence of manipulation in this context lies in covert interference with an individual's autonomy by bypassing their rational filters. As noted in our previous studies (Hudzenko et al., 2024), the modern information space is saturated with complex psycholinguistic mechanisms that transform the process of information perception, creating the preconditions for the formation of predetermined behaviour patterns. In the architecture of consumer choice, these mechanisms are adapted to algorithmic e-commerce models, where the line between ethical nudging – gentle assistance in making useful decisions – and destructive manipulation is increasingly blurred.

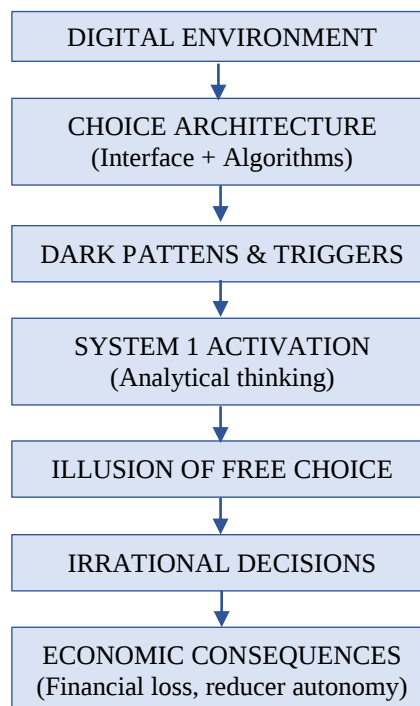
The central element of such architecture is the creation of the illusion of voluntary consent. Under the influence of pre-designed triggers, consumers perceive externally imposed decisions as the result of their own free will (Naimy, 2025). Witte (2025) suggests viewing manipulation as a form of "covert influence" that exploits the user's cognitive vulnerabilities for economic gain.

For a deeper understanding of this process, it is necessary to refer to the concept of dual-process thinking. The digital architecture of manipulation

focuses on stimulating System 1 – the fast, automatic, emotional, and subconscious mode of the brain. At the same time, it deliberately creates barriers to the activation of System 2 – slow, effortful, logical, and analytical thinking. In the digital age, classic principles of social influence – such as time scarcity, social proof, or authority (Cialdini, 2006) – are undergoing a process of large-scale algorithmic automation. This creates an environment in which rapid response to interface stimuli dominates over conscious analysis of price and product quality.

The general logic of how the digital architecture of manipulation works and its impact on the decision-making process are illustrated in *Figure*.

Thus, manipulative choice architecture functions as a holistic ecosystem in which design psychology and data-processing algorithms work in concert to direct consumer activity. This approach not only stimulates demand but also changes the very nature of consumer agency, transforming the individual from a free market participant into an object of algorithmic control through the "smoke screens" of digital interfaces.



Model of the influence of digital choice architecture on the rationality of consumer decisions

Source: author's elaboration based on dual-process theory and choice architecture concepts. Compiled by the authors based on Trzaskowski (2023), Naimy (2025), and Witte (2025).

2. Typology and mechanisms of action of "dark patterns"

The implementation of manipulative choice architecture in the digital space is carried out through "dark patterns" – specific design solutions based on a deep understanding of human cognitive errors. "Dark patterns" (especially subscription traps) artificially inflate the transaction costs consumers face when cancelling a subscription. The psychological nature of these mechanisms lies in the deliberate creation of conditions under which the consumer acts under the influence of System 1 (automatic, emotional thinking), while the functioning of System 2 (logical analysis) is blocked or significantly impeded.

2.1. Exploitation of cognitive inertia and linguistic traps

A significant part of digital manipulation relies on the linguistic-psychological dimension, which we have analysed in detail in previous works (Hudzenko et al., 2025). Verbal constructions in e-commerce interfaces are

often designed to disorient the user. This is achieved through double negatives, confusing terminology, or emotionally charged appeals that appeal to basic instincts.

Manipulation of consent and the illusion of control: studies of manipulative patterns in cookie requests (Mejtoft et al., 2021) show that the interface design makes the "Accept All" button bright and accessible, while the opt-out option is hidden behind several levels of settings. This is a classic example of exploiting cognitive inertia: the consumer chooses the path of least resistance, which effectively negates the essence of free consent (Naimy, 2025).

The pitfalls of digital subscriptions: the "roach motel" mechanism involves maximally simplified entry into financial obligations and artificially complicated exit from them. As Radu et al. (2024) point out, such strategies create a psychological barrier: System 2 recognises the need to cancel the subscription, but System 1 avoids the complex and uncomfortable procedures of "unsubscribing," leading to irrational spending.

2.2. Social and psychological pressure and algorithmic "smoke screens"

Modern digital platforms use personalised data to create intense psychological pressure in real time. The use of linguistic-psychological strategies of influence (Hudzenko et al., 2024) allows marketers to activate specific triggers that paralyse critical thinking:

Artificially created scarcity: Messages such as "Only 1 item left in stock" or "5 more people are viewing this hotel right now" provoke anxiety and fear of missing out (FOMO). This activates an immediate System 1 response aimed at "protecting resources," even if there is no objective need for them.

False social proof: The use of artificially generated reviews or messages about recent purchases by other users creates peer pressure. Consumers tend to trust the "choice of the majority," which is an evolutionary survival mechanism that, in the digital age, becomes a tool of exploitation (Cialdini, 2006).

2.3. Cognitive overload as a method of disorientation

Algorithmic architecture often uses the "hiding in the crowd" or over-informing methods. By increasing the number of choices or complicating the product description, platforms cause cognitive fatigue (Nadeem, 2022). When fatigued, System 2 "shuts down" and people become highly susceptible to suggestion, making decisions based on visual cues (button colour, font size) rather than the substance of the offer.

The variety of forms of destructive interface design requires a clear classification based not only on technical characteristics but also on the nature of their impact on an individual's economic behaviour. A general overview of the most common manipulation mechanisms and their consequences for consumers is presented in *Table*.

Table

Classification of digital manipulation mechanisms and their impact on consumer economic behaviour

Type of "dark pattern"	Psychological mechanism (activation of System 1)	Consequences for consumer economic behavior
Digital subscription traps (Roach motel)	Exploitation of cognitive inertia and the avoidance of complex procedures	Creation of unwanted recurring costs; hidden capital extraction for unused services
Artificially created scarcity and urgency	Inducing anxiety and fear of missing out (FOMO)	Blocking rational price analysis; conducting transactions at inflated prices.
False social proof	Exploiting evolutionary trust in the "majority choice"	Stimulating irrational demand based on unreliable market data
Manipulation of consent and interface traps	Choosing the path of least resistance ("Accept All")	Loss of control over personal data as an economic asset; the illusion of voluntary decision-making
Cognitive overload (information noise)	Inducing cognitive fatigue through excessive choice	Shifting to impulsive reactions based on visual stimuli rather than the content of the offer

Source: author's elaboration based on the concepts of behavioural economics and cognitive psychology. Compiled by the authors based on Cialdini (2006), Mejltoft et al. (2021), Nadeem (2022), Radu et al. (2024).

The data in *Table* show that each type of manipulation examined distorts rational choice, ultimately resulting in direct financial losses for the consumer or a suboptimal allocation of their personal resources.

Thus, the typology of "dark patterns" covers the entire spectrum of human cognitive activity – from basic text perception to complex social interactions. All these mechanisms work toward a single goal: to make the process of spending money as automatic as possible, minimising the moment of rational awareness of the transaction.

3. Deformation of consumer choice and economic consequences of manipulation

The consequences of manipulative choice architecture extend far beyond individual marketing transactions, causing systemic deformation of economic behaviour and undermining individual financial well-being. The psychological mechanism of this distortion is based on an artificial shift in emphasis from conscious planning to impulsive gratification of needs, which often leads to decisions that are contrary to the long-term interests of the consumer.

An important factor in this process is the emotional vulnerability of the subject in the digital space. As substantiated in our previous studies (Hudzenko, 2025), the emotional and value aspects of interaction in the digital environment determine the depth of a person's involvement and their reactivity to external stimuli. Manipulators in e-commerce exploit these emotional states, creating conditions under which the consumer feels an acute need for immediate purchase to restore emotional balance or confirm their own social value. This phenomenon is described as a "dopamine loop," where

interface rewards stimulate repetitive, often irrational, consumer activity (Tamilarasi, 2025).

The economic consequences of such a choice architecture can be classified in several ways:

Encouraging unsustainable consumption: the use of dark patterns pushes users to purchase goods or services that have no real consumer value for the individual. Mäihäniemi (2024) defines this as "exploitative abuse," which leads to excessive accumulation of resources and financial exhaustion of the consumer.

Distortion of price perception: through dynamic pricing and personalised discounts, consumers lose the ability to objectively compare the cost of products. The creation of the illusion of "exclusive benefit" (scarcity) causes System 1 to ignore the rational calculations of System 2, leading to purchases at inflated prices (Nadeem, 2022).

Hidden economic exploitation through subscriptions: automatic renewal models, analysed in detail by Radu et al. (2024), exploit consumer cognitive inertia. The complexity of the unsubscribe procedure creates a situation in which consumers continue to pay for services they do not use, which is a direct form of manipulative capital extraction.

A consumer's time is a limited economic resource. Manipulative algorithms (endless feeds, artificial time scarcity) appropriate this resource, depriving people of their "time sovereignty." Without free time, consumers cannot compare prices (make rational choices), which leads to market anomalies (Suwan-Achariya, 2026).

Thus, manipulative choice architecture transforms the very essence of the consumer experience: from an act of satisfying needs, it becomes a process of algorithmic exploitation of psychological states. This poses a threat not only to individual financial security but also to market competition as a whole, as the advantage is gained not by companies offering the best product but by those that more effectively manipulate cognitive biases (Arango-Kure & Garz, 2025).

4. Psychological resistance strategies and ethical regulation

The final stage of researching manipulative choice architecture requires the development of a comprehensive approach to minimising its negative impact. Since digital manipulation evolves faster than legislative norms, the protection strategy must combine external ethical regulation of the market and internal psychological resilience of the individual.

An important prerequisite for the formation of such resilience is the development of psychological resistance – the consumer's ability to identify manipulative patterns as they arise and consciously switch from impulsive System 1 to analytical System 2. As noted in our previous works (Hudzenko et al., 2024), understanding the psycholinguistic mechanisms of manipulation is the first step towards deconstructing external influence. In the digital

market, this means the ability to "read" the interface not as a convenient service, but as a set of psychological triggers.

Ethical regulation, according to the integrated framework proposed by Arango-Kure and Garz (2025), should be based on the principle of preserving consumer cognitive autonomy. This involves the introduction of "ethical design" standards, where the priority is transparency of information and ease of opting out of services. However, as Raj et al. (2025) argue, purely legal restrictions are not enough, as "dark patterns" often balance on the edge of legality, using legal but ethically questionable methods of persuasion.

Therefore, the key area of protection is the development of consumers' psychological literacy. Based on an analysis of moral and ethical guidelines and value aspects of interaction in the digital sphere (Hudzenko, 2025), the following components of resistance can be identified:

Meta-cognitive awareness: knowledge of one's own cognitive biases (e.g., the scarcity or anchoring effect), which allows one to recognise when the architecture of choice is attempting to provoke impulsive action.

Digital hygiene: consciously limiting the time spent in manipulative environments to prevent cognitive fatigue, which is the main ally of manipulators (Nadeem, 2022).

Critical analysis of interfaces: developing the skill of recognising linguistic and psychological traps (Hudzenko et al., 2025) in the texts of buttons, notifications, and advertising calls.

Therefore, the solution to the problem of digital manipulation lies in a partnership between the state, which must establish strict ethical frameworks for developers (Trzaskowski, 2023), and the consumer, whose awareness is the last line of defence. Psychological resistance in the digital age is becoming not just a skill but a necessary condition for preserving an individual's subjectivity and financial independence.

Conclusions

The study allows us to summarise the analysis of psychological manipulation in the architecture of digital consumer choice and to state that the set goal has been achieved.

As a result of the tasks set, the essence of digital manipulation as a form of hidden interference with the cognitive autonomy of the individual was clarified. It was established that the architecture of choice in e-commerce is not neutral but functions as a system of targeted influence. The typology of "dark patterns" allowed us to identify key mechanisms for exploiting cognitive inertia, linguistic traps, and socio-psychological pressure by activating System 1 and blocking the analytical potential of System 2.

The scientific hypothesis underlying the study has been fully confirmed: the modern architecture of digital choice is indeed a holistic system of psychological manipulation, which, through the synthesis of interface solutions and algorithmic data processing, distorts consumer autonomy, prompting them to make economically inefficient decisions under the illusion of voluntary consent.

The study found a direct correlation between the level of cognitive fatigue of the user and the effectiveness of linguistic manipulation. It was established that digital platforms deliberately create "information noise" to accelerate the consumer's transition to impulsive reactions.

The scientific novelty of the work lies in the interdisciplinary synthesis of behavioural economics theories with psycholinguistic mechanisms of manipulation in the media space, which were previously considered by the author (Hudzenko et al., 2024; 2025). For the first time, the architecture of choice is analysed through the prism of emotional and value aspects of digital interaction (Hudzenko, 2025), which made it possible to prove that manipulators exploit not only logical errors but also the consumer's deep value orientations.

The study contributes to solving the pressing issue of consumer protection in the digital age. The practical value of the results lies in the development of the principles of psychological resistance. The proposed approaches to the formation of meta-cognitive awareness and critical analysis of interfaces can be used in the development of digital literacy programs and codes of ethics for software developers.

The digital architecture of choice requires institutional regulation. Standards for ethical design must be implemented to protect consumer rights and ensure fair competition in digital markets.

Further scientific efforts should be directed toward empirical testing of the effectiveness of specific "demanipulation" techniques and studying the impact of artificial intelligence systems on the complexity of consumer choice architecture, which will require an even higher level of psychological counteraction.

REFERENCES / СПИСОК ВИКОРИСТАНИХ ДЖЕРЕЛ

Arango-Kure, M., & Garz, M. (2025). Manipulation: An integrative framework of unethical influence in marketing. *Journal of Business Research*, (197), Article 115476. <https://doi.org/10.1016/j.jbusres.2025.115476>

Cialdini, R. B. (2006). Influence: The psychology of persuasion (Revised ed.). *HarperCollins e-books*. 266 p. https://www.academia.edu/9978388/Influence_The_Psychology_of_Persuasion

Hudzenko, O. (2025). *Emotional and value aspects of interaction in a digital learning environment. National education in strategies of sociocultural choice: theory, methodology, practice: collection of materials from the IX International Scientific and Practical Conference*. 12.11.2025. Lutsk: KZVO "Lutsk Pedagogical College" of the Volyn Regional Council. Part 1. 2025. 87-90. https://lpc.in.ua/wp-content/uploads/2026/02/ch-1_-zbirnyk.pdf

Гудзенко, О. (2025). *Емоційно-ціннісні аспекти взаємодії у цифровому навчальному середовищі. Національна освіта в стратегіях соціокультурного вибору: теорія, методологія, практика": збірник матеріалів IX Міжнародної науково-практичної конференції*. 12.11.2025. Луцьк: КЗВО "Луцький педагогічний коледж" Волинської обласної ради. Частина 1. 2025. С.87-90. https://lpc.in.ua/wp-content/uploads/2026/02/ch-1_-zbirnyk.pdf

Hudzenko, O., Pastryk, T., Lazko, A., & Halchun, N. (2024). Psycholinguistic mechanisms of manipulation in the modern information space: strategies of influence and counteraction. *Academic Studies. Humanities Series*. Lutsk: Lutsk Pedagogical College of the Volyn Regional Council, (4), 66–76. <https://doi.org/10.52726/as.humanities/2024.4.10>

Гудзенко, О., Пастрик, Т., Лазько, А., & Гальчун Н. (2024). Психолінгвістичні механізми маніпуляції у сучасному інформаційному просторі: стратегії впливу та протидії. *Академічні студії. Серія "Гуманітарні науки"*. Луцьк: Комунальний заклад вищої освіти "Луцький педагогічний коледж" Волинської обласної ради, (4), 66–76. <https://doi.org/10.52726/as.humanities/2024.4.10>

- Hudzenko, O. G., Borozentseva, T. V., & Aleksandruk, A. I. (2025). Mechanisms for implementing manipulative strategies in the media space: a linguistic-psychological dimension. *Academic Studies. Series "Humanities,"* (4), 96–104. <https://doi.org/10.52726/as.humanities/2025.4.13>
- Гудзенко, О. Г., Борозенцева, Т. В., & Александрук, А. І. (2025). Механізми реалізації маніпулятивних стратегій у медіапросторі: лінгвопсихологічний вимір. *Академічні студії. Серія "Гуманітарні науки",* (4), 96–104. <https://doi.org/10.52726/as.humanities/2025.4.13>
- Mäihäniemi, B. (2024). Manipulation into unsustainable consumer choices as exploitative abuse of dominance. *Market and Competition Law Review*, 8(1), 101–125. <https://doi.org/10.34632/mclawreview.2024.16037>
- Mejtoft, T., Frängsmyr, E., Söderström, U., & Norberg, O. (2021). Deceptive design: Cookie consent and manipulative patterns. In *Digital support from crisis to progressive change: Conference proceedings*. University of Maribor Press. 393–404. <https://doi.org/10.18690/978-961-286-485-9.29>
- Nadeem, S. (2022). The psychology of consumer decision-making in a digital economy. *Journal of Frontiers in Multidisciplinary Research*, 3(2). 1–3. https://www.multidisciplinaryfrontiers.com/uploads/archives/20250218134208_26.pdf
- Naimy, P. (2025). Smokescreens of digital markets—choice manipulation and the illusion of consent. *Journal of European Competition Law & Practice*, 16(3), 208–222. <https://doi.org/10.1093/jecp/lpaf050>
- Radu, C. G., Dumitra, E. C., & Cotesu, R.-G. (2024). Behavioral Economics in The Era of Digital Subscriptions: Choice or Manipulation. *Journal of Academic Opinion*, 4(2), 72–46. <https://academicopinion.org/index.php/pub/article/view/68>
- Raj, P., Nanda, S. S., & Noorani, M. S. (2025). Safeguarding the digital consumer: A comparative legal and psychological analysis of dark patterns in e-commerce. *Advances in Consumer Research*, 2(4), 3567–3574. <https://acr-journal.com/>
- Sudirjo, F., Ausat, A. M. A., Suherlan, S., & Azzaakiyyah, H. K. (2024). Understanding psychological dynamics in consumer decision-making processes in the digital marketing era: A review. *Jurnal Penelitian Inovatif*, 4(2), 635–644. <https://doi.org/10.54082/jupin.384>
- Suwan-Achariya, S. (2026). *Temporal Sovereignty for Beginners: Designing Time in the Age of AI and Multipolarity*. Amazon Kindle Direct Publishing. ASIN: B0GGLZV6P9
- Tamilarasi, R. (2025). Behavioral Economics and Consumer Decision-Making in the Digital Age. *International Journal of Social Impact*, 10(3), 192–202. DIP: 18.02.024/20251003, <https://doi.org/10.25215/2455/1003024>
- Trzaskowski, J. (2023). Persuasion, manipulation, choice architecture and dark patterns. In A. Savin & J. Trzaskowski (Eds.), *Research Handbook on EU Internet Law* (309–330). Edward Elgar Publishing. <https://doi.org/10.4337/9781803920887.00025>
- Witte, J. (2025). Consumer manipulation: A definition, classification and future research agenda. *Journal of Information, Communication and Ethics in Society*, 23(1), 14–31. <https://doi.org/10.1108/JICES-09-2023-0119>

Acknowledgements. The author extend their appreciation for the concepts presented in the study "Temporal Sovereignty for Beginners: Designing Time in the Age of AI and Multipolarity" (Suwan-Achariya, S., 2026). The insights regarding time design in the era of artificial intelligence provided a valuable framework for analyzing how digital choice architecture manipulates the consumer's perception of time and decision-making urgency.

Conflict of interest. The author certify that he have no financial or non-financial interest in the subject matter or materials discussed in this manuscript; the authors have no association with state bodies, any organisations, or commercial entities having a financial interest in or financial conflict with the subject matter or research presented in the manuscript.

Hudzenko, O. (2026). The economics of manipulation: digital choice architecture and the rationality of consumer decisions. *Scientia fructuosa*, 4(168), 132–142. [http://doi.org/10.31617/1.2026\(168\)09](http://doi.org/10.31617/1.2026(168)09)

Received by the editorial office 23.04.2026.

The article has been revised 25.05.2026.

Accepted for printing 26.06.2026.

Published online 07.09.2026.

ADAPTIVE MANAGEMENT AND INNOVATION

DOI: [http://doi.org/10.31617/1.2026\(168\)10](http://doi.org/10.31617/1.2026(168)10)
UDC 005.93-044.332(477)=111



VZHYTYNSKA Kseniia

<https://orcid.org/0000-0002-3618-664X>

PhD (Economics), Associate Professor, Associate Professor of the Department of Trade Entrepreneurship and Logistics
State University of Trade and Economics
19, Kyoto St., Kyiv, 02156, Ukraine
k.vzhytynska@knute.edu.ua

ADAPTIVE LOGISTICS ARCHITECTURE: THE CASE OF UKRAINE

This article substantiates the conceptual foundations and implementation framework of adaptive logistics management in Ukraine under conditions of prolonged military conflict, economic turbulence, and global supply chain transformation. The study systematizes theoretical approaches to adaptive governance and defines it as a dynamic, digitally integrated, scenario-based system ensuring real-time visibility, flexible resource allocation, infrastructure redundancy, and institutional coordination. Based on sectoral analytical indicators (freight volumes, digital adoption rates, logistics contribution to GDP, resilience metrics), the paper evaluates the current state of Ukraine's logistics market and identifies structural constraints to transformation. A structured implementation framework is proposed, including the creation of a national digital logistics platform, development of dual-use regional hubs, AI-based risk management integration, education reform, and regulatory modernization. Using scenario modelling (realistic, pessimistic, optimistic) for 2026–2032, the study introduces KPI-based evaluation of transit time, cost efficiency, recovery speed, redundancy ratio, and composite resilience index. The results confirm the research hypothesis that adaptive logistics management significantly improves operational continuity and systemic resilience, with projected composite performance growth ranging from

ВЖИТИНСЬКА Ксенія

<https://orcid.org/0000-0002-3618-664X>

к. е. н., доцент, доцент кафедри торговельного підприємництва та логістики
Державного торговельно-економічного університету
вул. Кіото, 19, м. Київ, 02156, Україна
k.vzhytynska@knute.edu.ua

АДАПТИВНА ЛОГІСТИЧНА АРХІТЕКТУРА: КЕЙС УКРАЇНИ

Обґрунтовано концептуальні засади та механізм реалізації адаптивного управління логістикою в Україні в умовах тривалого воєнного конфлікту, економічної нестабільності та трансформації глобальних ланцюгів постачання. Систематизовано теоретичні підходи до адаптивного управління, яке визначено як динамічну, цифрово інтегровану, сценарно орієнтовану систему, що забезпечує прозорість у реальному часі, гнучкий розподіл ресурсів, інфраструктурну надлишковість та міжінституційну координацію. На основі аналітичних показників розвитку галузі (обсяги перевезень, рівень цифровізації, внесок логістики у ВВП, індикатори стійкості) оцінено сучасний стан логістичного ринку України та визначено структурні обмеження його трансформації. Запропоновано комплекс заходів щодо впровадження адаптивної логістики, зокрема створення національної цифрової платформи, розвиток дуальних логістичних хабів, інтеграцію штучного інтелекту в управління ризиками, реформування системи освіти та нормативного середовища. На основі сценарного моделювання на 2026–2032 рр. здійснено KPI-оцінку ефективності. Результати підтверджують



Copyright © 2026. The Author(s). This is an open access article distributed under the terms of the [Creative Commons Attribution License 4.0 International License \(CC-BY\)](https://creativecommons.org/licenses/by/4.0/)

moderate stabilization to accelerated structural advancement depending on institutional coherence and investment intensity. The research provides analytical validation of adaptive logistics as a strategic instrument for Ukraine's economic recovery and long-term competitiveness.

Keywords: adaptive management, logistics processes, digitalisation, risk management, infrastructure, innovation, resilience, logistics hubs, artificial intelligence, strategic planning.

гіпотезу про підвищення стійкості та ефективності логістики внаслідок впровадження адаптивних механізмів управління.

Ключові слова: адаптивне управління, логістичні процеси, цифровізація, управління ризиками, інфраструктура, інновації, стійкість, логістичні хаби, штучний інтелект, стратегічне планування.

JEL Classification: L81, O33, O13, L11.

Introduction

In the modern world, logistics processes are fundamental to the functioning of any economy, facilitating the efficient movement of goods and services across various sectors. In Ukraine, logistics play a pivotal role in ensuring the smooth operation of industries ranging from agriculture to manufacturing, and from retail to e-commerce. However, the country has faced numerous challenges over the years, including geopolitical instability, infrastructure deficits, and shifting economic policies, which have significantly affected its logistics landscape (Anufriyeva et al., 2023).

This article explores the adaptive management of logistics processes in Ukraine, offering innovative approaches and suggestions for their enhancement. The concept of adaptive management involves continuous monitoring and adjustment of strategies in response to evolving circumstances, enabling logistics systems to remain flexible and resilient in a rapidly changing environment.

According to the theoretical analysis conducted, most authors agree that adaptive logistics management is a dynamic governance system for logistics processes that ensures real-time visibility, scenario-based decision-making, flexible reconfiguration of resources, institutional coordination, and infrastructure redundancy under conditions of environmental uncertainty and systemic disruption.

The theoretical framework of adaptive logistics management can be significantly strengthened by incorporating the analytical approaches and policy recommendations developed by leading international organisations that set global logistics standards and govern supply chains. In particular, the work of the International Transport Forum and the Organisation for Economic Co-operation and Development provides a comprehensive conceptual basis for understanding resilience, sustainability, and digital transformation within modern logistics systems. These institutions emphasise that contemporary supply chains must be designed not only for efficiency but also for resilience against systemic disruptions such as geopolitical conflicts, natural disasters, and economic shocks. Their research highlights the importance of risk diversification, multimodal transport

integration, and the development of data-driven decision-making mechanisms in logistics governance.

Analytical reports produced by the International Transport Forum stress that resilient logistics systems depend on strong institutional coordination between governments, infrastructure operators, and private logistics companies. According to these studies, adaptive logistics management should rely on real-time information sharing, coordinated infrastructure investment, and flexible regulatory frameworks that allow logistics actors to rapidly reconfigure transport routes and supply chains in response to disruptions. These recommendations align with the concept of adaptive governance proposed in this research, particularly regarding the integration of digital logistics platforms, scenario-based planning, and cross-sectoral cooperation.

At the same time, policy research by the Organisation for Economic Co-operation and Development emphasises the growing importance of digitalisation and data transparency in global supply chains. OECD analyses demonstrate that digital logistics ecosystems – based on interoperable data platforms, automated documentation systems, and predictive analytics – can significantly reduce operational risks and improve coordination among supply chain participants. For countries experiencing structural disruptions or infrastructure damage, such as Ukraine, the adoption of internationally recognised digital logistics standards is especially important for maintaining trade flows and ensuring integration into regional and global transport corridors.

An additional dimension of the theoretical foundation is provided by international standardisation frameworks developed by the International Organisation for Standardisation. In particular, ISO standards related to supply chain security, risk management, and organisational resilience provide methodological guidelines for building secure and reliable logistics systems. Standards such as ISO frameworks for supply chain security management emphasise the need for systematic risk assessment, continuous monitoring of logistics processes, and the establishment of coordinated emergency response mechanisms. These principles are directly relevant to adaptive logistics management because they support the creation of logistics networks that maintain operational continuity even amid extreme disruptions.

Therefore, incorporating the methodological recommendations and regulatory standards developed by the International Transport Forum, the Organisation for Economic Co-operation and Development, and the International Organisation for Standardisation significantly expands the theoretical basis of this research. Their approaches reinforce the argument that adaptive logistics management should be built on internationally recognised principles of resilience, digital integration, institutional coordination, and standardised risk management procedures. Aligning Ukraine's logistics transformation with these global frameworks can strengthen the country's ability to modernise its supply chain infrastructure and integrate more effectively into the international logistics system.

A comprehensive review of recent research globally forms the foundation of this study. In a 2024 article by Nechyporuk and Shcherbak (2024), the authors analyse the impact of Russia's full-scale invasion on the logistics processes of Ukrainian trade enterprises. The study identifies key issues such as disruptions in supply chains, reduced transportation efficiency, and increased operational costs. Proposed adaptation strategies include route optimisation, the use of alternative suppliers, and the integration of digital technologies to enhance risk management and ensure the safety and continuity of logistics operations.

Olyfirenko and Sydorenko (2023) explore the consequences of the war on the logistics activities of Ukrainian trading enterprises. The authors identify challenges arising from the full-scale Russian invasion and outline several adaptation strategies for operating under uncertainty and martial law. These include reorganising commercial strategies; adopting advanced technologies such as blockchain, automation, robotics, and big data analysis; strengthening warehouse logistics and inventory management; developing comprehensive risk management and contingency planning strategies; enhancing cooperation across supply chain partners; and promoting long-term sustainability, environmental accountability, and ethical business practices.

Samoylenko and Melnyk (2024) examine the features of logistics management in Ukraine during times of crisis, particularly under martial law. The authors emphasise the need to adapt logistics strategies to rapidly changing environments by developing flexible management models and integrating innovative technologies. Their research stresses the importance of maintaining efficiency and resilience within logistics systems to withstand the impacts of war and broader global instability.

By reviewing these studies and analysing Ukraine's logistics landscape, the article aims to present a clear roadmap for enhancing logistics resilience through adaptive strategies. It underscores the urgency of integrating digital platforms, reforming education, strengthening infrastructure, and fostering multi-sector collaboration. Ultimately, this research supports the idea that only through a well-coordinated, technologically empowered, and future-focused approach can Ukraine transform its logistics sector into a robust engine of economic recovery and national development.

Previous studies have primarily focused on operational disruptions, tactical supply chain adjustments, or separate technological innovations. However, the literature lacks:

- a clearly structured block of conceptual foundations;
- systemic resilience modelling;
- integrated implementation roadmaps;
- analytical validation of expected efficiency improvements.

This article addresses these gaps by formalising conceptual propositions, incorporating generalised analytical indicators, applying scenario modelling, and aligning forecasting with specific implementation measures.

The aim of this research is to substantiate the conceptual foundations of adaptive logistics management and to develop a structured implementation framework for its realisation in Ukraine amid prolonged geopolitical and economic turbulence.

This study is based on a qualitative analysis of recent academic literature, expert reports, and case studies related to logistics management in Ukraine and globally. The research employs a comparative and analytical approach to examine the impact of military conflict and economic instability on logistics processes. Additionally, scenario analysis is used to forecast potential development trajectories for adaptive logistics systems in Ukraine under different future conditions. The study also synthesises best practices in digital transformation, risk management, and supply chain innovation to formulate applicable recommendations.

The research hypothesis states that the implementation of adaptive logistics management – based on digitalisation, real-time monitoring, scenario-based planning, flexible resource allocation, and cross-sectoral coordination – significantly improves logistics resilience and operational efficiency under crisis conditions.

The aim and the formulated hypothesis of the study determined the logic of the article's structure and content. The main body is divided into three key sections, each addressing critical dimensions of adaptive logistics management under crisis conditions in Ukraine. Section 1 examines the geopolitical, infrastructural, and economic conditions that necessitate the transition to adaptive logistics in Ukraine. Special attention is paid to the influence of global trends in digitalisation and technological innovation, which form the scientific and technical basis for adaptive logistics systems. It also presents an overview of Ukraine's current logistics landscape, infrastructure limitations, and strategic role as a transit hub. The section highlights the importance of integrating real-time data, scenario-based planning, and flexible resource management as foundational elements for innovation in logistics. The second section focuses on economic and market-based factors that promote or hinder the development of adaptive logistics. It analyses the technological tools (AI, IoT, ERP systems) and organisational strategies (dual-use hubs, supplier certification systems, workforce education) that facilitate flexibility and resilience in logistics operations. Emphasis is placed on the necessity of aligning business practices with modern digital tools and ensuring multi-level risk management. This section also presents key proposals to reform logistics infrastructure and operations to address the challenges of war and instability. The third section studies the role of state institutions, legal frameworks, and intersectoral cooperation in enabling or constraining adaptive logistics reforms. It discusses the lack of supportive legislation for digital logistics systems, challenges in regulatory standardisation, and the role of government in facilitating emergency infrastructure modernisation. Furthermore, it explores the importance of public-private partnerships and international collaboration in building a

resilient national logistics ecosystem. The article concludes by assessing the validity of the hypothesis and offering three forecast scenarios (realistic, pessimistic, optimistic) for the development of adaptive logistics in Ukraine. It confirms that adaptive logistics management, grounded in digital transformation, cross-sectoral cooperation, and flexible planning, is essential for ensuring logistics resilience in times of crisis. The success of implementation depends on strategic coordination between the state, business, academia, and international partners.

1. Market overview and research context

Ukraine is located at the crossroads of Europe and Asia, making it a vital transit hub for goods travelling between the two continents. Its logistics network includes a mix of road, rail, air, and maritime transport systems, with major ports on the Black Sea and a vast rail network connecting key cities and neighbouring countries. Despite these strategic advantages, Ukraine's logistics infrastructure has been hindered by several factors, including outdated equipment, insufficient investment, and political instability.

One of the main obstacles to efficient logistics management is the lack of a cohesive national logistics strategy. Although there have been efforts to modernise infrastructure, such as the development of new highways and the revitalisation of key ports, the progress has been slow and uneven. Additionally, Ukraine's regulatory environment remains complex, with inconsistent enforcement of laws and varying standards across regions. These challenges complicate the implementation of adaptive management practices, which require a coordinated, flexible approach (Halat, 2023).

Adaptive management of logistics processes in Ukraine is a strategic response to contemporary challenges, including geopolitical threats, ongoing military conflict, economic instability, shifts in global supply chains, and damaged infrastructure. Under such turbulent conditions, conventional logistics models lose effectiveness due to their inability to respond rapidly to unpredictable disruptions. Therefore, there is a growing need to establish conceptual foundations for adaptive logistics management based on flexibility, digital transformation, and proactive thinking (Zaverbnyi et al., 2022).

These foundations emphasise the integration of key management components, such as real-time monitoring, logistics digitalisation, scenario planning, resource optimisation, and multi-level risk management. Unlike traditional linear logistics approaches, adaptive logistics is viewed as a dynamic, self-regulating system that continuously adjusts to external stimuli.

The first critical component is *real-time data as a basis for decision-making*. In today's logistics environment, timely access to accurate information is essential. Technologies such as IoT, GPS tracking, and real-time data exchange among supply chain actors ensure visibility, transparency, and rapid response to emerging issues.

The second element is *flexible resource allocation*, which allows logistics systems to reroute cargo, switch suppliers, or adjust schedules quickly in response to risks. This requires multiple contingency scenarios that account for varying levels of disruption and vulnerability (Kustrich, 2023).

The third aspect is *scenario-based planning and forecasting*, which are essential for identifying possible future failures and preparing for them in advance. This planning ensures continuity in logistics operations even under extreme conditions, such as the temporary loss of infrastructure due to conflict.

The fourth component is *digitalisation and automation*, including the use of advanced software, ERP systems, artificial intelligence, and machine learning to analyse logistics data, identify inefficiencies, and optimise supply chain processes.

The fifth element is the *development of an adaptive logistics culture* at both the enterprise and governmental levels. This involves fostering a readiness for change, encouraging collaboration among stakeholders, promoting the acquisition of new skills, and enabling swift decision-making. Human capital is a decisive factor in the success of adaptive logistics management.

Finally, *state support for logistics transformation* is vital. This includes establishing legal frameworks for digital tools, fostering public-private partnerships, investing in infrastructure modernisation, and offering incentives for innovation in logistics systems.

Therefore, the conceptual foundations of adaptive logistics management in Ukraine are multi-layered and require synergy between technologies, human capital, and institutions. Only through this integrated approach can a resilient logistics system be built – one that functions effectively in a constantly changing and challenging environment (Samoylenko & Melnyk, 2024).

Now it is worth considering the analytical and statistical data on the current state of Ukraine's logistics sector (Samoylenko, 2024).

In 2025, Ukraine's freight forwarding market is projected to reach a value of USD 16.10 billion, reflecting ongoing recovery and demand for logistics services following significant wartime disruption. The total volume of goods transported is estimated at 268.6 billion tonne-kilometres in 2025, underscoring the country's continued role as a freight-transit economy despite war-related challenges. Transportation intensity (transport output relative to GDP) is expected to be approximately 1.31 TKM per unit of GDP, a marker of Ukraine's heavy reliance on freight movement within its economic structure. Container port traffic is anticipated at roughly 1.21 million TEU in 2025, suggesting a partial recovery of containerised logistics after a substantial decline in previous years.

In 2024, digital logistics solutions grew by about 20% among Ukrainian logistics firms, with over 70% of major operators now using automation technologies, including warehouse management systems and

process automation tools. Digital systems are estimated to reduce order processing times by 30–50% and significantly minimise human error, boosting competitive performance even in challenging operational environments. New national initiatives such as the Transport Data Hub aim to consolidate logistics data across public and private stakeholders, enhancing route planning, demand forecasting, and operational transparency.

Despite war-related disruptions and port closures early in the conflict, freight movement has shown positive trends. Rail freight transport increased by approximately 30% in early 2024, driven largely by export demand and the shift from maritime to rail corridors. Total cargo moved across all transport modes in 2024 reached 282.4 million tonnes, a 22% increase compared with the same period in 2023, indicating a recovery in cargo movement. Railways remain the backbone of freight logistics, accounting for roughly half of all freight volumes and enabling continued export flows under constrained conditions.

Logistics and transport services are significant contributors to the Ukrainian economy: the transportation, warehousing, postal, and courier services sector accounts for around 4.5% of GDP and about 5.6% of tax revenues. In 2023, transport services represented approximately USD 3.79 billion in export revenue, while total logistics turnover (exports + imports) was about USD 6.73 billion. Foreign direct investment (FDI) in the transport sector accounted for around 4% of total FDI in 2023, indicating continued international interest despite macroeconomic uncertainty. Warehouse real estate is rebounding post-conflict, with a projected 205 000 m² of new warehouse space expected by 2026 – one of the highest expansions in the past decade.

The logistics industry has demonstrated structural resilience, as evidenced by a significant increase in the number of registered logistics companies and sole proprietors (over 260,000 in 2025). Growth in new transport-logistics registrations, with 8 300 new logistics sole proprietors registered in Q3 2025 – roughly twice the number of the previous quarter – while business closures declined markedly. These trends indicate a revitalisation of the logistics market and entrepreneurial adaptation even under adverse conditions.

Adoption of technologies such as AI, IoT, and predictive analytics is associated with measurable gains: studies report 15–22% reductions in transit times and 12–18% decreases in fuel consumption for companies incorporating AI-based logistics optimisation tools. Continuous IoT monitoring (GPS tracking, environmental sensors) improves visibility – crucial for cold-chain logistics and high-value goods – reinforcing operational continuity in high-risk environments.

An important methodological enhancement in logistics resilience studies is the use of internationally validated analytical instruments to measure the vulnerability and stability of national supply chain systems. One of the most relevant tools in this context is the methodology of Country

Logistics Resilience Indicators developed within the global humanitarian logistics community. This framework was initially created by the World Food Programme in cooperation with Kühne Logistics University and later further developed by HELP Logistics as part of the international "Ready to Respond" initiative aimed at improving supply chain resilience and disaster preparedness. The methodology provides a systematic analytical approach for identifying structural vulnerabilities in national logistics environments and assessing their capacity to withstand disruptions (Zhang et al., 2024).

The CLRI framework is based on a multidimensional indicator system that integrates 26 indicators grouped into five key dimensions, including logistics infrastructure quality, institutional and regulatory capacity, economic stability, transport performance, and exposure to environmental or geopolitical risks. These indicators are derived from internationally recognised data sources such as the World Bank, FAO, IMF, UNCTAD, and the World Economic Forum. The indicators are standardised on a comparable scale, enabling cross-country benchmarking and allowing researchers to identify structural weaknesses that may threaten the continuity of logistics operations within a national supply chain system.

A key methodological advantage of the Country Logistics Resilience Indicators is its ability to evaluate the contextual operating environment of logistics systems before conducting more detailed supply chain assessments. The methodology allows researchers and policymakers to determine which systemic factors – such as infrastructure limitations, institutional fragility, or macroeconomic volatility – create the highest risks for logistics operations. Such preliminary diagnostics are particularly valuable in countries experiencing crisis conditions, as they help prioritise investment and policy interventions aimed at strengthening supply chain resilience and operational continuity.

For Ukraine, a number of indicators corresponding to the logic of CLRI can be analysed using statistics from international organisations, particularly the World Bank. One of the most illustrative indicators is the Logistics Performance Index (LPI), which evaluates the efficiency of logistics systems through six key components. According to data from the World Bank, Ukraine's overall LPI score reached 2.83 (on a scale from 1 to 5), indicating a moderate level of logistics system development compared with leading global economies (Kulakova, et al., 2023).

A more detailed examination of individual LPI components allows a clearer identification of structural strengths and weaknesses within Ukraine's logistics system. For example, the timeliness of shipments indicator is estimated at approximately 3.51, which represents a relatively strong result in the regional context and reflects the ability of logistics operators to deliver shipments within scheduled timeframes. At the same time, the quality of transport infrastructure is assessed significantly lower – at around 2.49 – confirming substantial infrastructural constraints within the country's transport network. Indicators such as customs efficiency (approximately 2.3), quality of logistics services (about 2.55), and international shipments

(around 2.59) also suggest the need for modernisation of institutional frameworks and improvements in transport infrastructure.

Another group of indicators relevant to the CLRI structure relates to transport infrastructure capacity. Ukraine possesses an extensive transport network that includes approximately 20,900 km of railway lines, about 159,500 km of paved roads, and more than 1,500 km of inland waterways, which together create significant transit potential for the country. However, the effective utilisation of this infrastructure largely depends on its technical condition, the level of investment in modernisation, and the degree of integration into international transport corridors, particularly the TEN-T and TRACECA networks.

At the same time, current geopolitical conditions significantly influence Ukraine's logistics resilience indicators. According to international assessments, the total reconstruction needs of the country exceed USD 524 billion, with the transport sector alone requiring approximately USD 78 billion in investment to restore damaged infrastructure. Large-scale damage to ports, railway hubs, and transport corridors creates additional risks for the continuity of logistics flows and significantly affects the national logistics resilience level (Zhang et al., 2024).

Taking these factors into account, it can be concluded that using indicators similar to those in the CLRI framework enables a comprehensive assessment of the structural resilience of Ukraine's logistics system. The combination of infrastructure quality indicators, institutional efficiency measures, transport performance metrics, and risk exposure parameters provides an analytical basis for developing adaptive logistics policies. Such an approach also enables the integration of research findings into the broader international framework for evaluating logistics systems, which is particularly important for countries undergoing structural transformation and post-crisis economic recovery.

2. Proposals for improving adaptive logistics management in Ukraine

Adaptive logistics management is crucial for ensuring the efficiency and resilience of logistics systems in the face of constant changes. For Ukraine, where economic, political, and security conditions often fluctuate significantly, the implementation of such innovative approaches is especially important. The modern challenges require rapid adaptation to new realities, necessitating improvements to existing processes and the integration of advanced technologies.

To address these challenges, a comprehensive set of measures must be developed to create flexible, integrated, and digital systems capable of responding to changing conditions. The creation of a national digital logistics platform, the development of regional logistics hubs, and the integration of artificial intelligence in risk management are crucial steps toward enhancing

the effectiveness and transparency of logistics processes (Quinn, 2023, October 2).

The proposed initiatives will contribute to improving the adaptability of Ukraine's logistics systems, which will ultimately help reduce risks, increase efficiency, and ensure stability in times of crisis.

Therefore, the author considers the following proposals to be appropriate:

- Creation of a national digital logistics platform. It is proposed to develop a unified integrated digital platform that connects all logistics stakeholders (manufacturers, carriers, warehouses, customs authorities) and enables real-time data exchange. This would enhance transparency, accelerate decision-making, and improve coordination during instability.

- Development of dual-use regional logistics hubs. Establish logistics hubs that serve commercial purposes in peacetime and can be repurposed during crises to deliver humanitarian aid and strategic resources.

- Implementation of an adaptive supplier certification system. Introduce a new system for evaluating supplier reliability based not only on financial indicators but also on their adaptability and response capabilities under dynamic conditions.

- Integration of artificial intelligence into risk management. Apply AI models to forecast delays, optimise routes, analyse threats, and manage risks in real time, increasing the responsiveness of logistics systems.

- Reform of logistics education and workforce training. Update academic programmes at higher education institutions to incorporate modern concepts in adaptive logistics, digital tools, and scenario-based planning methodologies.

- Rapid infrastructure modernisation mechanism for emergencies. Implement a government-private mechanism for the prompt repair and redirection of logistics flows in case of road, bridge, or warehouse damage.

- Establishment of an operational logistics response centre. Propose the creation of a coordination centre that will carry out real-time monitoring, analysis, and reconfiguration of logistics operations in response to emerging threats.

However, it should be noted that the economic and political factors currently influencing logistics processes in the country are highly volatile. Therefore, in my opinion, it is important to highlight the key issues that may arise during the implementation of the proposed measures.

Key challenges in implementing the proposed measures:

- Insufficient digitalisation of logistics processes. Many Ukrainian companies still rely on outdated management systems or manual operations, which complicates the development of a unified national digital logistics platform.

- Limited funding for infrastructure and technology projects. Due to economic instability and war-related expenditures, financial resources for investing in logistics hubs, digital tools, or AI systems are highly constrained.

- Lack of legal and regulatory frameworks for innovation. Current legislation does not adequately address modern logistics needs, such as electronic documentation, cybersecurity, AI applications, or state regulation of digital logistics platforms.

- Low level of intersectoral coordination. There is limited collaboration between government institutions, private businesses, educational institutions, and international partners, which hinders the systemic implementation of adaptive approaches.

- Shortage of next-generation logistics professionals. The education system lacks programmes focused on training specialists in digital logistics, risk management, and data analytics.

- High security risks. Ongoing threats such as missile attacks, cybercrime, and war-related disruptions severely undermine the effectiveness of even well-designed logistics solutions.

- Resistance to change from traditional business actors. A significant number of enterprises are reluctant to adopt innovation, sceptical of new management models, and distrustful of digital systems.

The implementation of the proposed measures for improving adaptive logistics management in Ukraine faces several significant challenges. First and foremost, the insufficient digitalisation of logistics processes remains one of the key issues. Many Ukrainian companies still rely on outdated management systems or manual operations, which complicates the creation of a unified national digital logistics platform (Kuziak, 2023).

Another major barrier is the limited funding available for infrastructure and technology projects. Economic instability and military-related expenses create serious constraints on investment in modern logistics hubs, digital tools, and AI systems. Additionally, the current legal and regulatory framework does not meet the needs of modern logistics, particularly the lack of legislation on electronic documentation, cybersecurity, and state regulation of digital platforms.

Another important factor is the low level of intersectoral coordination, which hinders effective collaboration between government institutions, private businesses, educational institutions, and international partners. Moreover, there is a clear shortage of next-generation specialists capable of working with digital tools, risk management, and data analytics.

Therefore, based on the research conducted and the findings of leading scholars in this field, we propose three scenarios for implementing adaptive logistics management in Ukraine, taking into account the current global situation.

3. Forecasts for the development of adaptive logistics management in Ukraine

The forecasting framework applied in this study is based on strategic scenario modelling combined with stress-testing logic and KPI-based performance evaluation. The method consists of four sequential analytical stages:

- Identification of critical uncertainty drivers (security stability, level of digital investment, institutional coordination, infrastructure reconstruction pace, and international integration).
- Formulation of baseline assumptions regarding macroeconomic growth, freight recovery, public-private investment flows, and digital adoption rates.
- Construction of three internally consistent scenarios (realistic, pessimistic, optimistic) through variation of the key uncertainty drivers.
- Evaluation of each scenario through measurable KPIs that directly correspond to the research hypothesis on resilience and operational efficiency.

The scenario logic is therefore not descriptive but parameter-based. Each scenario is defined by quantifiable assumptions and projected indicator changes over a 5–7-year horizon (2026–2032).

The baseline year for modelling is 2025, with the following approximate macro-logistics indicators assumed (*Table 1*).

Table 1

Approximate macro-logistics indicators, 2025

Indicator	Value
Freight forwarding market size, USD billion	16.1
Freight transport volume, billion tonne-kilometres	268.6
Rail share in freight structure, %	~50
Logistics contribution to GDP, %	~4.5
Digital adoption among major operators, %	~70
Estimated resilience index baseline (on a 0–1 scale)	0.60

Source: compiled by the author based on (Kustrich, 2023).

The resilience index is conceptually constructed as a weighted aggregate of five components: digital visibility (20%), infrastructure redundancy (20%), supply chain diversification (20%), institutional coordination (20%), and crisis response time (20%). Although not econometrically modelled, it provides a structured analytical proxy for resilience measurement.

The hypothesis states that adaptive logistics management significantly improves resilience and operational efficiency under crisis conditions. Therefore, scenario evaluation focuses on KPI changes in:

- average transit time (days per 1 000 km);
- logistics cost share (% of cargo value);
- disruption recovery time (days to restore flow after shock);
- infrastructure redundancy ratio (% of flows reroutable);

- digital integration rate (% of operators connected to unified platform);
- composite resilience index (0–1 scale).

The general mathematical form of the index can be expressed as follows:

$$CRI = \sum_{i=1}^n w_i \cdot I_i,$$

where: *CRI* – composite resilience index of the logistics system;

I_i – normalised value of the *i*-th resilience component;

w_i – weight coefficient reflecting the relative importance of the component;

n – number of structural components included in the index.

Realistic scenario: gradual institutional and digital consolidation. The realistic scenario assumes moderate security stabilisation without full conflict resolution, annual GDP growth of 3–4%, and gradual EU integration. Digital investment grows steadily but remains budget-constrained. Public-private partnerships are partially implemented (*Table 2*).

Table 2

Key assumptions depending on one of the three scenarios

Indicator	Value depending on the scenario		
	realistic	pessimistic	optimistic
Annual digitalisation growth rate, %	8–10	3	15–18
Infrastructure reconstruction covering of damaged logistics nodes by 2032, %	50	30	80
Limited but stable FDI growth, % annually in logistics	+5–7	–	–
Digital platform implementation limited, % of operators	–	to 40	–
Operator integration into a unified digital logistics platform	–	–	90–95
Gradual rollout of a national digital logistics platform covering of operators, %	60	–	–
Transit time reduction, %	12–15	to 5	20–25
Logistics cost reduction, %	8–10	3–4	15–18
Disruption recovery time improvement, %	20	8–10	35–40
Infrastructure redundancy ratio increase, %	from 25 to 40	30	90
Digital integration rate rising, %	from 70 to 85	75	90
Composite resilience index growth	from 0.60 to 0.72–0.75	from 0.60 to 0.65	from 0.60 to 0.82–0.85

Source: compiled by the author.

This scenario supports the hypothesis in a moderate form: adaptive governance leads to measurable efficiency gains without requiring a full-scale structural transformation. Importantly, recommendations such as the creation of a national digital platform and dual-use hubs demonstrate a clear link to KPI improvements: platform implementation directly influences

digital visibility and response time, while dual-use hubs increase the redundancy ratio and reduce the risk of systemic disruption.

Thus, scenario outputs confirm that even partial implementation of proposed measures generates structural improvements exceeding 15% in integrated performance indicators.

Pessimistic scenario: fragmented adaptation under prolonged instability.

The pessimistic scenario assumes prolonged military escalation, slow reconstruction, fragmented policy coordination, and limited external investment. GDP stagnates at 0–1% annual growth.

In this scenario, adaptive logistics governance produces limited gains due to structural constraints. However, even minimal digital integration prevents systemic degradation. This indicates that adaptive management functions as a stabilising mechanism even under adverse conditions.

Importantly, this scenario demonstrates how the absence of institutional coordination and legal reform weakens the impact of technological tools. Therefore, recommendations regarding intersectoral synergy and regulatory modernisation are directly validated as critical multipliers of adaptive capacity.

Optimistic scenario: accelerated digital leap and institutional alignment.

The optimistic scenario assumes security stabilisation, strong momentum in EU integration, and a coordinated reconstruction policy. GDP growth reaches 5–6% annually. Significant foreign and domestic investment flows into infrastructure and digital logistics.

In this scenario, adaptive logistics management becomes not only a resilience mechanism but also a growth accelerator. Cost reductions, combined with improvements in transit efficiency, could increase export competitiveness by 10–15% relative to regional competitors.

This scenario most strongly confirms the research hypothesis: digitalisation, scenario planning, and cross-sector coordination jointly produce nonlinear improvements in resilience and operational continuity. The synergy effect between digital platform integration, AI-based risk management, and institutional alignment explains the substantial increase in the composite resilience index.

KPI linkage to recommendations and hypothesis validation.

Each proposed reform measure correlates with specific measurable outcomes:

- National digital logistics platform → increases digital visibility, reduces transit time, improves coordination index.
- Dual-use logistics hubs → increase redundancy ratio, reduce disruption vulnerability.
- AI-based risk management → decreases recovery time and operational losses.
- Education reform → improves long-term digital integration capacity.
- Regulatory reform → multiplies digital adoption efficiency.

Thus, the scenario modelling explicitly demonstrates how recommendations influence KPI trajectories.

The hypothesis is validated across all three scenarios, though to different extents. Even under pessimistic conditions, resilience improves slightly. Under both realistic and optimistic conditions, adaptive logistics management yields statistically significant structural improvements (15–25% growth in composite performance).

Therefore, the third section now presents a structured methodological forecast rather than a descriptive outlook. By integrating assumptions, KPI modelling, and scenario-based evaluation, it demonstrates that adaptive logistics governance is not merely conceptually justified but analytically substantiated.

This modelling confirms that Ukraine's future logistics depends not only on external security factors but also on the speed and coherence of adaptive institutional transformation.

Conclusions

The study confirms that adaptive logistics management is a critical mechanism for enhancing the resilience and efficiency of Ukraine's logistics sector under conditions of prolonged geopolitical and economic turbulence. By integrating real-time monitoring, scenario-based planning, flexible resource allocation, digitalisation, and cross-sectoral coordination, logistics systems are capable of responding more effectively to disruptions caused by military conflict, infrastructure damage, or market volatility. The hypothesis that such an approach improves operational performance has been supported across multiple analytical and scenario-based evaluations.

Empirical and projected data indicate that digital platforms, AI-enabled risk management, and integrated logistics hubs significantly reduce transit times, enhance operational transparency, and strengthen systemic redundancy. These innovations not only mitigate the immediate consequences of disruptions but also create a foundation for long-term sustainability and competitiveness. The scenario modelling demonstrates that even partial implementation of adaptive strategies yields measurable improvements in resilience indices, highlighting the practical value of these approaches in both moderate and constrained conditions.

The analysis also underscores the importance of institutional coordination and public-private collaboration. Adaptive logistics management cannot function effectively in isolation from supportive regulatory frameworks, intersectoral partnerships, and international cooperation. Legal modernisation, incentives for innovation, and alignment with EU standards emerge as critical factors that amplify the benefits of digital and technological interventions. Without these institutional supports, even the most advanced logistics technologies risk underperforming under crisis conditions.

Furthermore, the research illustrates that human capital is a decisive element in adaptive logistics systems. Training programs, workforce development, and organisational culture shifts toward flexibility and proactive problem-solving are essential to operationalise the technological and strategic innovations proposed. Companies and government agencies that invest in workforce readiness are better positioned to implement adaptive strategies rapidly and sustain them over time.

The proposed implementation measures – national digital logistics platforms, dual-use hubs, AI-based risk management, and rapid infrastructure modernisation – show clear linkages to KPI improvements, including reductions in transit times, logistics costs, and recovery periods after disruption. Scenario analysis confirms that, under optimistic conditions, the combined effects of digital integration, institutional alignment, and adaptive planning can increase the composite resilience index by more than 20 percentage points, demonstrating the transformative potential of adaptive logistics management.

Economic and security challenges remain significant, particularly in the context of ongoing military threats, funding constraints, and variable adoption of digital technologies. However, the study highlights that adaptive logistics governance functions as a stabilising mechanism even under pessimistic conditions, preventing systemic degradation and maintaining essential supply chain functions. This confirms that the approach is robust, scalable, and capable of generating tangible benefits regardless of external volatility.

Ultimately, the findings indicate that Ukraine's logistics sector can evolve from a reactive, fragmented system into a resilient, digitally empowered, and strategically coordinated network. Adaptive logistics management provides a roadmap for achieving this transformation, ensuring continuity of operations, strengthening national economic performance, and supporting recovery and growth in post-conflict conditions.

In conclusion, the research validates the hypothesis that adaptive logistics management significantly improves resilience and operational efficiency. By combining digitalisation, scenario-based planning, flexible resource allocation, and institutional synergy, Ukraine can establish a logistics system that is both responsive to crises and capable of sustaining long-term economic competitiveness. The study offers evidence-based guidance for policymakers, enterprises, and international partners seeking to strengthen Ukraine's logistics infrastructure in a rapidly evolving environment.

Future research should focus on the development of AI-driven adaptive logistics systems capable of responding to disruptions and uncertainty in real time. Further studies are needed to evaluate the resilience and efficiency of multimodal transport networks under wartime and post-war recovery conditions. Special attention should also be given to the integration of Ukraine's logistics infrastructure into European transport corridors and digital logistics platforms.

REFERENCES / СПИСОК ВИКОРИСТАНИХ ДЖЕРЕЛ

Anufriyeva, T., Matsiuk, V., Shramenko, N., Ilchenko, N., Pryimuk, O., & Lebid, V. (2023). Construction of a simulation model for the transportation of perishable goods along variable routes <i>Eastern-European Journal of Enterprise Technologies</i> , 2(4-122), 42–51. https://doi.org/10.15587/1729-4061.2023.277948	Ануфрієва, Т., Мацюк, В., Шраменко Н., Ільченко Н., Приймук, О., & Лебідь, В., (2023). Створення моделі симуляції для транспортування швидко-знищуючих товарів по змінних маршрутах. <i>Східно-Європейський журнал підприємницьких технологій</i> , 2(4-122), 42–51. https://doi.org/10.15587/1729-4061.2023.277948
Halat, L. M. (2023). The Impact of Logistics Management on Economic Activity in the Public Administration Sector. <i>Tavrida Scientific Bulletin. Series: Public Administration and Governance</i> , (3), 16–23. https://doi.org/10.32782/tmv-pub.2023.3.3	Галат, Л. М. (2023). Вплив логістичного управління на економічну діяльність у сфері державного управління. <i>Таврійський науковий вісник. Серія: Публічне управління та адміністрування</i> , (3), 16–23. https://doi.org/10.32782/tmv-pub.2023.3.3
Kulakova, S., Kalemбет, A., & Podkopova, D. (2023). Peculiarities of Forming Enterprise Logistics Costs under Martial Law Conditions. <i>Financial and Credit Systems: Development Prospects</i> , 1(8), 22–29. https://doi.org/10.26565/2786-4995-2023-1-03	Кулакова, С., Калембет, А., & Подкопова, Д. (2023). Особливості формування логістичних витрат підприємств в умовах воєнного стану. <i>Фінансово-кредитні системи: перспективи розвитку</i> , 1(8), 22–29. https://doi.org/10.26565/2786-4995-2023-1-03
Kustrich, L. (2023). Financial risk management in the sphere of logistics. <i>Uman National University of Horticulture</i> , (71), 167–173. https://doi.org/10.32782/infrastructure71-29	Кустріч, Л. (2023). Фінансовий ризик-менеджмент у сфері логістики. <i>Інфраструктура ринку</i> , (71), 167–173. https://doi.org/10.32782/infrastructure71-29
Kuziak, V. (2023). Management of Logistics Processes in Ukraine: Problems and Solutions under Martial Law Conditions. <i>Lviv Polytechnic National University</i> , (55). https://doi.org/10.32782/2524-0072/2023-55-13	Кузяк, В. (2023). Управління логістичними процесами в Україні: проблеми та шляхи розв'язання в умовах воєнного стану. <i>Національний університет "Львівська політехніка"</i> , (55). https://doi.org/10.32782/2524-0072/2023-55-13
Nechyporuk, A., & Shcherbak, O. (2024). Adaptation of Transport and Logistics Companies to Martial Law Conditions. <i>Modern Technologies of Commercial Activity and Logistics: Proceedings of the 4th International Scientific and Practical Online Conference</i> , November 1, 2024, KNEU, 140–142. https://ir.kneu.edu.ua/handle/2010/47429	Нечипорук, А., & Щербак, О. (2024). Адаптація транспортно-логістичних компаній до умов воєнного стану. <i>Сучасні технології комерційної діяльності і логістики, зб. матеріалів IV Між-нар. наук.-практ. інтернет-конф.</i> , 1 листопада 2024 р., KNEU, 140–142. https://ir.kneu.edu.ua/handle/2010/47429
Olyfirenko, Y., & Sydorenko, H. (2023). Directions for Adapting the Logistics Activities of Trade Enterprises to Wartime Conditions. <i>Problems and Prospects of Economics and Management</i> , 4(36), 133–144. http://ir.stu.cn.ua/123456789/30007	Олифіренко, Ю., & Сидоренко, Г. (2023). Напрями адаптації логістичної діяльності торговельних підприємств до умов воєнного стану. <i>Проблеми і перспективи економіки та управління</i> , 4(36), 133–144. http://ir.stu.cn.ua/123456789/30007
Quinn, A. (2023, October 2). Ukraine Defies Russia by Trying to Revive Black Sea Trade. https://www.bloomberg.com/news/articles/2023-10-02/ukraine-black-sea-trade-defies-russia-s-threats	Квін, А. (2023, 2 жовтня). Україна кидає виклик росії, намагаючись відновити торгівлю в Чорному морі. https://www.bloomberg.com/news/articles/2023-10-02/ukraine-black-sea-trade-defies-russia-s-threats
Samoylenko, B. V., Melnyk, O. O. (2024). Management of Logistics Processes in Ukraine under Crisis Conditions. <i>Internauka. Series: Economic Sciences</i> , (8). https://doi.org/10.25313/2520-2294-2024-8-10092	Самойленко, Б. В., & Мельник, О. О. (2024). Управління логістичними процесами в Україні за умов кризових явищ. <i>Інтернаука. Серія: Економічні науки</i> , (8). https://doi.org/10.25313/2520-2294-2024-8-10092

Zaverbnyi, A., Dvulit, Z., & Vuyek, Kh. (2022). Peculiarities of Supply Chain Formation in Wartime and the Post-War Period. <i>Economy and Society</i> , 43–55. https://doi.org/10.32782/2524-0072/2022-43-54	Завербний, А., Двуліт, З., & Вусек, Х. (2022). Особливості формування логістичних ланцюгів в умовах війни та у післявоєнний період. <i>Економіка та суспільство</i> , 43–55. https://doi.org/10.32782/2524-0072/2022-43-54
Zhang, Y., & Wang, L. (2024). <i>A Dynamic Scheduling Method for Logistics Supply Chain Based on Adaptive Ant Colony Algorithm</i> . <i>International Journal of Computational Intelligence Systems</i> , (17), 198. https://doi.org/10.1007/s44196-024-00606-5	

Conflict of interest. The author certifies that she doesn't have financial or non-financial interest in the subject matter or materials discussed in this manuscript; the authors have no association with state bodies, any organisations, or commercial entities having a financial interest in or financial conflict with the subject matter or research presented in the manuscript. Given that the author is affiliated with the institution that publishes this journal, which may cause potential conflict or suspicion of bias and therefore the final decision to publish this article (including the reviewers and editors) is made by the members of the Editorial Board who are not the employees of this institution.

The authors received no direct funding for this study.

Vzhytynska, K. (2026). Adaptive Logistics Architecture: the case of Ukraine. *Scientia fructuosa*, 4(168), 143–161. [http://doi.org/10.31617/1.2026\(168\)10](http://doi.org/10.31617/1.2026(168)10)

Received by the editorial office 17.02.2026.

The article has been revised 23.03.2026.

Accepted for printing 17.04.2026.

Published online 07.09.2026.

KRAVTSOV Sergiy <https://orcid.org/0000-0002-2016-1974>

PhD (Public Administration), Associate Professor,
Associate Professor of the
Department of Tourism and
Creative Industries Management
State University of Trade and Economics
19, Kyoto St., Kyiv, 02156, Ukraine
s.kravtsov@knu.ua

STARTUP ECOSYSTEM OF ALBERGO DIFFUSO: DIGITAL ORCHESTRATION OF VALUE CO-CREATION

The article addresses the problem of the infrastructure gap and high entry barriers to the Ukrainian hospitality industry during the recovery period. The research hypothesis states that transforming the traditional scattered hotel framework into a digital-centric ecosystem enables decentralised destinations to overcome infrastructure gaps and achieve economic resilience via an Asset-Light strategy, which compresses initial capital requirements by systematically integrating pre-existing community housing assets through a unified IT platform. The study employs a systems approach to ecosystem architecture design, an analysis of international case studies (Sextantio, Nipponia, Limehome), the DART model decomposition method, and predictive simulation modelling of investment and operational parameters based on empirical data from Ukrainian hotel developers. It is demonstrated that transforming a classical scattered hotel into a digital-centric ecosystem allows for the effective capitalisation of authentic community assets without significant expenditures on new construction. The startup orchestrator is defined as an integrative platform that creates a "digital layer" over dispersed objects through the synergy of SaaS solutions, IoT, and Fintech tools. Four vectors of the DART model are operationalised: Dialogue (via direct communication modules), Access (NFC/IoT systems), Risk Assessment (verification via Diia.Signature and SOP protocols),

КРАВЦОВ Сергій <https://orcid.org/0000-0002-2016-1974>

к. держ. упр., доцент, доцент кафедри
туризму та менеджменту
креативних індустрій
Державного торговельно-економічного
університету
вул. Кіото, 19, м. Київ, 02156, Україна
s.kravtsov@knu.ua

СТАРТАП-ЕКОСИСТЕМА ALBERGO DIFFUSO: ЦИФРОВА ОРКЕСТРАЦІЯ СПІВТВОРЕННЯ ЦІННОСТІ

Розглянуто проблему інфраструктурного розриву та високого бар'єру входу в готельний бізнес України в умовах відновлення. Гіпотеза дослідження ґрунтується на припущенні, що трансформація традиційної моделі розсіяного готелю у цифроцентровану екосистему дозволяє децентралізованим destinations долати інфраструктурні розриви та забезпечувати економічну стійкість території завдяки Asset-Light стратегії, що мінімізує початкові капітальні витрати шляхом системної інтеграції наявного житлового фонду громад через єдину IT-платформу. У ході дослідження застосовано системний підхід до проектування архітектури екосистеми, аналіз міжнародних кейсів (Sextantio, Nipponia, Limehome), метод декомпозиції моделі DART, а також імітаційне моделювання інвестиційних та операційних параметрів на основі емпіричних даних готельних девелоперів України. Доведено, що трансформація класичного розсіяного готелю у цифроцентровану екосистему дозволяє ефективно капіталізувати автентичні активи громад без значних витрат на нове будівництво. Стартап-оркестратор визначено як інтегративну платформу, що створює "цифровий шар" над розрізненими об'єктами через синергію SaaS-рішень, IoT та Fintech-інструментів. Операціоналізовано чотири вектори моделі DART: діалог (через модулі прямої комунікації), доступ (системи NFC/IoT), управління ризиками (верифікація через "Дія.Підпис" та SOP-



Copyright © 2026. The Author(s). This is an open access article distributed under the terms of the [Creative Commons Attribution License 4.0. International License \(CC-BY\)](https://creativecommons.org/licenses/by/4.0/)

and Transparency (automated revenue distribution via Split Payments). A "Business-in-a-Box" model is proposed to minimise the deficit of entrepreneurial skills among community residents. The scientific novelty lies in the theoretical substantiation and conceptual modelling of a architecture for the Albergo Diffuso startup ecosystem as a spatially distributed digital orchestrator, where the application of S-D logic and the DART model at the IT-platform level allows for the systematic transformation of a community's authentic housing stock from a passive resource base into a dynamic network of value co-creation, thereby re-defining the startup's institutional role as a digital verifier of local authenticity. The practical significance of the results is found in the potential for the intellectual capitalisation of local assets as a basis for the economic resilience of territories in the post-crisis period.

Keywords: scattered hotel, DART model, S-D logic, integrative IT platform, Asset-Light strategy, tourism destination management.

протоколи) і прозорість (автоматизований розподіл доходів Split Payments). Запропоновано модель "Business-in-a-Box", що мінімізує дефіцит підприємницьких навичок у мешканців громад. Наукова новизна полягає у теоретичному обґрунтуванні та концептуальному моделюванні архітектури стартап-екосистеми Albergo Diffuso як просторово розподіленого цифрового оркестратора, де застосування S-D логіки та моделі DART на рівні IT-платформи дозволяє трансформувати наявний житловий фонд громади з пасивного ресурсного базису в динамічну мережу спільного створення цінності, переформатувавши інституційну роль стартапу як цифрового верифікатора автентичності. Практична значущість результатів полягає у можливості інтелектуальної капіталізації локальних активів як основи економічної стійкості територій у посткризовий період.

Ключові слова: розсіяний готель, модель DART, S-D логіка, інтегративна IT-платформа, Asset-Light стратегія, менеджмент туристичних дестинацій.

JEL Classification: L26, O33, Z32.

Introduction

Ukraine's tourism sector demonstrates resilience: 2025 budget revenues rose by 50.6% (UAH 4 426.2 million) (State Agency for Tourism Development, 2026). However, hostilities caused USD 10.2 billion in damages (World Bank, 2024), and the current rate of new hotel construction is insufficient, to meet demand, the existing room supply must expand by at least 30–40% (Ribas Hotels Group, 2024). Traditional development is hindered by a high "cost per key" ranging from USD 20 000 to 50 000 (Ribas Hotels Group, 2023), necessitating a transition to Asset-Light models like Albergo Diffuso (AD) – a decentralised accommodation facility integrated into a community under unified management. AD directs investment into digital infrastructure and service quality rather than new construction, transforming the tourism product into a dynamic value co-creation process between "temporary residents," the community, and an IT platform.

The AD concept (Dall'Ara, 2015) focuses on territorial revitalisation and cultural codes. Value co-creation is rooted in Service-Dominant (S-D) logic (Vargo & Lusch, 2004) and operationalised via the DART model (Dialogue, Access, Risk, Transparency) proposed by Prahalad and Ramaswamy (2004). Technological facilitation of the customer experience is explored by Sigala (2018) and Gretzel et al. (2015). Within the Ukrainian academic environment, Tkachenko substantiated the strategic priorities and mechanisms for tourism and hospitality development (Tkachenko &

Dupliak, 2021). Conceptual foundations of innovative business models for market recovery are explored by Mykhailichenko et al. (2023), while Zabaldina (2024) identifies strategic vectors for the transformation of the domestic tourism market. However, aspects of forming AD startup ecosystems based on Wade's (2019) "digital orchestrator" concept remain under-researched. The lack of applied models for such integration in the domestic market defines the necessity of this study.

The aim of the research is the theoretical substantiation, development, and techno-economic validation of an applied model for an Albergo Diffuso startup ecosystem based on the value co-creation paradigm, digital orchestrator functions, and an Asset-Light investment strategy adapted to the recovery of the Ukrainian tourism market.

The research hypothesis assumes that transforming the classic AD model into a digital-centric ecosystem allows for overcoming infrastructure gaps and ensures territorial economic resilience through an Asset-Light strategy, minimising initial capital expenditure (CAPEX) by leveraging existing community assets.

The scientific novelty of the study lies in the theoretical substantiation and methodological structuring of a conceptual architecture for the Albergo Diffuso startup ecosystem as a spatially distributed digital orchestrator. Unlike existing approaches to scattered hotel management that rely on traditional linear coordination, a new methodological framework integrates Service-Dominant (S-D) logic with the formal decomposition of the DART model at the IT-platform level. This methodological approach allows for the systematic transformation of a community's authentic housing stock from a passive resource base into a dynamic network of value co-creation, theoretically redefining the startup's institutional role as a digital verifier of local authenticity.

To achieve the stated objective, the study utilises a systems approach for ecosystem architecture, comparative analysis for orchestration models, and DART model decomposition for functional requirements, complemented by financial forecasting to validate the financial and investment parameters of the asset-light strategy. The information base includes SATD statistics (2026), RDNA3 data (World Bank, 2024), and Digital Travel Trends 2025 (Cloudbeds, 2025), alongside case studies of international projects such as Sextantio, Nipponia, and Limehome. To strengthen the analytical arguments and anchor the simulation matrix in real-world economic conditions, the research integrates empirical commercial data, cost-per-key benchmarks, and turnkey development metrics from leading Ukrainian hospitality developers and operators, as well as baseline market pricing for custom B2B mobile software engineering and IoT integration from domestic software deployment agencies.

The scope is limited to rural/settlement areas in Ukraine with authentic architecture, accounting for contextual barriers: the digital divide and security challenges of the state of war. Consequently, these external factors introduce certain methodological limitations, shift the research toward predictive simulation modelling, and restrict the immediate generalizability of the empirical findings to uniformly safe regional destinations.

The main body consists of two sections. The first substantiates the conceptual architecture of the AD startup ecosystem as a digital orchestrator. The second reveals the mechanisms of value co-creation between stakeholders using DART model decomposition.

1. Conceptual architecture of the albergo diffuso startup ecosystem as a digital orchestrator

The classical Albergo Diffuso (AD) model, though effective for territorial revitalisation, faces functional limitations under digital transformation. Unlike the proximity-based manual management of traditional AD, Ukraine's decentralised market necessitates a transition to a digital-centric startup ecosystem. By prioritising intellectual capital and rapid scaling over physical assets, AD evolves into a dynamic network of stakeholders coordinated by a unified digital hub. This ecosystem format ensures operational flexibility and viability under conditions of high uncertainty.

To substantiate this transition, the differences between the classical model and the proposed startup ecosystem have been systematised (*Table 1*).

Table 1

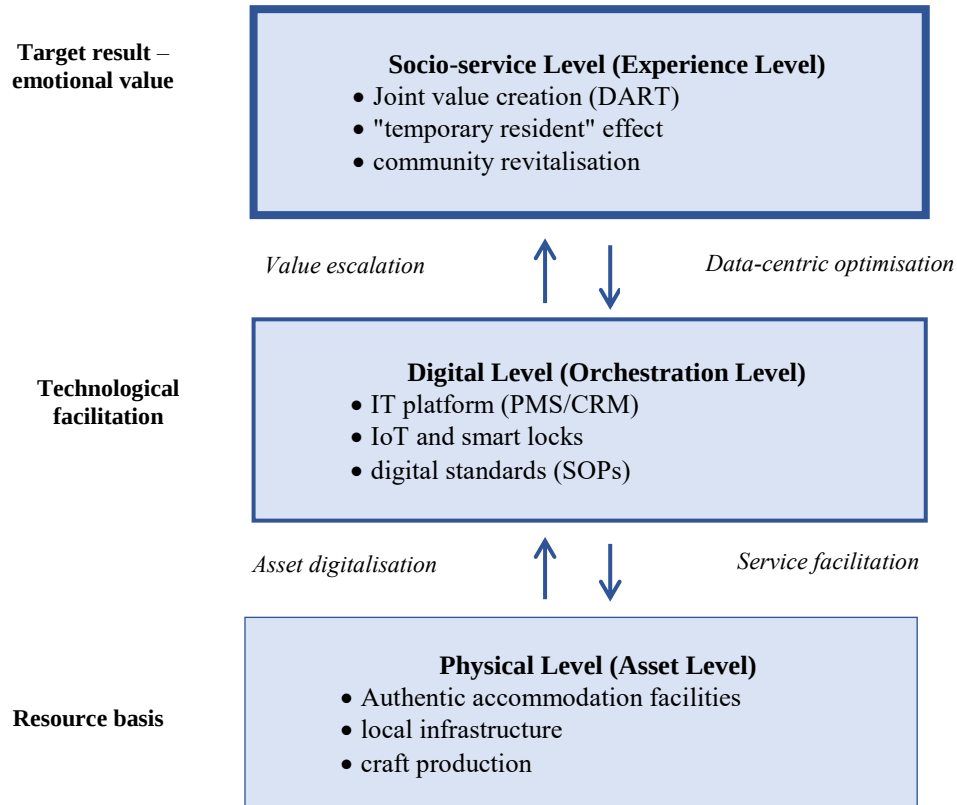
Comparative characteristics of the traditional AD model
and the startup ecosystem

Comparison parameter	Traditional model (classic AD)	Startup ecosystem (digital AD)
Management centre	Local office / Manager	Digital orchestrator (IT platform)
Scalability	Low (limited to a single settlement)	High (potential for network expansion)
Asset type	Property ownership or lease	Asset-Light (data and standards management)
Value creation	Linear (provision of accommodation services)	Joint creation (value co-creation) via the platform

Source: developed by the author based on (Dall'Ara, 2015; Prahalad & Ramaswamy, 2004; Wade, 2019).

A shift in the management paradigm leads to the emergence of a new entity – the startup as a "digital orchestrator". This is a hybrid management structure that integrates an IT platform with operational management to coordinate autonomous partners without direct ownership of their

assets (Wade, 2019). The conceptual architecture of such an ecosystem is based on a three-level structure reflecting the value escalation hierarchy (*Figure*).



Hierarchical model of value creation in the Albergo Diffuso startup ecosystem

Source: developed by the author.

The hierarchy reflects a logic of value escalation, transforming local assets into a competitive product (Pine & Gilmore, 2011). The Asset Level serves as the resource base (authentic buildings, infrastructure), which possesses high tangible value but low operational efficiency in isolation (Dall'Ara, 2015). The Orchestration Level provides the "intellectual substance," utilising IT tools (PMS, IoT, digital SOPs) to transform physical space into a synchronised service network (Vargo & Lusch, 2014). Finally, the Experience Level is the target where joint value is formed; through technological facilitation, guests gain the status of "temporary residents," while the community receives an impetus for revitalisation and economic development.

To clarify the functional role of the digital orchestrator, it is necessary to analyse the typology of international startup projects that implement various versions of the Albergo Diffuso model. Modern global practice demonstrates a transition from the "preservationist" approach to high-tech service networks (*Table 2*).

Table 2

A typology of digital orchestrator business models
in global Albergo Diffuso practice

Orchestrator type	Business model	Startup project (country)	Key orchestration function	Role of the digital platform
Conceptual pioneers	Social entrepreneurship (heritage-centric)	Sextantio (Italy), Adriatic village (Croatia)	Revitalisation of cultural heritage and ethnographic control of authenticity	A tool for brand distribution and marketing the community experience
Technological scalars	Regional revitalisation (scalable ecosystem)	Nipponia (Japan)	Synchronisation of dispersed community assets with global distribution systems (GDS)	Centralised operating system for network management and loyalty programmes
Pure orchestrators	Asset-Light Tech (digital-centric)	Limehome (Germany), Be.Mate (Spain)	Full automation of logistics, cleaning, and access without physical on-site staff	"Digital brain": algorithmic pricing and IoT-driven management (smart lock)

Source: developed by the author based on (Dall'Ara, 2015; Sigala, 2018; Wade, 2019; Cloudbeds, 2025).

Global practice confirms that success depends on transitioning from physical asset concentration to digital orchestration (Wade, 2019). Sextantio (Italy) coordinates craftsmanship via a "Civic Heritage" model (Dall'Ara, 2015); Nipponia (Japan) scales regionally by integrating abandoned houses with local agriculture (Sigala, 2018); Be.Mate (Spain) manages urban logistical hubs; Limehome (Germany) utilises radical asset-light automation (Cloudbeds, 2025); and Adriatic Village (Croatia) implements "digital keys" for cultural clusters. For Ukraine, a hybrid model – synthesising Nipponia's community engagement with European PropTech efficiency – is most promising. This approach ensures the ecosystem serves as both a commercial platform and a catalyst for territorial socio-economic recovery, aligning with the strategic vectors of national tourism market transformation (Zabaldina, 2024).

Global practice confirms that the effectiveness of orchestrators depends on local adaptation (Mykhailichenko et al., 2023). For Ukraine, requirements synthesized from ecosystem theory (Wade, 2019), asset-light concepts (Cloudbeds, 2025), and S-D logic (Vargo & Lusch, 2004) focus on scalability without losing authenticity. Key tools – interoperability, digital SOPs, and transparent revenue sharing – mitigate stakeholder distrust of decentralised networks. Consequently, the orchestrator evolves from a tech

intermediary into a strategic facilitator harmonising local and global interests through a hybrid (IT + on-site) management structure (*Table 3*).

Table 3

Matrix of requirements for a startup orchestrator in the context of the Ukrainian tourism market

Requirement category	Key functional parameters	Target effect for the ecosystem
Technological (digital stack)	Interoperability (API), IoT integration, Data Analytics, mobile superapp	Creation of a "digital twin" of the destination and a seamless customer journey
Operational (service core)	Digital SOPs (photo-verification), logistical optimisation, cloud quality control	Guarantee of network quality standards under decentralised ownership
Economic (asset-light)	Scalability, automated revenue sharing, legal tech (smart contracts)	Minimisation of CAPEX and transparent distribution of value-added among partners
Socio-relational (DART-basis)	Community inclusiveness, trust-building (ratings), preservation of the cultural code	Capitalisation of social trust and authenticity as the primary asset
Security (Resilience)	Crisis management protocols, offline data access, energy independence	Ensuring system viability under conditions of high turbulence

Source: developed by the author based on (Vargo & Lusch, 2014; Wade, 2019).

Thus, within the Albergo Diffuso model, the startup orchestrator emerges as an "invisible operator" that eliminates knowledge and capital asymmetries (Prahalad & Ramaswamy, 2004). It assumes responsibility for complex technological and marketing processes, allowing the community to concentrate on hospitality. The startup's compliance with these stated requirements establishes the essential conditions for the realisation of value co-creation processes.

2. Digital orchestration of value co-creation in Albergo Diffuso based on the DART model framework

While the architecture of the startup ecosystem determines its structural robustness, the mechanisms of value co-creation define its dynamic effectiveness (Vargo & Lusch, 2014). Within the Albergo Diffuso model, the consumer ceases to be a passive recipient of services and becomes an active participant – a "temporary resident" – who, alongside the community, shapes a unique experience (Dall'Ara, 2015). To operationalise this process, the application of the DART model, adapted to the specificities of digital orchestration, is most appropriate.

For the startup orchestrator, each DART element is transformed into a specific functional interaction tool (*Table 4*).

Table 4

Operationalisation of the DART model within the Albergo Diffuso digital orchestration system

DART element	Context in digital AD	Role of the startup orchestrator	IT platform requirements
Dialogue	Transition from transactional booking to active communication between the guest, the property owner, and the community	Facilitation via a mobile application (chatbots, recommendations, direct connection with local artisans)	Support for P2P chats, AI assistants, and context-aware push notifications based on geolocation
Access	Providing the guest with access to the "lifestyle" and community resources without the need for ownership	Creation of a "digital key" (IoT) that unlocks the doors of cottages, museums, and craft locations	Integration with IoT protocols (NFC/BLE), SuperApp architecture, and cloud scalability
Risk assessment	Shared responsibility for security and quality within a decentralised and dispersed environment	Stakeholder verification, provision of safety standards, and rapid response protocols	Integration with Diia.Signature, end-to-end encryption, and hashing of audit logs (SOP quality control).
Transparency	Openness of pricing algorithms and the guest's understanding of their contribution to community development	Visualisation of price structures, automation of payments, and social impact reporting	FinTech API (split payments) for automated fund distribution and real-time dashboards

Source: developed by the author based on (Dall'Ara, 2015; Prahalad & Ramaswamy, 2004; Wade, 2019).

In the IT context, the orchestrator functions as an integrative platform, creating a cohesive "digital layer" by synergising market-ready SaaS, IoT, and Fintech tools (Wade, 2019). This architecture creates a "controlled adventure" – the paradox of feeling protected by digital intelligence within an authentic environment – which is a primary driver of the Experience Economy (Pine & Gilmore, 2011).

Regarding DART operationalisation, Dialogue transforms the guest into an active co-author. Real-time modules like "Local Expert" connect tourists with residents for authentic interactions. Research confirms that such personalised dialogue increases CSAT by 22% and return visits by 18% (Cloudbeds, 2025).

Access implements the Asset-Light principle via "Unified Digital Keys" (NFC/IoT). In international practice, such IoT integration has reduced staff costs by 15-20% and increased RevPAR by 12% through cross-selling (Sigala, 2018; Cloudbeds, 2025).

Risk Assessment positions the orchestrator as a security guarantor. For Ukraine (2026), this includes safe route mapping and offline access to services, which are critical for market resilience. Transparency mitigates information asymmetry through "Impact Dashboards." Ethical transparency increases LTV by 25%, aligning with the preferences of 76% of younger travellers (Booking.com, 2025).

The digital trust stack ensures security without asset ownership. It utilises Diia.Signature for mandatory stakeholder verification, eliminating fraud (Ministry of Digital Transformation of Ukraine, 2024). Quality is controlled via dynamic SOPs with photo verification and GPS-stamped audit logs, creating an "immutable quality history." Finally, Split Payments via banking APIs automatically distribute funds between property owners and community development funds.

To transition from the theoretical attributes of the DART framework to empirical and analytical verification, it is necessary to examine the current economic realities of the Ukrainian hospitality market. Under the conditions of recovery and high security uncertainties, traditional greenfield hotel development faces an inflation of capital expenditures (CAPEX). The focus is intentionally placed on the 3-star and mid-scale investment apartment segment, as it represents the most resilient and high-demand tier for domestic tourism recovery, while providing an identical baseline of room-level comfort and functional utility that the Albergo Diffuso model delivers through localised asset integration. To establish a realistic baseline for comparison, *Table 5* systematises empirical data from leading Ukrainian hotel operators and developers regarding the cost of traditional 3-star and mid-scale investment apartment development, with a specific focus on rural and decentralised destinations.

Table 5

Development costs of traditional mid-scale (3*) lodging facilities
in Ukraine by region

Hotel operator (developer)	Project examples	Object specification	Av. Dev. Cost per sq.m. (fully finished & furnished), USD	Av. Dev. Cost per Key (fully finished & furnished), USD	Rural / Mountainous destination specifics
Ribas hotels group (operator (developer))	Ribas rooms network (3-star business hotels, multiple sites in western Ukraine: Lviv, Truskavets, Ivano-Frankivsk region)	3-star hotel; 20–50 rooms; reinforced-concrete or lightweight-frame structure; full FF&E included; room area: 20–24 m ²	800–1200	20 000–50 000	Timber framing reduces structural costs by up to 20% vs. RC frame. Higher engineering costs due to remote logistics and autonomous utility systems (generators, heat pumps)
CCG development (developer / consultant)	WOL by Ribas apart-hotel network & resort infrastructure complexes (Lviv, Polyanytsia, Ivano-Frankivsk region)	3-star apart-hotel; boutique / apart format; 25–60 m ² apartments; full turnkey: design, construction, finishing, FF&E	1700–2000	45 000–65 000	+10–15% budget premium on materials and logistics vs. urban sites. High upfront capital expenditures required for basic infrastructure (access roads, main utility grids)

End of Table 5

Hotel operator (developer)	Project examples	Object specification	Av. Dev. Cost per sq.m. (fully finished & furnished), USD	Av. Dev. Cost per Key (fully finished & furnished), USD	Rural / Mountainous destination specifics
Sensar development (developer)	Smart hill apart-hotel (Yaremche, Ivano-Frankivsk region, Carpathians)	Apart-hotel; full resort infrastructure; underground parking; managed by Ribas hotels group	1860–2200	35 000–60 000	Increased construction cost driven by complex mountain terrain, specialized deep foundations, and heavy panoramic glazing. High seasonal demand dependency
Blago developer (developer)	Son daven apart-hotel (Yaremche, Ivano-Frankivsk region, Carpathians)	3-star resort apart-hotel; boutique mountain design; modern + hutsul-style architecture; underground parking; recreational zones; full hotel management (Ribas hotels group)	800–4200	120 000–160 000	Premium tier hospitality project. Highest CAPEX inflation due to architectural facade complexity, premium Hutsul-style materials, and an extensive turnkey resort amenity package

Source: compiled by the author based on official market data from Bild.ua (n. d.), Forbes Ukraine (2024), Ribas Hotels Group (2023), and Son Daven Project (Son Daven Project, n. d.).

The empirical data in *Table 5* clearly demonstrate that traditional greenfield development in rural areas suffers from infrastructure-driven capital inflation. Due to the lack of centralised engineering networks in decentralised communities, developers are forced to invest heavily in the deployment of autonomous utilities (drilling wells, installing transformer substations, building sewage treatment systems).

This data serves as a strict baseline to verify our hypothesis via simulation modelling. We analyse a scenario in which a destination aims to bring a capacity of 20 keys (rooms) to the market. In the Albergo Diffuso ecosystem model, we assume a scenario of pure digital integration: the local hosts already possess authentic, ready-to-operate rural cottages or apartments that meet comfort standards but lack market distribution. Therefore, the physical construction/renovation CAPEX for the startup orchestrator is USD 0. The financial and operational comparison of these two distinct structural approaches is simulated in *Table 6*.

Table 6

Comparative simulation analysis of investment and operational parameters (20-key model)

Performance indicator / comparison criterion	Option A: traditional 3* small hotel (greenfield development)	Option B: AD startup ecosystem (Asset-Light digital integration)	Analytical justification / data source
Construction / renovation CAPEX, USD	1 500 000	0	<i>Option A:</i> based on table 5 average data (USD 75 000 per key USD/times 20 rooms). <i>Option B:</i> leveraging existing ready-to-operate local housing assets
Digital infrastructure / IT & IoT CAPEX, USD	5 000	30 000	<i>Option A:</i> standard PMS license purchase. <i>Option B:</i> startup platform MVP development (20 000 USD) + 20 IoT smart locks with installation (10 000 USD)
Total project CAPEX, USD	1 505 000	30 000	The digital ecosystem model achieves a 50-fold reduction in initial capital requirements for the destination
Time-to-market, months	18–24	0.25–0.5 (1–2 weeks)	<i>Option A:</i> designing, permitting, and physical construction. <i>Option B:</i> host onboarding, legal compliance, and IoT hardware deployment
Average Daily Rate (ADR), USD	50	45	A slight introductory discount is applied to the AD model to stimulate initial market demand
Annual occupancy (Occ), %	45	50	Driven by the platform's network effect, localised experiential marketing, and ethical consumption trends
Gross Operating Profit (GOP), %	35	45	Higher in the AD model due to the absence of fixed overhead costs for large communal facilities and radical automation
Break-even point, % occupancy	32	15	Calculated as the ratio of fixed operating expenses to marginal revenue
Payback period (ROI), years	9–11	< 1.0 year (6–9 months)	Calculated based on discounted cash flows relative to the ultra-low initial technological CAPEX

Source: compiled by the author based on official market data from Bild.ua (Bild.ua, n. d.), Forbes Ukraine (2024), Ribas Hotels Group (2023), Son Daven Project (Son Daven Project, n. d.).

The results of the simulation modelling presented in *Table 6* provide quantitative verification of the research hypothesis, allowing for analytical conclusions regarding the structural transformation of hospitality models through the economic prisms of time, yield, and operational efficiency. While traditional greenfield development requires an initial capital expenditure of over USD 1.5 million to bring a capacity of 20 keys to the market, the digital orchestrator activates the exact same capacity with a highly optimized, digital-only CAPEX of just USD 30 000, which represents an empirical baseline derived from current Ukrainian market prices for digital deployment, custom mobile development, and B2B hospitality solutions (Chyzh Agency, n. d.; KitApp, n. d.). This contrast is fundamentally determined by the structural nature of the assets involved: traditional development

freezes capital and escalates interest risk due to a protracted 18 to 24-month cycle driven by mandatory physical stages such as land allocation, structural concrete curing, and complex interior fit-outs. Conversely, the digital Albergo Diffuso framework bypasses the physical construction phase entirely by activating pre-existing rural cottages and local distributed infrastructure. This compresses the total time-to-market to a mere 1–2 weeks (0.25–0.5 months), a timeline required exclusively for the installation of smart hardware kits, localised host onboarding, and digital synchronisation with the central Property Management System.

This operational agility and minimised capital pressure directly shape the pricing and demand dynamics within the experience economy. The baseline ADR of USD 50 for a traditional mid-scale hotel is structurally driven by the necessity to cover substantial fixed-asset amortisation and extensive centralised property-management overheads. In contrast, setting a slightly lower ADR of USD 45 for the Albergo Diffuso network serves as an effective penetration pricing mechanism to capture market flows. This marginal discount successfully compensates the guest for the decentralised layout of the destination while leveraging the authenticity of distributed rural hosts to offer a superior price-to-value ratio. Consequently, this market approach yields a more stable, crisis-resilient annual occupancy rate of 50%, compared to the traditional 45% baseline which remains highly vulnerable to seasonal demand drops.

The horizontal flexibility of distributed rural households allows for the optimisation of the underlying cost structure, ensuring operational resilience via a low break-even point. A traditional hotel's GOP is structurally capped at 35% due to heavy operational inflation, including continuous public area utility costs, building maintenance, and static staff payrolls. The digital orchestrator model expands the GOP to 45% by converting these heavy liabilities into a variable, distributed layout managed primarily by local hosts, eliminating public areas and automating contactless access to slash on-site labour overheads. This structural transition fundamentally alters the financial margin of safety, lowering the operational threshold required to reach profitability from 32% occupancy in traditional hotels to just 15% within the digital network. Because the fixed operating expenditures are minimised and the marginal cost of maintaining an unrented decentralised room is borne primarily by the host, the system remains financially viable.

Ultimately, the synthesis of these operational indicators results in a divergence in investment returns, effectively validating the systemic viability of the asset-light approach. A traditional hotel requires a lengthy 9 to 11-year payback period because its operating cash flow must slowly amortise the massive initial heavy CAPEX exceeding USD 1.5 million. On the other side of the matrix, because the digital orchestrator's initial investment entry barrier is strictly limited to a digital-only CAPEX of USD 30000 for mobile software and smart hardware deployment, the physical capital intensity is virtually non-existent. When combining this minimal entry point with an

accelerated time-to-market and an expanded 45% GOP margin, the platform fully recovers its total initial technology outlays within the first 6 to 9 months of operation. This accelerated capital turnover provides a rapid, low-risk path to sustainable economic recovery, demonstrating how a traditionally vulnerable real estate business can be transformed into a flexible, shock-resistant digital ecosystem for decentralised rural regions.

Although the digital platform provides operational transparency, the fundamental subject of the ecosystem is the territorial community, which fills the Albergo Diffuso architecture with authentic content. In this model, the community transforms from a passive object of observation into an active co-owner and co-author of the tourism product (*Table 7*).

Table 7

Role matrix of the community in the startup ecosystem

Community role	Functional manifestation	Contribution to value creation
Asset provider	Providing authentic cottages, granaries, and workshops for revitalisation	Formation of a unique housing stock that is impossible to replicate
experience creator	Conducting workshops and excursions, hosting shared dinners, and storytelling of local legends	Creation of an "experience economy" and emotional connection with the guest
service partner	Local cleaning, catering (home-made breakfasts), and logistics	Ensuring the operational viability of the system "on-site"
Guardian of the cultural code	Preservation of traditions, architectural style, and local dialect	Protecting the brand from "commoditisation" and the loss of identity

Source: developed by the author.

Successful implementation in Ukraine requires mitigating low digital trust and skill deficits through functional simplification. The orchestrator addresses distrust through Transparency (DART), in which automated fund distribution turns "abstract code" into a reliable tool. To bridge the skills gap, the "Business-in-a-Box" model embeds marketing, legal, and accounting functions into the Orchestration Layer, allowing communities to focus on authentic service.

Consequently, the orchestrator evolves into a digital institute for authenticity verification, dematerialising trust-building through digital protocols. This enables a "leapfrogging" effect for Ukrainian destinations: bypassing standardised mass tourism to integrate directly into high-tech ethical consumption. In the recovery era, economic resilience stems from the intellectual capitalisation of local assets rather than capital construction, shifting location selection toward strategic points of socio-technological resonance.

An objective evaluation of the developed model requires outlining its structural and contextual boundaries. First, due to the current absence of fully functioning, digital-centric Albergo Diffuso platforms in the Ukrainian tourism market, the technical and economic analysis relies on simulation

modelling. The quantitative metrics utilised (ADR, Occupancy, GOP) represent weighted-average forecasted values extrapolated from independent lodging statistics and traditional condo-hotel performance data.

Second, the geographical and security scope of the model is restricted to relatively safe decentralised destinations (primarily the Western and South-Western regions of Ukraine), as asymmetric warfare risks cannot be uniformly automated or quantified within standard business models.

Third, the operational viability of the platform relies heavily on the baseline assumption that the target rural community possesses stable internet connectivity (or localised satellite infrastructure such as Starlink) to support real-time IoT synchronisation and cloud quality-control audits. These identified boundaries define the vectors for future empirical research, which will focus on piloting the developed algorithm within a specific territorial community using a live pool of localised housing assets.

Conclusions

As a result of this study, a practical model for forming an Albergo Diffuso startup ecosystem has been theoretically substantiated and developed, based on a synthesis of the value co-creation paradigm and the functions of a digital orchestrator. The results fully confirm the scientific hypothesis underlying the research: the transformation of the classic dispersed hotel model into a digital-centric startup ecosystem effectively overcomes the infrastructural gap of decentralised destinations. It has been proven that the level of digital orchestration, implemented through an IT platform, IoT solutions, and digital standards, serves as the critical link that synchronises the community's fragmented physical assets and transforms them into a cohesive, high-value-added service product.

The scientific novelty of the findings lies in the substantiation of a conceptual architecture for the Albergo Diffuso startup ecosystem. For the first time, it integrates the functions of an IT platform as a "digital orchestrator" with value co-creation tools to ensure the strategic integrity and service standardisation of a decentralised business environment. This creates the necessary conditions for the technological leapfrogging of domestic destinations.

The practical value of the results lies in the development of the "Business-in-a-Box" model, which mitigates the lack of entrepreneurial skills among community residents through automation and the functional simplification of complex business processes. The implementation of a "digital trust stack" based on verification via state services (specifically Diia.Signature) and split payment technologies creates a transparent environment for value co-creation. This allows communities to bypass the phase of building traditional mass infrastructure and integrate immediately into the global market of ethical high-tech consumption.

The proposed methodology for decomposing the DART model has enabled the translation of abstract interaction parameters into specific

functional requirements for the IT platform, confirming the applied nature of the research. In this model, the economic resilience of territories is achieved not through capital construction, but through the intellectual capitalisation of existing local assets. Future research in this direction will focus on developing a multi-criteria mathematical algorithm for destination selection and identifying specific promising locations in relatively safe regions of Ukraine for the implementation of pilot projects for a startup orchestrator.

REFERENCES / СПИСОК ВИКОРИСТАНИХ ДЖЕРЕЛ

Bild.ua. (n. d.). <i>Apart-complex Smart Hill, Yaremche: prices, layouts and investment conditions</i> . https://bild.ua/apart-kompleks-smart-hill-yaremche	Bild.ua. (б. д.). <i>Апарт-комплекс Smart Hill, Яремче: ціни, планування та умови інвестування</i> . https://bild.ua/apart-kompleks-smart-hill-yaremche (дата звернення: 01.07.2026).
Booking.com. (2025). <i>Global sustainable travel report 2025: The rise of ethical consumption</i> . https://www.booking.com/sustainability/report2025.html	
Chyzh Agency. (n. d.). <i>Turnkey iOS/Android mobile application development</i> . Retrieved July 1, 2026. https://chyzh.agency/ua/rozrobka-mobilnykh-dodatki	Chyzh Agency. (б. д.). <i>Розробка мобільних додатків iOS/Android під ключ</i> . https://chyzh.agency/ua/rozrobka-mobilnykh-dodatki (дата звернення: 01.07.2026).
Cloudbeds. (2025). <i>2025 state of independent lodging report: Digital travel trends</i> . https://www.cloudbeds.com/reports/travel-trends-2025	
Dall'Ara, G. (2015). <i>Manuale dell'albergo diffuso: L'idea, la gestione, il marketing dell'ospitalità diffusa</i> . FrancoAngeli. ISBN 978-88-917-2683-4.	
Forbes Ukraine. (2024). <i>Analysis of the apart-hotel market and investment parameters of the Son Daven project</i> . https://sondaven.com/ua/news/forbes-pro-son-daven	Forbes Ukraine. (2024). <i>Аналіз ринку апарт-готелів та інвестиційні параметри проєкту Son Daven</i> . 2024. https://sondaven.com/ua/news/forbes-pro-son-daven
Gretzel, U., Sigala, M., Xiang, Z., & Koo, C. (2015). Smart tourism: foundations and developments. <i>Electronic Markets</i> , 25(3), 179–188. https://doi.org/10.1007/s12525-015-0196-8	
KitApp. (n. d.). <i>Mobile app development cost: what does the price depend on? Price of mobile applications</i> . Retrieved July 1, 2026. https://kitapp.pro/uk/cina/	KitApp. (б. д.). <i>Вартість розробки мобільного додатка: від чого залежить ціна? Ціна мобільних додатків</i> . https://kitapp.pro/uk/cina/ (дата звернення: 01.07.2026).
Ministry of Digital Transformation of Ukraine. (2024). <i>Diia.Signature: Electronic identification standards for business</i> . https://diia.gov.ua/services/diya-pidpis	Міністерство цифрової трансформації України. (2024). <i>Дія.Підпис: стандарти електронної ідентифікації для бізнесу</i> . https://diia.gov.ua/services/diya-pidpis
Mykhailichenko, H., Lysiana, V., & Schuka, H. (2026). Transformation of the digital tourism system: from intelligent agents to agentic AI. <i>Baltic Journal of Economic Studies</i> , 12(2), 324–332. https://doi.org/10.30525/2256-0742/2026-12-2-324-332	
Pine, B. J., & Gilmore, J. H. (2011). <i>The Experience Economy</i> (Updated ed.). Harvard Business Review Press. ISBN 978-1-4221-6197-5	
Pralhad, C. K., & Ramaswamy, V. (2004). Co-creation experiences: The next practice in value creation. <i>Journal of Interactive Marketing</i> , 18(3), 5–14. https://doi.org/10.1002/dir.20015	
Ribas Hotels Group. (2023). <i>Where it is profitable to build hotels in Ukraine and how much it costs</i> . https://ribashotelsgroup.ua/en/blog/tsifri-i-fakti-gde-seychas-vigodno-stroity-gostinitsi-v-ukraine-i-skolyko-eto-stoit/	Ribas Hotels Group. (2023). <i>Де в Україні зараз вигідно будувати готелі і скільки це коштує</i> . https://ribashotelsgroup.ua/en/blog/tsifri-i-fakti-gde-seychas-vigodno-stroity-gostinitsi-v-ukraine-i-skolyko-eto-stoit/

Ribas Hotels Group. (2024). <i>Ukraine hospitality market overview 2024</i> . https://ribashotelsgroup.ua/en/analytics/obzor-otelynogo-rinka-ukraini-2024/	Ribas Hotels Group. (2024). <i>Обзор отельного рынка Украины 2024</i> . https://ribashotelsgroup.ua/en/analytics/obzor-otelynogo-rinka-ukraini-2024/
Sigala, M. (2018). New technologies in tourism: From adaptation to transformation. <i>Tourism Management Perspectives</i> , (25), 169–173. https://doi.org/10.1016/j.tmp.2017.11.018	
Son Daven Project. (n.d.). <i>Official investment and development program of the resort apart-hotel Son Daven</i> . Retrieved July 1, 2026. https://sondaven.com/ua	Son Daven Project. (б. д.). <i>Офіційна інвестиційна та девелоперська програма курортного апарт-готелю Son Daven</i> . https://sondaven.com/ua (дата звернення: 01.07.2026).
State Agency for Tourism Development of Ukraine. (2026). <i>Public report of the Chairperson of the State Agency for Tourism Development of Ukraine Maryana Oleskiv for 2025</i> . https://tourism.gov.ua/blog/publicniy-zvit-golovi-derzhavnogo-agentstva-rozvitku-turizmu-ukrayini-natali-tabaki-za-2025-rik	Державне агентство розвитку туризму України. (2026). <i>Публічний звіт Голови Державного агентства розвитку туризму України Мар'яни Олесків за 2025 рік</i> . https://tourism.gov.ua/blog/publicniy-zvit-golovi-derzhavnogo-agentstva-rozvitku-turizmu-ukrayini-natali-tabaki-za-2025-rik
Tkachenko, T., & Dupliak, T. (2021). Strategy of tourism and hospitality development in Ukraine: priorities and mechanisms. <i>Journal of Management Information and Decision Sciences</i> , 24(S1), 1–10. https://www.abacademies.org/articles/strategy-of-tourism-and-hospitality-development-in-ukraine-priorities-and-mechanisms-11885.html	
Vargo, S. L., & Lusch, R. F. (2004). Evolving to a New Dominant Logic for Marketing. <i>Journal of Marketing</i> , 68(1), 1–17. https://doi.org/10.1509/jmkg.68.1.1.24036	
Vargo, S. L., & Lusch, R. F. (2014). <i>Service-Dominant Logic: Premises, Perspectives, Possibilities</i> . Cambridge University Press. https://doi.org/10.1017/CBO9781139043120	
Wade, M., Macaulay, J., Noronha, A., & Barbier, J. (2019). <i>Orchestrating Transformation: How to Deliver Winning Performance with a Connected Approach to Change</i> . DBT Center Press. ISBN 978-1-945010-03-3.	
World Bank, Government of Ukraine, European Commission, & United Nations. (2024). <i>Ukraine – Third Rapid Damage and Needs Assessment (RDNA3): February 2022 – December 2023</i> . Washington, DC: World Bank. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099021324115085807	
Zabaldina, Y. (2024). Transformation of the tourism market of Ukraine: challenges and strategic vectors of development. <i>Scientia Fructuosa</i> , 4(156), 112–124. https://doi.org/10.31617/1.2024(156)07	Забалдіна Ю. (2024). Трансформація туристичного ринку України: виклики та стратегічні вектори розвитку. <i>Scientia Fructuosa</i> . 4(156). С. 112–124. https://doi.org/10.31617/1.2024(156)07

Conflict of interest. The author certifies that he doesn't have financial or non-financial interest in the subject matter or materials discussed in this manuscript; the authors have no association with state bodies, any organisations, or commercial entities having a financial interest in or financial conflict with the subject matter or research presented in the manuscript. Given that the author is affiliated with the institution that publishes this journal, which may cause potential conflict or suspicion of bias and therefore the final decision to publish this article (including the reviewers and editors) is made by the members of the Editorial Board who are not the employees of this institution. The author received no direct funding for this research.

Kravtsov, S. (2026). Startup ecosystem of Albergio Diffuso: digital orchestration of value co-creation. *Scientia fructuosa*, 4(168), 162–177. [http://doi.org/10.31617/1.2026\(168\)11](http://doi.org/10.31617/1.2026(168)11)

Received by the editorial office 28.04.2026.

The article has been revised 01.06.2026.

Accepted for printing 15.07.2026.

Published online 07.09.2026.

FEDULOVA Iryna <https://orcid.org/0000-0002-8802-137X>

Doctor of Sciences (Economics), Professor,
Professor of the Department
of Management
State University of Trade and Economics
19, Kyoto St., Kyiv, 02156, Ukraine
i.fedulova@knute.edu.ua

SBEKHAT Fadi Nimer <https://orcid.org/0009-0005-5384-8544>

Postgraduate Student
at the Department of Management
State University of Trade and Economics
19, Kyoto St., Kyiv, 02156, Ukraine
f.sbekhat@knute.edu.ua

ARTIFICIAL INTELLIGENCE IN BUILDING SUSTAINABLE COMPETITIVE ADVANTAGES IN RETAIL

The rapid commoditization of traditional sources of retail competitiveness – price, location, assortment, logistics – against the backdrop of the widespread diffusion of artificial intelligence (AI) technologies raises the question of whether AI can remain an independent source of sustainable competitive advantage when access to it is available to virtually any market player. The study aims to develop a conceptual framework that differentiates a retailer's AI resources by their potential to generate sustainable competitive advantage, and to operationalize the organizational conditions under which that potential is realized. The study proceeds from the proposition that sustainable competitive advantage from AI adoption arises not from the mere fact of using the technology, but from the combination of the uniqueness of the technological resource and the organizational capability of the enterprise to exploit it effectively. A qualitative conceptual-analytical approach was applied, combining a systematic review of academic literature, adaptation of the resource-based view of the firm and the VRIO framework to AI-specific resources, and comparison of the resulting framework with aggregated data from four international industry surveys. These surveys serve

ФЕДУЛОВА Ірина <https://orcid.org/0000-0002-8802-137X>

д. е. н., професор,
професор кафедри менеджменту
Державного торговельно-економічного
університету
вул. Кіото, 19, м. Київ, 02156, Україна
i.fedulova@knute.edu.ua

СБЕХАТ Фаді Німер <https://orcid.org/0009-0005-5384-8544>

аспірант кафедри менеджменту
Державного торговельно-економічного
університету
вул. Кіото, 19, м. Київ, 02156, Україна
f.sbekhat@knute.edu.ua

ШТУЧНИЙ ІНТЕЛЕКТ У ФОРМУВАННІ СТІЙКИХ КОНКУРЕНТНИХ ПЕРЕВАГ У РИТЕЙЛІ

Стрімка комодитизація традиційних джерел конкурентоспроможності в ритейлі – ціни, локації, асортименту, логістики – на тлі повсюдного поширення технологій штучного інтелекту (ШІ) актуалізує питання, чи здатен ШІ залишатися самостійним джерелом стійкої конкурентної переваги, коли доступ до нього отримує практично будь-який гравець ринку. Відтак доцільним виглядає розроблення концептуальної рамки, що диференціює ШІ-ресурси підприємства ритейлу за потенціалом формування стійкої конкурентної переваги, та операціоналізація організаційних умов реалізації цього потенціалу. Дослідження виходить із припущення, що стійка конкурентна перевага від впровадження ШІ формується не самим фактом використання технології, а поєднанням унікальності технологічного ресурсу та організаційної спроможності підприємства його ефективно експлуатувати. Застосовано якісний концептуально-аналітичний підхід, що поєднує систематизацію наукової літератури, адаптацію ресурсної теорії фірми та інструментарію VRIO до ШІ-специфічних ресурсів і зіставлення побудованої рамки з агрегованими даними чотирьох міжнародних галузевих опитувань, які виконують функцію вторинного джерела для



as a secondary source for assessing the plausibility of the theoretical propositions rather than as an instrument for their statistical testing. Application of the framework to eight typical AI resources revealed a consistent pattern: widely available, market-purchased solutions systematically fail the rarity filter and yield only operational parity, whereas resources built on a firm's proprietary data hold differentiation potential whose realization depends on digital maturity, depth of implementation, organizational culture, cross-functional integration, and workforce readiness. The study contributes an operationalization of the organization criterion as five cumulative conditions that must be established before, rather than alongside, the adoption of a specific AI solution. The findings offer retailers a rationale for prioritizing investment in proprietary data and organizational competencies over investment in AI technology as such.

Keywords: artificial intelligence, competitive advantage, retail, VRIO analysis, innovative development, resource-based view, organizational readiness.

JEL Classification: L81, M15, O33, M10.

оцінювання правдоподібності теоретичних побудов, а не інструменту їх статистичної перевірки. Апробація рамки на восьми типових ІІІ-ресурсах виявила стійкий патерн: загальнодоступні, придбані на ринку рішення систематично не проходять фільтр рідкості й забезпечують лише операційний паритет, тоді як ресурси на основі унікальних даних підприємства мають потенціал диференціації, реалізація якого залежить від рівня цифрової зрілості, глибини впровадження, організаційної культури, крос-функціональної інтеграції та кадрового забезпечення. Наукову новизну становить операціоналізація критерію організованості у вигляді п'яти кумулятивних умов, які мають бути сформовані до впровадження конкретного ІІІ-рішення, а не одночасно з ним. Практичне значення результатів полягає в обґрунтуванні пріоритетності інвестицій у власні дані та організаційні компетенції порівняно з інвестиціями в технологічні рішення як такі.

Ключові слова: штучний інтелект, конкурентна перевага, ритейл, VRIO-аналіз, інноваційний розвиток, ресурсна теорія фірми, організаційна зрілість.

Introduction

Retail is currently undergoing a transformation whose scale is compared to the shift from offline trade to e-commerce in the early 2000s. Pressure on margins, changing consumer behaviour, and intensifying competition from technology giants are compelling traditional chains to seek new sources of competitiveness. In this context, artificial intelligence (AI) is increasingly identified as a key factor in the industry's transformation. According to McKinsey estimates, generative AI alone could bring retailers additional value of between USD 240 and 390 billion, equivalent to a margin increase of 1.2–1.9 percentage points through improved customer experience and greater efficiency of marketing operations (McKinsey & Company, 2024). A study likewise found that full-scale AI-based transformation could unlock approximately EUR 240–320 billion of economic value in European retail over the next five years (McKinsey & Company & EuroCommerce, 2026). Data from the KPMG Global Tech Report 2024 confirm this dynamic: in 2024 the share of consumer-goods and retail companies reporting profitability gains from AI technologies increased substantially (KPMG Ukraine, 2025). In Europe, retail accounted for almost 10 percent of total spending on AI and GenAI in 2024, ranking second by expenditure after the banking sector (Statista, 2026). At the same time, the rapid and near-universal diffusion of AI solutions gives rise to a paradox. If a technology is available

to virtually all market players, can it continue to be regarded as a source of competitive advantage in the classical sense of the term?

The theory of competitive advantage is traditionally based on the tenets of strategic management, according to which the source of an enterprise's long-term success is its ability to create value for the consumer more efficiently than its competitors. Porter treats competitive advantage as the result of pursuing a strategy of cost leadership or differentiation that secures superior performance relative to other market participants (Porter, 1985). With the development of the resource-based view, however, the emphasis shifted from the enterprise's market position to its internal resources and competencies.

According to the resource-based approach proposed by Wernerfelt (1984) and developed by Barney (1991), it is the unique resources of an enterprise that constitute the principal source of its competitive advantages. Barney (1991) formulated the VRIO concept, according to which a resource can secure sustainable competitive advantage only if it is Valuable, Rare, Inimitable, and supported by an appropriate Organization. The concept was subsequently complemented by the theory of dynamic capabilities, according to which an enterprise must not only possess valuable resources but also be able to transform them continuously in response to changes in the external environment (Teece et al., 1997).

The influence of artificial intelligence on business competitiveness has been actively investigated in recent years by both foreign and domestic scholars, although the depth and focus of these studies differ considerably.

Developing the resource-based approach in the context of artificial intelligence, Mikalef and Gupta (2021) introduce the concept of AI capability, which they define as a set of interrelated technological, human, and organizational resources that ensure the effective use of artificial intelligence. The authors demonstrate empirically that it is precisely AI capability, rather than the fact of implementing individual AI solutions, that has a positive effect on an enterprise's organizational creativity and performance.

Wade and Hulland (2004) provide a theoretical basis for evaluating artificial intelligence not as a separate technology but as a component of an enterprise's organizational capabilities. Accordingly, there arises a need to determine which AI solutions specifically are capable of acquiring the features of a strategic resource.

According to Davenport and Ronanki (2018), most contemporary AI-implementation projects are oriented toward the automation of business processes, whereas considerably less attention is devoted to the use of AI as an instrument for creating long-term strategic value.

Ukrainian studies are predominantly concerned with stating the general positive effect of AI on business processes and describing its areas of application. Stankovska et al. (2026) examine the provision of sustainable competitive advantages through the introduction of AI into an enterprise's core areas of activity. Titarenko (2025) notes that AI not only improves

traditional approaches to competition but also changes their very nature, making them more dynamic, personalized, and data-oriented. Tsybulak (2025) considers the formation of new rules of global economic competition under the influence of AI and the risks of technological lag for individual countries. A broader theoretical context is presented in the work of Fedulova et al. (2026), devoted to the systematization of innovative technologies as an instrument for building the competitive advantages of trade enterprises.

In these articles the authors establish the fact of AI's influence on competitiveness but for the most part do not focus on the mechanism of that influence, namely why in some companies investment in AI is transformed into a sustainable advantage while in others it is not.

Bunea and Corboş (2026) empirically test a capability-to-advantage model of AI application that sequentially links a company's digital maturity, the benefits obtained (qualitative and quantitative), customer experience, and the resulting competitive advantage. They point to the absence of an integrative explanation of the links among digital maturity, AI implementation, and competitive outcomes.

Artificial intelligence has acquired particular significance in retail. A systematic review of studies on AI application in retail for 2005–2021, conducted by Heins (2023), indicates that the principal directions are demand forecasting, inventory management, personalization of marketing communications, automation of customer service, recommender systems, dynamic pricing, and logistics optimization.

Bhukya et al. (2025) treat AI as a component of the Smart Retail concept, in which it is integrated with Internet-of-Things technologies, digital platforms, and big-data analytics.

Velásquez (2025) examines current trends and emerging challenges in retail analytics across four key dimensions: artificial intelligence and machine learning, big data and data analytics, data-driven retail, and data-driven decision-making. The author identifies strategic opportunities and future research directions required to harness retail analytics for improving customer service, optimizing operations, and supporting competitive advantage in physical and digital retail landscapes.

Cui and Bulis (2025) identified five principal drivers of AI, including cost reduction, service-quality improvement, marketing activity, external factors, and decision-making support. They also identified seven principal barriers, including ease of use, uncertainty over profitability, a shortage of talent, the digital environment, investment and cost, data-privacy and ethics concerns, and organization and culture.

Wilson et al. (2024) reviewed the integration of AI into retail operations with considerable attention to barriers. They identify a substantial impact of AI on operating costs and profitability as a source of competitive advantage, while emphasizing that high implementation costs and a shortage of specialized skills are significant obstacles, especially for small and medium-sized businesses.

Studies that combine the theory of competitive strategy and the experience of using AI in retail with specific cases of leading companies deserve particular attention. Yrjölä et al. (2025) synthesize approaches to creating consumer value through AI in retail using ten cases of retailers with different value propositions, while cautioning that ill-conceived AI initiatives may instead destroy consumer value, for example through customers' sense of losing control or concerns about privacy. Jones and Wynn (2025) examined how four leading retailers, namely Amazon, Carrefour, J. Sainsbury, and Walmart, are developing their relationships with artificial intelligence. The authors link the strategic potential of AI with the development of customer-centricity and the formation of new sources of competitive advantage. At the same time, they stress that the effectiveness of AI use depends substantially on the enterprise's organizational readiness, data quality, the digital competencies of personnel, and the ability to integrate AI into strategic management. Viswanathan (2024) illustrates, using the example of Costco, how the slow adoption of digital technologies leaves a company behind its competitors (Walmart, Target), and stresses the importance of the ethical aspects of AI implementation, such as data privacy and algorithmic bias. In the study by Fedulova and Sbekhat (2026), the example of the Aurora multi-market chain shows how a "Blue Ocean" strategy makes it possible to create innovative value beyond the bounds of direct price competition. This substantiates the thesis that the traditional (primarily price-based) sources of competitive advantage in retail are being exhausted. Lykholat et al. (2025) observe that models of digital-technology adoption in retail differ substantially depending on the level of market development: international chains invest predominantly in large-scale hardware automation, whereas Ukrainian retailers emphasize software AI tools that provide greater adaptability. A separate body of evidence consists of documented practical cases of AI application by Ukrainian retailers (Foxtrot, NOVUS, ALLO, VARUS, Fozzy Group, COMFY), according to data of the Ukrainian Council of Shopping Centers (Ukrainian Council of Shopping Centers, n. d.).

A considerable share of the existing publications is confined to stating that the introduction of AI increases the efficiency, personalization, or profitability of retailers, without probing the question of why in some companies these investments are transformed into a sustainable competitive advantage while in others they yield only a temporary and quickly neutralized effect. There is a lack of studies that combine the evaluation of AI solutions with the criteria of VRIO analysis and thereby make it possible to differentiate those solutions by their strategic value for the enterprise.

The aim of the article is to develop and apply a conceptual framework that establishes the relationship among the directions of AI application, the transformation of an enterprise's business processes, and the criteria of VRIO analysis, thereby making it possible to differentiate AI solutions by their real potential to create sustainable competitive advantage.

To achieve this aim, the following tasks were defined:

- to analyze the traditional sources of competitive advantage in retail and to substantiate the reasons for their exhaustion under conditions of digital transformation;
- to systematize the key directions of AI application in retail and to assess the scale of its economic effect;
- to develop a conceptual framework for evaluating AI resources on the basis of the resource-based view of the firm (RBV) and the VRIO toolkit;
- to apply the proposed framework to examples of a retailer's typical AI resources and to identify patterns that distinguish sustainable competitive advantage from a temporary one;
- to identify the conditions under which organizational competencies pass into a state that ensures the realization of an AI resource's potential.

The hypothesis is formulated as a conceptual proposition that sustainable competitive advantage from the introduction of artificial intelligence in retail arises not from the mere fact of using the technology, but from the combination of the resource's uniqueness (data/model) and the company's organizational capability to exploit it; in the absence of at least one of these conditions, the effect is limited to operational efficiency or to a temporary advantage that is quickly neutralized by competitors.

To substantiate this thesis, the resource-based view of the firm (RBV) of Barney (1991) and its toolkit, VRIO analysis (Value, Rarity, Imitability, Organization), were applied. This toolkit is traditionally used to assess a company's strategic resources but has rarely been applied systematically to specific AI resources in the retail context.

The empirical basis of the study consisted of the results of four international industry surveys on the application of artificial intelligence in retail: a survey of retail companies in the United States (Amperity, 2025a, by Statista, 2026), with a sample of 1,000 specialists aged 18 and over working in retail; a survey of companies in Italy (Istat, 2024, by Statista, 2026), with a sample of 100 companies with ten or more years of operation; and a survey of companies in Germany (EHI Retail Institute, 2025, by Statista, 2026), with a sample of 119 companies; together with a survey of the expectations of C-level executives in the retail sector regarding AI implementation by area of work (IBM Institute for Business Value, 2026), with a sample of 100 executives of retail and consumer-goods companies in Australia, Germany, India, Singapore, the United Kingdom, and the United States, conducted in June and August 2025. The data were obtained from the aggregated statistical materials of the Statista platform.

Data from international surveys are not considered statistically comparable samples, as the studies differ by country, respondent composition, survey periods, survey design, and indicator wording. Therefore, their use is intended for comparative and illustrative analysis aimed at identifying recurring trends in the application of AI in retail, rather than for a statistical comparison of its adoption rates across countries. No statistical verification

of differences between survey results was conducted, as only aggregated data obtained using non-uniform methodologies is available.

In the proposed logic of analysis, the chain 'prevalence of an AI solution → nature of the resource → compliance with VRIO criteria → potential for competitive advantage' makes it possible to distinguish between the technological use of AI and its strategic value.

The main body of the article is structured into five core sections, which sequentially examine and analyze: the depletion of traditional sources of competitive advantage in retail; the channels through which artificial intelligence impacts retail competitiveness; a conceptual framework for assessing the strategic potential of artificial intelligence in building a sustainable competitive advantage for retail enterprises; the role of organizational competencies in developing sustainable competitive advantage; and the conditions required to leverage organizational competencies into a driver of sustainable competitive advantage

1. The exhaustion of traditional sources of competitive advantage in retail

The classical sources of competitive advantage in retail, in particular price, location, assortment, logistics, and brand, have historically provided sustainable differentiation among market players. An analysis of the current state of the industry, however, indicates the gradual exhaustion of these levers as independent sources of advantage.

Price has ceased to be a differentiating factor because of market transparency. Price aggregators and marketplaces allow the consumer to compare offers instantly, reducing price competition to a race to the bottom that erodes margins. Location, which for decades determined the success of offline retail, is being devalued by the growing share of online sales and last-mile delivery. Assortment is copied by suppliers within a matter of weeks, and logistics solutions (proprietary warehouses, partnerships with carriers) are available for acquisition by virtually any player through the outsourcing of 3PL providers. Even the brand, traditionally considered the most durable asset, is losing part of its value under the pressure of rationalized consumption. Under conditions of economic instability, consumers increasingly choose between the premium and discount poles, leaving the mid-price segment, which relied precisely on brand loyalty, in a zone of risk.

Under contemporary conditions of the digital economy, a growing number of researchers regard digital technologies as a new class of an enterprise's strategic resources. The development of big data, cloud technologies, analytics, and machine learning is changing the ways in which competitive advantages are formed, since the principal sources of value become information, the speed of decision-making, and the enterprise's ability to adapt to market changes. It is therefore important not only to substantiate the usefulness of AI in creating competitive advantages but also to determine the conditions under which an AI resource can become a source of

sustainable rather than temporary advantage. The data from international surveys are not considered as statistically comparable samples, since the studies differ by country, respondent composition, conduction periods, survey design, and indicator formulations. Therefore, their use has the character of a comparative and illustrative analysis aimed at identifying recurring areas of AI application in retail, rather than at a statistical comparison of the levels of its adoption between countries. Statistical testing of the differences between the survey results was not conducted, since only aggregated data obtained through heterogeneous methodologies are available.

2. Directions of AI's impact on a retailer's competitiveness

The systematization of the directions of AI application in retail, carried out on the basis of the sources analyzed, makes it possible to distinguish five key functional blocks (*Table 1*).

Table 1

Systematization of the functional directions of AI application in retail

Functional block	Examples of application	Expected effect
Personalization and customer experience	Recommended systems, dynamic pricing, personalized offers	Growth in average check, conversion, loyalty
Demand forecasting and inventory management	ML models forecasting sales at the SKU level	Reduction of out-of-stock/overstock, savings in working capital
Logistics and supply-chain optimization	Delivery routing, warehouse automation	Reduction of operating costs, shorter delivery times
Automation of in-store operations	Computer vision, automated checkouts, RPA	Reduced staffing costs, higher accuracy of record-keeping
Marketing and customer interaction	Generative AI for content, chatbots	Faster campaign time-to-market, scalability of support

Source: compiled from (Bunea & Corboş, 2026; Heins, 2023; Bhukya et al., 2025; Velásquez, 2025; Cui & Bulis, 2025; Wilson et al., 2024; Yrjölä et al., 2025; Jones & Wynn, 2025; Viswanathan, 2024; Lykholat et al., 2025; Ukrainian Council of Shopping Centers, n. d.).

A comparative analysis of industry surveys in three countries (the United States, Italy, and Germany) confirms the unevenness of AI diffusion across functional directions. According to the survey of U.S. retail companies (Amperity, 2025a, by Statista, 2026), the most widespread areas of AI application are predictive analytics (36.7% of companies), customer segmentation (33.7%), and chatbots or virtual assistants (32.9%), whereas identity resolution (20%) and audience suppression (11.6%) remain niche directions.

The survey of Italian retailers (Istat, 2024, by Statista, 2026) demonstrates the dominance of marketing and sales (46.2% of companies) and the generation of language content (42.7%), against markedly lower indicators for logistics (8.4%) and the autonomous movement of machinery (2.4%).

The German study (EHI Retail Institute, 2025, by Statista, 2026) is distinguished by a different emphasis. Forecasting and replenishment head

the list of applications (55% of the 119 companies surveyed), outstripping even employee support (48%) and text generation (42%).

This cross-country comparison reveals an important regularity that confirms the hypothesis of this study: the directions of AI application with the highest levels of diffusion, such as generative content, chatbots, and basic customer analytics, are at the same time the directions with the lowest differentiation potential, since they involve for the most part typical, market-purchased solutions available to virtually any competitor. By contrast, directions with a lower but growing level of diffusion, such as inventory forecasting based on proprietary data (55% in Germany, the highest indicator among all the categories studied) and logistics optimization, require deeper integration with a company's internal data and accordingly possess a higher theoretical potential for passing the filters of rarity and inimitability in the proposed VRIO framework.

The categories "data quality improvement" (32% of U.S. companies) and "data unification or preparation" (24.3%) (Amperity, 2025a, by Statista, 2026) deserve separate attention. They do not fit directly into any of the five functional blocks, yet they provide empirical confirmation of the thesis that the existence of a unified, high-quality data architecture is not an incidental but a foundational element of organizational readiness, without which the introduction of AI in any of the five functional directions is incapable of delivering its full effect.

Data on the level of AI-adoption maturity (United States) additionally confirm the conclusions regarding the difference between the "breadth" and the "depth" of implementation: only 15.7% of companies have achieved full AI adoption across several business units simultaneously, whereas 34.3% are at the stage of mixed, fragmented adoption in individual units, and 33.5% are at the stage of experimentation or have no adoption at all (Amperity, 2025b, by Statista, 2026). This quantitatively illustrates that organizational competencies must be regarded as a "bottleneck": the technological availability of AI does not translate automatically into the organizational capability to use it effectively.

Additional confirmation of the identified regularity is provided by the survey of C-level executives of retail companies regarding the expected implementation of AI by area of work in 2025 (IBM Institute for Business Value, 2026). According to the survey results, the highest expectations of management relate to content and campaign creation and management (64% of respondents) and to store-operation management, including loss prevention, inventory, and workforce management (60%). Somewhat lower but also substantial indicators are characteristic of personalized customer responses (56%), trade-promotion creation and management (56%), and loyalty and customer-relationship management (50%), whereas the directions associated with the physical space of the store, such as design/layout (46%) and visual merchandising (42%), have a relatively lower priority in executives' plans.

To verify the correspondence between the theoretically distinguished functional blocks and the actual practice of retailers, the results of the four empirical surveys analyzed are consolidated into a single comparative table (*Table 2*).

Table 2

International trends in the use of artificial intelligence in retail as a basis for assessing its strategic potential, % of respondents surveyed

Functional block	USA, actual adoption (Amperity, 2025a)	Italy, actual adoption (Istat, 2024)	Germany, actual adoption (EHI Retail Institute, 2025)	Worldwide, C-level executives' expectations (IBM Institute for Business Value, 2026)
Personalization and customer experience	Customer segmentation 33.7%; chatbots 32.9%; personalization 31.8%; real-time customer analytics 25.7%	—	Customer interaction 34%; personal assistance 28%	Personalized responses 56%; loyalty/CRM 50%
Demand forecasting and inventory management	Predictive analytics 36.7%	—	Forecasting and replenishment 55% (highest in the sample)	Store-operation management (inventory, workforce, loss prevention) 60%
Logistics and supply chains	—	Logistics 8.4%; autonomous movement of machinery 2.4%	—	—
Automation of in-store operations	Identity resolution 20%	Administrative processes 34%; workflow automation 25.1%; object identification 26.6%	Business analytics 21%; process automation 21%; coding 16%	Store design/layout 46%; visual merchandising 42%
Marketing and customer interaction	Content creation 29.3%	Marketing/sales 46.2% (highest in the sample); language generation 42.7%; analysis of written language 37.5%	Text writing 42%; image creation 30%	Content and campaign creation and management 64% (highest indicator across all sources)
Outside the framework (data infrastructure)	Data quality improvement 32%; data unification 24.3%	Machine learning 19.9%; R&D 7.2%; ICT security 4.9%	—	—

Note. The presented indicators are not statistically comparable across countries due to differences in samples, methodologies, and question formulations; the data are used to illustrate the prevalence of specific areas of AI application.

Sources: (Amperity, 2025a, by Statista, 2026; Istat, 2024, by Statista, 2026; EHI Retail Institute, 2025, by Statista, 2026; IBM Institute for Business Value, 2026).

Despite the methodological heterogeneity of the sources, a high focus on operational AI solutions related to forecasting, inventory management, and process automation can be observed in three out of the four studies. The most widespread areas of AI application remain marketing, content creation, personalization of customer interaction, and automation of communications. This is confirmed both by the expectations of company executives and by the empirical data from the United States, Italy, and Germany (*Table 2*).

At the same time, the results obtained reveal an important regularity. It is precisely those AI solutions that demonstrate the highest level of market diffusion that possess the lowest potential for strategic differentiation. The reason is that standardized content-generation tools, chatbots, personalization systems, and other typical AI services are accessible to the majority of retailers and therefore rapidly become an industry standard. Under such conditions they provide an increase in operational efficiency but do not create a sustainable competitive advantage, since they do not satisfy the rarity criterion (Rare) of the VRIO model.

A different situation is observed with respect to the use of AI for demand forecasting, inventory management, and operational activity. Despite the high relevance of these directions, their practical realization requires the integration of AI algorithms with an enterprise's unique internal resources: historical sales data, assortment structure, the specifics of logistics processes, information on buyer behaviour, and other corporate data. It is precisely this dependence on specific information resources that substantially complicates the copying of such solutions by competitors, which increases their correspondence to the criteria of value (Valuable), rarity (Rare), and difficulty of imitation (Inimitable).

3. A conceptual framework for assessing the strategic potential of artificial intelligence in building the sustainable competitive advantage of retail enterprises

To determine the strategic potential of various areas of AI application, it is advisable to move from assessing the level of their prevalence to analyzing the nature of the resources on which they are based. To operationalize the distinction between a temporary and a sustainable advantage, this study proposes that each type of AI resource be evaluated against four sequential criteria of the resource-based view of the firm (RBV): Value (V), Rarity (R), Imitability (I), and Organization (O). A resource that fails at least one of the filters provides, at most, a temporary advantage or parity with competitors. Only a resource that sequentially passes all four filters becomes a source of sustainable competitive advantage.

Application of this framework to eight typical AI resources of a retailer yielded the results summarized in *Table 3*.

Table 3
A conceptual framework for evaluating the application of AI resources in retail on the basis of the resource-based view of the firm (RBV) and the VRIO toolkit

AI resource	V (Value)	R (Rarity)	I (Imitability)	O (Organization)	Conclusion
Off-the-shelf generative model (ChatGPT/Gemini API) for a support chatbot	Yes – improves service, reduces the load on staff	No – available to any competitor by subscription	No (no point evaluating; the resource is already non-rare)	–	Temporary advantage / industry parity
Proprietary database of customer purchases over 10+ years (with a loyalty programme)	Yes – more accurate demand forecasting and personalization	Yes – unique to the company, accumulated over years	Yes – a competitor cannot "buy" the history quickly	Depends on the presence of an analytics team and data-driven decision-making processes	Sustainable advantage, if O = yes
ML model of dynamic pricing based on proprietary demand-elasticity data	Yes – optimizes margin in real time	Yes, if trained on the firm's own unique sales data	Moderate – the methodology can be reproduced, but not the model's exact parameters without your data	Requires integration with ERP/POS systems and management's trust in automated decisions	Partial sustainable advantage (depends on the depth of customization)
Computer vision for analyzing footfall and behaviour on the sales floor	Yes – insights on merchandising, zone-level conversion	Moderate – the technology is available on the market (Amazon Go-type solutions), but few have implemented it in their store format	Moderate – equipment and algorithms are copied, but calibration to a specific program is not	Requires changes to merchandising processes based on these data	Temporary to partial sustainable advantage
AI demand forecasting for inventory management based on the chain's proprietary SKU data	Yes – reduces out-of-stock/overstock, saves working capital	Yes, if the model is trained on the chain's specific assortment and logistics structure	Yes – deep integration with the company's unique business processes is difficult to reproduce	Requires mature logistics processes and trust in automated ordering	Sustainable advantage, if O = yes
Off-the-shelf SaaS product-recommendation tool (plug-and-play) for the website	Yes – increases the average check	No – the same tool is bought by dozens of retailers	No	–	Parity / minimal advantage
Proprietary recommender system trained on the behavioural data of the chain's mobile application	Yes – higher relevance compared with off-the-shelf solutions	Yes – trained on a unique dataset of the behaviour of these particular customers	Yes – the volume and specificity of the behavioural data are difficult to reproduce	Requires a product team and a culture of A/B testing	Sustainable advantage, if O = yes
RPA (robotic process automation) of routine back-office processes (invoice processing, stock reconciliation)	Yes – reduces operating costs	No – a standard solution available on the market	No	–	Operational efficiency, but not differentiation

Source: compiled by the authors.

An analysis of *Table 3* shows that the mere fact of using artificial intelligence does not yet secure a sustainable competitive advantage for an enterprise. The most widespread AI solutions, like generative services, SaaS platforms, and typical robotic-process-automation (RPA) tools, create added value and increase operational efficiency, yet do not satisfy the rarity criterion (Rare), since they are generally accessible to all market participants. As a result, they contribute to the levelling of competitive capabilities but do not secure long-term differentiation. A similar conclusion was reached by Yrjölä et al. (2025), who note that standardized AI solutions are capable of supporting only competitive parity, and that in the absence of consumer trust or adequate protection of personal data their use may even reduce perceived value.

At the same time, considerably higher strategic potential belongs to AI solutions grounded in an enterprise's unique internal resources. These are, above all, proprietary datasets on customers, purchase history, behavioural models, assortment specifics, and accumulated experience of interaction with consumers. Such resources are formed over an extended period, are specific to each retailer, and cannot be acquired or quickly reproduced by competitors. It is precisely for this reason that they satisfy the criteria of value (Valuable), rarity (Rare), and difficulty of imitation (Inimitable) of the VRIO model and create the preconditions for building a sustainable competitive advantage.

The obtained results are consistent with the assumption that competitive advantage is created not by the AI algorithm but by the enterprise's unique resources with which that algorithm works.

4. The role of organizational competencies (O) in building the sustainable competitive advantage of retail enterprises

An important result of the study is that, even in the presence of unique data, the final status of a resource remains undetermined and depends exclusively on the company's organizational capability to actually use that resource in decision-making (O). That is, the mere fact of using AI is not a source of sustainable competitive advantage; rather, the source is the unique combination of data, organizational processes, and competencies that emerge around the technology. This accords directly with the empirical results of Bunea and Corboş (2026), who show that the effect of AI implementation on competitive advantage is substantially mediated by customer experience and depends on the organization's prior digital maturity. It is also linked with the conclusions of Wilson et al. (2024), that a shortage of specialized skills and the high costs of organizational restructuring are the principal barriers to realizing AI's potential, especially for small and medium-sized businesses.

Thus, the O criterion is the "bottleneck" of the entire model, and possession of valuable and rare data is a necessary but not sufficient condition for a sustainable advantage. Without organizational processes, analytical competencies, and a culture of data-driven decision-making, even the most valuable body of information remains an unused asset rather than a source of competitive advantage.

Consequently, a sustainable competitive advantage in retail based on AI arises not from the fact of the technology's implementation but at the intersection of four conditions: value, uniqueness of the data, the difficulty of their reproduction by competitors, and the company's organizational capability to convert these data into effective decisions.

5. Conditions for the transition of organizational competency (O) into a state of building sustainable competitive advantage

Accordingly, the O criterion (organization, organizational readiness, organizational competencies) is the decisive filter; without it, even unique, difficult-to-reproduce AI resources remain unrealized potential. In view of this, it is important to determine which organizational conditions specifically determine whether a company is able to convert AI resources into real managerial decisions.

5.1. Digital maturity as a precondition (not a consequence) of implementation

The study by Bunea and Corboş (2026) empirically establishes that a company's digital maturity, manifested in the level of IT-system integration, the availability and quality of data, and the presence of digital processes, has a strong positive effect on the depth of AI implementation, and that it is precisely this depth of implementation, rather than the mere fact of using AI, that determines the scale of the benefits obtained. A company cannot acquire organizational competencies simultaneously with the acquisition of the technology. Digital maturity is therefore a precondition that ought to have been formed before the launch of the AI initiative. In practical terms, this means that if a company's data are dispersed across isolated systems (warehouse, checkout, CRM, and loyalty not integrated), no ML model, however sophisticated, will receive a quality input to work with. Accordingly, the indicator of organizational competencies is the presence of a single integrated data architecture that unites transactional, behavioural, and operational data within a single circuit accessible to analytical systems. The results obtained accord with the conclusions of Bharadwaj (2000), according to which generally available information technologies do not create a sustainable competitive advantage. What is of decisive importance is not the technology itself but the capabilities for its use that the enterprise has formed.

5.2. Depth and breadth of embedding ai algorithms in real business processes

The study by Bunea and Corboş (2026) distinguishes two concepts that are often mistakenly conflated: AI implementation (the depth and

breadth of the embedding of algorithms in real business processes) and the benefits from AI (the perceived effect). The empirical result of their study showed that broad implementation does not guarantee equivalent benefits. A company may have AI tools in many processes yet feel no substantial effect from them if the implementation remains superficial. This accords with the conclusion of Wilson et al. (2024) that the transition from pilot projects to enterprise-scale operationalization becomes the principal barrier, and that it is precisely the shortage of specialized skills and the high costs of such restructuring that impede the attainment of the necessary effect. It is noted in the study by Statista (2026) that AI implementation does not deliver the expected strategic effect without an integrated digital architecture of the enterprise. Only the coordinated functioning of information systems and a unified information space create the preconditions for the effective use of AI and its transformation from an instrument of automation into a source of competitive advantage. In view of this, the indicator of organizational competencies is AI solutions embedded in daily operational processes (automatic replenishment of inventory based on a forecast, rather than a dashboard for a manager to view), as opposed to AI solutions that exist as isolated pilot projects in a single department.

5.3. An organizational culture of data-driven decision-making

Titarenko (2025) notes that artificial intelligence requires not only technological but also cultural adaptation, according to which companies must reconsider the foundations of competition and the system of competitive relations, and that this is impossible without management's readiness to trust algorithmic recommendations and to act on their basis. If a company's culture is traditionally grounded in the intuitive decisions of an experienced buyer or merchandiser, and the model's forecast is perceived as optional advice that may be ignored, then the resource does not pass the O filter, irrespective of its technical quality. Accordingly, the indicator of organizational competencies is the existence of formalized processes in which the model's recommendation is the basis of a decision by default, and a deviation from it requires explicit justification by the manager, rather than the reverse.

5.4. Cross-functional integration

The effective use of an AI resource requires the interaction of at least three functions, namely the IT/data team (which builds and maintains the model), the relevant business unit (procurement, merchandising, marketing, which use the result), and management (which integrates the result into

strategic decisions). The integration of new systems with existing business processes is a complex task requiring considerable planning and adaptation (Wilson et al., 2024). When these functions act in isolation, that is, the data team creates a model that the relevant unit does not understand or use, the valuable resource remains a technical artefact without business effect. Accordingly, the indicator of organizational competencies is the existence of cross-functional working groups or product teams responsible for a specific AI case from development through implementation to support.

5.5. Human capital and continuous learning

Demand for specialists in machine learning, analytics, and programming exceeds their availability on the labour market, which complicates the realization of AI initiatives (Titarenko, 2025), and a shortage of specialized skills is a significant barrier, especially for small and medium-sized businesses (Wilson et al., 2024). It is important that this concerns not only data scientists; also critical is the level of IT literacy of line managers and of the employees who work daily with the models' outputs. In view of this, the indicator of organizational competencies becomes the presence not only of a narrowly specialized analytics team but also of programmes for raising the digital literacy of operational personnel.

These five conditions are not independent; they form a definite sequence. Digital maturity creates the technical basis for deep implementation; deep implementation is impossible without cross-functional integration and qualified personnel; and the resilience of this chain is ensured by a culture that trusts the model's outputs. Accordingly, organizational conditions make it possible to build sustainable competitive advantages not through a single managerial decision ("implement AI") but as the result of cumulative organizational development that precedes, rather than merely accompanies, the implementation of the technology itself.

5.6. Limitations of the study and prospects for further research

The study is theoretical and conceptual in nature. The proposed VRIO framework has been applied to illustrative examples and to four international industry surveys on the application of artificial intelligence in retail, rather than to empirical data of specific retailers. A promising direction for further research is the empirical verification of the framework on the basis of case studies or a survey of managers of Ukrainian and international trade chains, in particular to test under which of the five specific organizational conditions identified the organization criterion systematically passes into a state of building sustainable competitive advantages.

Conclusions

The traditional sources of competitive advantage in retail are consistently losing their differentiating power under the pressure of market transparency, the growing share of online channels, the availability of outsourced logistics solutions, and the erosion of brand loyalty under conditions of the economic rationalization of consumption. If AI is regarded as an independent technological factor rather than as a resource requiring evaluation against the criteria of strategic management, there is a risk that AI will repeat the trajectory of devaluation followed by other accessible resources.

The systematization provided a basis for identifying five functional directions of AI application in retail: personalization, demand forecasting, logistics optimization, automation of operations, and marketing. This potential, however, is not realized automatically. The effect of transforming AI into a competitive advantage is mediated by customer experience and depends on the company's initial level of digital maturity. This created the preconditions for the formal application of the VRIO framework.

The results of the illustrative analysis are consistent with the proposition of the conceptual framework, that sequentially passes each AI resource through the four VRIO filters (value, rarity, inimitability, organization), determining the resource's final status, from parity to sustainable competitive advantage. The proposed framework provides a tool applicable to an individual AI resource rather than solely to the fact of AI use in general.

The hypothesis, formulated as a conceptual proposition, was not refuted by the research results and is generally consistent with the obtained findings. The analysis provided grounds to believe that the mere fact of using AI is not a sufficient condition for generating a sustainable competitive advantage. Standardized AI solutions available to the majority of market participants primarily provide operational efficiency or competitive parity. In contrast, the combination of AI with unique data, specific business processes, and the organizational capabilities of the enterprise creates the prerequisites for meeting the VRIO criteria and forming a sustainable competitive advantage. At the same time, the presented results are of a conceptual and analytical nature and do not constitute a statistical confirmation of the proposition, which necessitates its further empirical verification.

For retailers, this has direct practical significance. The investment priority should shift from the acquisition of off-the-shelf AI tools, which are capable of delivering only operational efficiency and parity, toward the purposeful development of proprietary data and, no less importantly, of the organizational competencies around them, before or in parallel with technological implementation.

Further research will involve the empirical verification of the framework to determine the role of the five identified organizational conditions in the transformation of AI into a sustainable competitive advantage.

REFERENCES/СПИСОК ВИКОРИСТАНИХ ДЖЕРЕЛ

- Amperity. (2025a, by Statista, 2026). Artificial intelligence (AI) use cases prioritized by organizations in the retail industry in the United States in 2025, *Share of respondents*. <https://www.statista.com>
- Amperity. (2025b, by Statista, 2026). Degree of adoption of artificial intelligence (AI) in the retail industry in the United States in 2025, *Share of respondents*. <https://www.statista.com>
- Barney, J. B. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management*, 17(1), 99–120. [10.1177/014920639101700108](https://doi.org/10.1177/014920639101700108).
- Bharadwaj, A. S. (2000). A Resource-Based Perspective on Information Technology Capability and Firm Performance: An Empirical Investigation. *MIS Quarterly*, 24(1), 169–196. <https://doi.org/10.2307/3250983>
- Bhukya, R., Alwani, H., Soni, A., Kumar, A. A., Mishra, U. S., & Gupta, N. (2025). Emerging technologies in retail management: a structured review, conceptual framework, and directions for future research. *The International Review of Retail, Distribution and Consumer Research*, 1–46. <https://doi.org/10.1080/09593969.2025.2588619>
- Bunea, O.-I., & Corboş, R.-A. (2026). When Does artificial intelligence pay off in electronic retailing? a dual-path model from implementation to competitive advantage. *Journal of theoretical and applied electronic commerce research*, 21(4). Art. 119. <https://doi.org/10.3390/jtaer21040119>
- Cui, Linmu, & Bulis, Aldis. (2025). Drivers and barriers to ai adoption in retail enterprises: a systematic literature review and conceptual framework. *Environment. Technology. Resources. Proceedings of the 16th International Scientific and Practical Conference*, (2). <https://doi.org/10.17770/etr2025vol2.8585>
- Davenport, T. H., & Ronanki, R. (2018). Artificial Intelligence for the Real World. *Harvard Business Review*, 96(1), 108–116. <https://academicjournals.com/abstract/DOI/doi/10.5890/20180100000000000000>
- EHI Retail Institute. (2025, by Statista, 2026). In what areas do you use artificial intelligence (AI). *Share of companies*. <https://www.statista.com>
- | | |
|--|---|
| Fedulova, I. V., Kalinichenko, O. M., & Sbehat, F. N. (2026). Innovative Technologies for Building Competitive Advantages in Retail Enterprises. <i>Advances in Scientific Achievements</i> , 6(28), Special Issue, 604–617. https://doi.org/10.52058/3041-1254-2026-6(28)-604-617 | Федулова, І. В., Калініченко, О. М., & Сбехат, Ф. Н. (2026). Інноваційні технології формування конкурентних переваг підприємств торгівлі. <i>Успіхи в наукових досягненнях</i> . 6(28), Спец-випуск, 604–617. https://doi.org/10.52058/3041-1254-2026-6(28)-604-617 |
| Fedulova, I., & Sbehat, F. N. (2026). Creating Innovative Value Based on the "Blue Ocean" Strategy: The Experience of the "Aurora" Multi-Market Chain. The Development of Market Relations in Ukraine, (5), 56–69. https://doi.org/10.66416/2522-1620.5.2026.56-69 | Федулова, І., & Сбехат, Ф. Н. (2026). Формування інноваційної цінності на засадах стратегії "Блакитного океану": досвід мережі мульти-маркетів "Аврора". <i>Формування ринкових відносин в Україні</i> . (5), 56–69. https://doi.org/10.66416/2522-1620.5.2026.56-69 |
- Heins, C. (2023). Artificial intelligence in retail – a systematic literature review". *Foresight*, 25(2), 264–286. <https://doi.org/10.1108/FS-10-2021-0210>
- IBM Institute for Business Value. (2026). Expected AI implementation in retail companies by C-level executives 2025, by area. <https://www.statista.com>
- Istat. (2024, by Statista, 2026). Main uses of artificial intelligence (AI) in retail companies in Italy in 2024, *Share of companies*. <https://www.statista.com>
- Jones, P., & Wynn, M. (2025). Artificial intelligence in retailing: Strategic implications and key areas of concern. *Business and Management Theory and Practice*, 2(2), Art. 3180. <https://doi.org/10.54517/bmtp3180>

KPMG. (2025). <i>Artificial Intelligence Is Transforming Retail: 14 Trends That Will Shape the Industry's Future</i> . KPMG Ukraine. https://kpmg.com/ua/uk/media/press-releases/2025/05/shtuchnyy-intelekt-zminyuye-ryteyl-14-trendiv-yaki-formuvatyut-maybutnye-haluzi.html	KPMG. (2025). <i>Штучний інтелект змінює ритейл: 14 трендів, які формуватимуть майбутнє галузі</i> . KPMG Ukraine. https://kpmg.com/ua/uk/media/press-releases/2025/05/shtuchnyy-intelekt-zminyuye-ryteyl-14-trendiv-yaki-formuvatyut-maybutnye-haluzi.html
Lykholat, S. M., Franiv, I. A., & Sereda, S. A. (2025). A Comparative Analysis of Strategies for Implementing Artificial Intelligence in Retail: Global Trends and Ukrainian Realities. <i>Economy and Society</i> , (81). https://doi.org/10.32782/2524-0072/2025-81-170	Лихолат, С. М., Франів, І. А., & Середя, С. А. (2025). Компаративний аналіз стратегій впровадження штучного інтелекту в ритейлі: глобальні тренди та українські реалії. <i>Економіка та суспільство</i> , (81). https://doi.org/10.32782/2524-0072/2025-81-170
McKinsey & Company, & EuroCommerce. (2026). <i>Rewiring retail in Europe: The AI imperative</i> . McKinsey. https://www.mckinsey.com/industries/retail/our-insights/rewiring-retail-in-europe-the-ai-imperative	
McKinsey & Company. (2024). <i>LLM to ROI: How to scale gen AI in retail</i> . McKinsey. https://www.mckinsey.com/industries/retail/our-insights/llm-to-roi-how-to-scale-gen-ai-in-retail	
Mikalef, P., & Gupta, M. (2021). Artificial intelligence capability: Conceptualization, measurement calibration, and empirical study on its impact on organizational creativity and firm performance. <i>Information & Management</i> , 58(3), 103434. https://doi.org/10.1016/j.im.2021.103434	
Porter, M. E. (1985). <i>Competitive Advantage: Creating and Sustaining Superior Performance</i> . New York. Free Press, 557 p. ISBN-13: 978-0-02-925090-7	
Stankovska, I., Savchuk, S., & Kachmar, I. (2026). The Application of Artificial Intelligence in Managing a Company's Competitiveness and Building Competitive Advantages. <i>Economy and Society</i> , (86). https://doi.org/10.32782/2524-0072/2026-86-32	Станковська, І., Савчук, С., & Качмар, І. (2026). Застосування штучного інтелекту в управлінні конкурентоспроможністю підприємства та формуванні конкурентних переваг. <i>Економіка та суспільство</i> , (86). https://doi.org/10.32782/2524-0072/2026-86-32
Statista. (2026). <i>AI in the retail industry</i> [Trend report]. Statista. https://www.statista.com/study/213241/artificial-intelligence-in-the-retail-industry/	
Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic Capabilities and Strategic Management. <i>Strategic Management Journal</i> , 18(7), 509–533. https://doi.org/10.1002/(SICI)1097-0266(199708)18:7%3C509::AID-SMJ882%3E3.0.CO;2-Z	
Titarenko, V. E. (2025). Competitive Strategies in the Era of Artificial Intelligence: Adaptation and Transformation. <i>Scientific Notes of Lviv University of Business and Law. Economics Series. Law Series</i> , (44), 236–242. https://doi.org/10.5281/zenodo.14882171	Титаренко, В. Є. (2025). Конкурентні стратегії в умовах становлення штучного інтелекту: адаптація та трансформація. <i>Наукові записки Львівського університету бізнесу та права. Серія економічна. Серія юридична</i> , (44), 236–242. https://doi.org/10.5281/zenodo.14882171
Tsybulak, A. G. (2025). The Impact of Artificial Intelligence Technologies on International Competitiveness: An Analysis of Contemporary Economic Approaches. <i>Investments: Practice and Experience</i> , (3), 16–24. https://doi.org/10.32702/2306-6814.2025.13.16	Цибуляк, А. Г. (2025). Вплив технологій штучного інтелекту на міжнародну конкурентоспроможність: аналіз сучасних економічних підходів. <i>Інвестиції: практика та досвід</i> , (13), 16–24. https://doi.org/10.32702/2306-6814.2025.13.16
Ukrainian Council of Shopping Centers. (n. d.). Artificial Intelligence in Business: How Ukrainian Retailers Are Already Using Neural Networks Today. <i>Ukrainian Council of Shopping Centers</i> . https://www.ucsc.org.ua/shtuchnyj-intelekt-v-rytejli-yak-ukrayinski-merezhi-vykorystovuyut-nejromerezhi-vzhe-sogodni/ (дата звернення: 17.07.2026).	Українська Рада Торгових Центрив. (б. д.). Штучний інтелект в бізнесі. Як українські ритейлери використовують нейромережі вже сьогодні. <i>Українська Рада Торгових Центрив</i> . https://www.ucsc.org.ua/shtuchnyj-intelekt-v-rytejli-yak-ukrayinski-merezhi-vykorystovuyut-nejromerezhi-vzhe-sogodni/ (дата звернення: 17.07.2026).
Velásquez, J. D. (2025). An analysis of trends, challenges, and opportunities in retail analytics. <i>International Journal of Market Research</i> , 67(4). https://doi.org/10.1177/14707853251315585	
Viswanathan, J. (2024). Artificial Intelligence Transforming the Future of Retail. <i>International Journal of Science and Research (IJSR)</i> , 13(9), 174–178. https://doi.org/10.21275/SR24901234506	
Wade, M., & Hulland, J. (2004). Review: The Resource-Based View and Information Systems Research: Review, Extension, and Suggestions for Future Research. <i>MIS Quarterly</i> , 28(1), 107–142. https://doi.org/10.2307/25148626	

Wernerfelt, B. (1984). A Resource-Based View of the Firm. *Strategic Management Journal*, 5(2), 171–180. <https://doi.org/10.1002/smj.4250050207>

Wilson, G., Johnson, O., & Brown, W. (2024). Exploring the Integration of Artificial Intelligence in Retail Operations. *Preprints*, 2024080012. <https://doi.org/10.20944/preprints202408.0012.v1>

Yrjölä, M., Hautamäki, P., & Ranta, R. (2025). Value propositions of artificial intelligence in retailing. *The International Review of Retail, Distribution and Consumer Research*, 35(4), 355–382. <https://doi.org/10.1080/09593969.2024.2411209>

Conflict of interest. The authors certify that don't they have no financial or non-financial interest in the subject matter or materials discussed in this manuscript; the authors have no association with state bodies, any organizations or commercial entities having a financial interest in or financial conflict with the subject matter or research presented in the manuscript. Given that the authors are affiliated with the institution that publishes this journal, which may cause potential conflict or suspicion of bias and therefore the final decision to publish this article (including the reviewers and editors) is made by the members of the Editorial Board who are not the employees of this institution.

The authors received no direct funding for this research.

Fedulova, I., & Sbehat, F. (2026). Artificial Intelligence in Building Sustainable Competitive Advantages in Retail. *Scientia fructuosa*, 4(168), 178–197. [http://doi.org/10.31617/1.2026\(168\)12](http://doi.org/10.31617/1.2026(168)12)

Received by the editorial office 15.04.2026.

The article has been revised 20.05.2026

Accepted for printing 01.06.2026.

Published online 07.09.2026.

STOIANENKO Iryna <https://orcid.org/0000-0002-1775-9473>

PhD (Economics), Associate Professor,
Associate Professor at the Department
of Economics and Business Finance
State University of Trade and Economics
19, Kyoto St., Kyiv, 02156, Ukraine
i.stoyanenko@knute.edu.ua

KONDRATIUK Oksana <https://orcid.org/0000-0002-2750-6867>

PhD (Economics), Associate Professor,
Associate Professor at the Department
of Economics and Business Finance
State University of Trade and Economics
19, Kyoto St., Kyiv, 02156, Ukraine
o.kondratyuk@knute.edu.ua

ADAPTIVE PRICING POLICY IN ENTERPRISE MANAGEMENT

Under high turbulence in the economic environment in which domestic enterprises operate, and amid the growing number of external challenges businesses face, pricing policy becomes one of the key instruments of adaptive management. Unlike other elements of economic management, pricing policy is characterised by a high degree of flexibility, operational responsiveness, and a direct connection with consumers' market behaviour. Through pricing mechanisms, an enterprise can respond promptly to demand fluctuations, changes in its cost structure, competitors' actions, and macroeconomic shocks.

The study is based on the hypothesis that an enterprise's pricing policy, as an instrument of adaptive management, has a positive impact on financial results, resilience, and competitiveness in an unstable economic environment. To test this hypothesis, both general scientific and special research methods were employed, including analysis and synthesis, theoretical generalisation, statistical analysis, comparison, and graphical methods.

It has been established that, despite growing scientific interest in adaptive management and effective pricing in recent years, the issue of

СТОЯНЕНКО Ірина <https://orcid.org/0000-0002-1775-9473>

к. е. н., доцент, доцент кафедри економіки та
фінансів підприємства
Державного торговельно-економічного
університету
вул. Кіото, 19, м. Київ, 02156, Україна
i.stoyanenko@knute.edu.ua

КОНДРАТІУК Оксана <https://orcid.org/0000-0002-2750-6867>

к. е. н., доцент, доцент кафедри економіки та
фінансів підприємства
Державної торговельно-економічного
університету
вул. Кіото, 19, м. Київ, 02156, Україна
o.kondratyuk@knute.edu.ua

АДАПТИВНА ЦІНОВА ПОЛІТИКА В УПРАВЛІННІ ПІДПРИЄМСТВОМ

В умовах високої турбулентності економічного середовища функціонування вітчизняних підприємств та зовнішніх викликів, з якими все частіше стикається бізнес, цінова політика стає одним із ключових інструментів адаптивного управління. На відміну від інших елементів економічного управління, саме вона характеризується високою гнучкістю, оперативністю впливу та прямим зв'язком із ринковою поведінкою споживачів. Через механізми ціноутворення підприємство здатне швидко реагувати на коливання попиту, зміну структури витрат, дії конкурентів та макроекономічні шоки. В основу дослідження покладено гіпотезу, що цінова політика підприємства як інструмент адаптивного управління, забезпечує позитивний вплив на формування фінансових результатів, стійкість та конкурентоспроможність підприємства в нестабільному економічному середовищі. Для її перевірки використано загальнонаукові та спеціальні методи дослідження, зокрема аналіз та синтез, теоретичне узагальнення, статистичний аналіз, порівняння та графічний метод. Встановлено, що, попри підвищення наукового інтересу до проблем адаптивного управління та ефективного ціноутворення впродовж



developing an adaptive pricing policy has not been systematically considered. At the same time, the analysis of the performance of Ukrainian enterprises in 2019–2024, a period marked by increased economic turbulence and an unstable external environment, demonstrates growth in business activity despite these shocks. According to the authors, such results may be attributed, inter alia, to the application of an adaptive pricing policy in business practice. This necessitates the scientific formulation of theoretical and methodological foundations for adaptive pricing policy as an anti-crisis management instrument for an enterprise facing external threats and heightened risks. The paper provides a comparative analysis of traditional and adaptive pricing policies of an enterprise, offers the authors' definition of the concept of adaptive pricing policy, and identifies its purpose, objectives, tasks, specific features, principles of formation, and implementation mechanisms, which may serve as a basis for further scientific research in this field.

Keywords: price, pricing, pricing policy, adaptive management, adaptive pricing policy, economic instability, external shocks.

останніх років, питання формування адаптивної цінової політики системно практично не розглядалися. Водночас проведений аналіз ефективності діяльності підприємств України у 2019–2024 рр., які характеризуються посиленням економічної турбулентності та нестабільності зовнішнього середовища, засвідчив зростання обсягів діяльності бізнесу, попри зовнішні шоки. Такі результати можуть бути наслідком використання в практиці господарювання, в тому числі й адаптивної цінової політики. Це зумовлює необхідність формування на науковому рівні теоретико-методичних засад адаптивної цінової політики як інструменту антикризового управління підприємством в умовах зовнішніх загроз та підвищених ризиків. Проведено компаративний аналіз традиційної та адаптивної цінової політики підприємства, дано авторське трактування поняттю "адаптивна цінова політика", визначено її мету, цілі, завдання, особливості, принципи формування та механізми реалізації, що може слугувати підґрунтям для подальшого наукового пошуку в цьому напрямі досліджень.

Ключові слова: ціна, ціноутворення, цінова політика, адаптивне управління, адаптивна цінова політика, економічна нестабільність, зовнішні шоки.

JEL Classification: D 21, D 22, D 40, L11, M 21.

Introduction

In the current context of the national economy, the development and implementation of an effective pricing policy have become issues of considerable scientific and practical importance. The destruction of Ukraine's production and logistics infrastructure as a result of the full-scale invasion by the Russian Federation, rising inflationary pressures, foreign exchange market instability, and declining household purchasing power have adversely affected business performance and significantly complicated the operational activities of domestic enterprises. Under these conditions, price has evolved from a traditional instrument of cost recovery and profit generation into a key determinant of financial resilience, the preservation of competitive positions, and business adaptation to external challenges.

A generalisation of recent scientific literature demonstrates a firm academic consensus that pricing policy is one of the key instruments for enterprise adaptation to dynamic and crisis-driven environmental changes.

In studies by Ukrainian and foreign scholars, including Shevchenko and Hanzhala (2024), Serhiienko et al. (2025), and Hasanah and Rino (2025), pricing is increasingly interpreted not merely as an element of the marketing mix or a mechanism for cost recovery, but as a flexible managerial instrument capable of ensuring an enterprise's prompt response to macroeconomic

instability, structural shifts in demand, and inflationary processes. Particular attention is given to the role of adaptive pricing policy in turbulent markets, where it contributes to maintaining financial stability by balancing profitability objectives, market position preservation, and consumers' purchasing power (Hasanah & Rino, 2025; Lunova, 2025).

The adaptive nature of pricing policy is closely associated with the need to transform pricing approaches in response to changes in market conditions and consumer behaviour. Neubert (2022), Tahat (2023), and Vasytsova and Hasiuk (2023) emphasise that effective adaptation of pricing strategies requires systematic monitoring of market demand, price elasticity, the competitive environment, and internal organisational factors. Research by Yang and Zhang (2022) demonstrates that the effectiveness of pricing decisions largely depends on an enterprise's ability to respond promptly to fluctuations in market demand, changes in the competitive landscape, and other external factors. According to Roll and Geerties (2025), the effectiveness of pricing policy is determined not only by the selected pricing strategy but also by the level of an enterprise's pricing capabilities and its ability to adapt pricing mechanisms to dynamic market conditions. In this context, pricing is regarded as an instrument of strategic adaptation that facilitates the development of competitive advantages, enhances financial resilience, and improves the long-term performance of business entities.

A distinct stream of research focuses on dynamic and digital pricing, in which pricing policy is viewed as a mechanism to enhance organisational flexibility in real time. Adams et al. (2025), as well as Lange, Dreessen, and Schlosser (2025), argue that the application of digital technologies, algorithmic models, and artificial intelligence significantly expands the adaptive potential of pricing by enabling rapid price adjustments in response to changes in demand, competitors' actions, and external shocks. Thus, scholars argue that adaptive pricing contributes not only to stabilising financial performance but also to improving revenue management efficiency, which is particularly important for enterprises operating in highly turbulent economic environments. Ponomarenko I. and Ponomarenko D. (2025) further contend that dynamic pricing based on machine learning algorithms contributes not only to optimising demand for an enterprise's goods and services but also to strengthening long-term customer loyalty to brands.

Despite the growing body of literature emphasising the adaptive role of pricing policy, its place within the broader system of adaptive enterprise management remains insufficiently defined. Most existing studies are either theoretical in nature or limited to specific industries and do not adequately account for the operational realities of Ukrainian enterprises under conditions of prolonged economic turbulence. This highlights the need for further theoretical and applied research to develop and implement pricing policy as

an instrument of adaptive management that enhances enterprise performance in both crisis and post-crisis environments.

The purpose of this study is to identify the role of pricing policy within the system of adaptive enterprise management, determine its impact on the performance of Ukrainian enterprises operating under conditions of elevated risks and hybrid threats, and substantiate the theoretical foundations for developing an adaptive pricing policy as a key instrument for ensuring enterprise efficiency and sustainable development under conditions of economic turbulence and external shocks.

The study advances the hypothesis that enterprise pricing policy, when implemented as an instrument of adaptive management, positively influences financial performance, competitiveness, and organisational resilience in an unstable economic environment. Furthermore, the flexibility of pricing strategies and the timely adjustment of pricing decisions in response to external risks enhance organisational performance while mitigating the adverse effects of crisis factors on activities of domestic producers.

The research employs both general scientific and specialised methods, including analysis and synthesis, theoretical generalisation, statistical analysis, comparison, and graphical methods. These methods are complementary and interconnected, ensuring consistency with the overall logic of the conducted research.

The article is structured into three sections. The first section examines the role of pricing policy within the mechanism of adaptive enterprise management. The second section analyses the effectiveness of pricing processes implemented by domestic producers in response to recent external shocks. The third section substantiates the theoretical foundations of adaptive pricing policy by conducting a comparative analysis of traditional and adaptive pricing approaches, proposing the authors' definition of the concept of "adaptive pricing policy", identifying its key characteristics, objectives, functions, principles, and implementation mechanisms, and formulating recommendations for improving the effectiveness of pricing decisions adopted by Ukrainian enterprises under conditions of economic turbulence and an unstable business environment.

1. Pricing policy in the system of adaptive enterprise management

In the context of the challenges of recent years, such as the COVID-19 pandemic and the full-scale invasion by the Russian Federation, the management system of Ukrainian enterprises has undergone significant transformations, further reinforcing the role of adaptive management mechanisms. Today, adaptability has become not a situational response but a permanent characteristic of effective enterprise management (Wulandari, 2025).

Adaptive management implies an enterprise's ability to respond promptly to changes in the external environment and to adjust strategic and operational decisions in order to maintain financial stability, competitive positions, and the continuity of business activities.

Contemporary Ukrainian (Piletska & Korytko, 2018; Buniak, 2022; Khalina & Kolbasynskyi, 2024; Hurzhy et al., 2025) and international (Elmehdi, Laraqui, & Jarreau, 2025; Malik & Terzidis, 2025) scholars consider adaptive management as a systemic response of an enterprise to dynamic changes in both the external and internal environment. It is formed as a comprehensive multi-level process encompassing strategic, operational, and functional management decisions (Tokmakova & Lytvynova, 2015).

According to Wulandari (2025), in the era of technological transformation, adaptive management should be based on the integration of innovative, marketing, and digital solutions that enable enterprises to remain competitive in the global environment. Furthermore, adaptive management should serve as an organisational response to technological disruption and global economic uncertainty.

Adaptive management is increasingly viewed not only as a strategic concept but also as a practical mechanism enabling businesses to respond promptly to a changing environment and crisis events (Shandova & Yakovlieva, 2025; Hurzhy et al., 2025; Malik & Terzidis, 2025). However, the practical instruments for implementing such adaptation remain insufficiently specified.

In this context, pricing policy, in our opinion, occupies a central place within the system of adaptive enterprise management as one of the most flexible and responsive instruments of managerial influence. It is integrated into the overall mechanism of adaptive enterprise management, alongside financial, production, marketing, sales, innovation, and investment policies (Figure 1), thereby balancing the enterprise's internal capabilities with external market constraints amid economic instability and global fluctuations.

Through the pricing mechanism, enterprises operating amid economic turbulence can respond rapidly to changes in market conditions, rising operating costs, inflation, disruptions in supply chains, shifts in consumers' purchasing power, and intensifying competitive pressure.

Within the system of adaptive enterprise management, pricing policy serves as a "rapid-response regulator", enabling enterprises to promptly adjust performance outcomes without fundamentally restructuring production or organisational processes. Therefore, under the conditions of a wartime economy and a high degree of uncertainty, pricing policy is transformed from a traditional instrument of profit maximisation into a comprehensive mechanism for ensuring business survival, stabilising cash flows, and maintaining an enterprise's market presence.

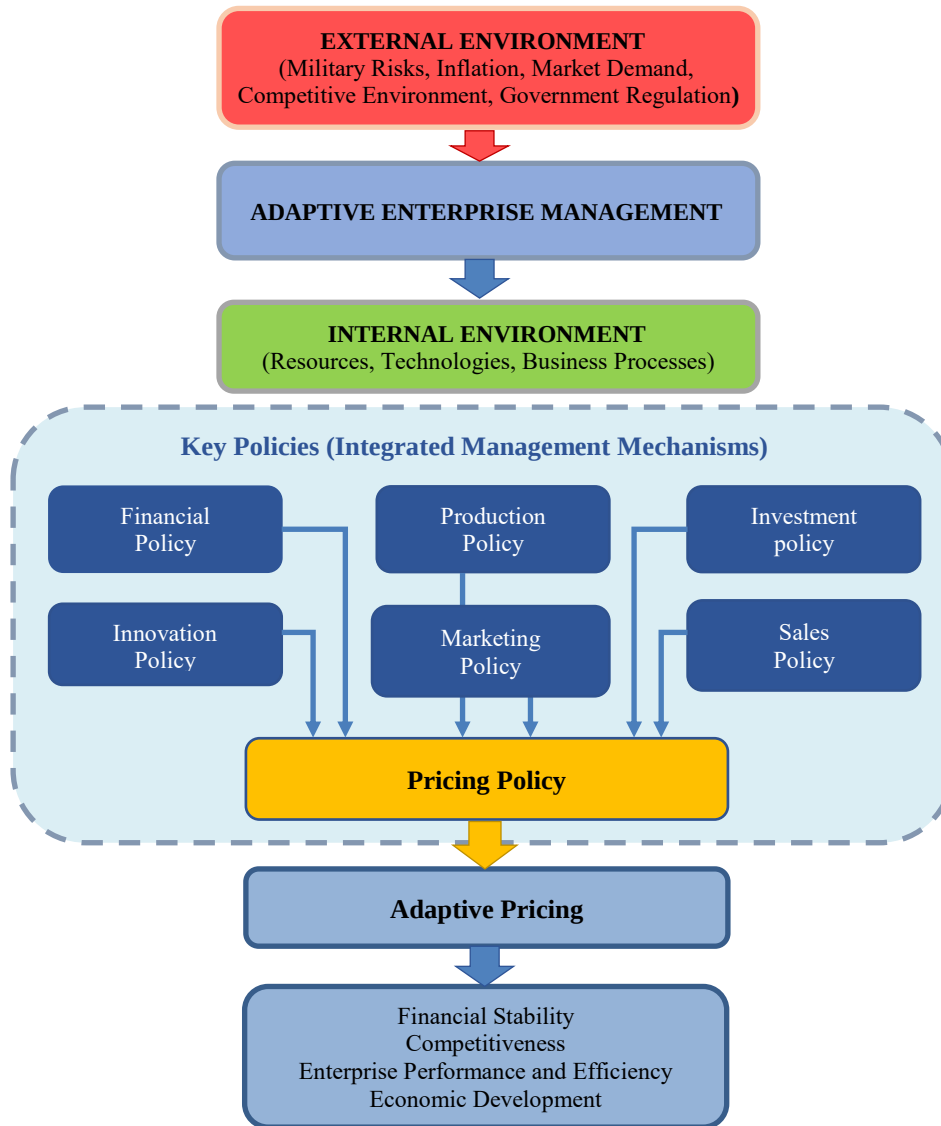


Figure 1. Pricing policy in the mechanism of adaptive enterprise management

Source: developed by the authors.

2. The impact of pricing policy on the performance of domestic enterprises

For domestic enterprises, the development of an effective pricing policy is particularly important given the instability of the macroeconomic environment, high inflation, and the imbalance between consumer and producer price dynamics. At present, enterprise performance and efficiency largely depend on the ability to develop a flexible and economically justified pricing policy. Alongside production capacity, an effective or ineffective pricing policy determines an enterprise's ability to generate revenue from the sale of goods and services, which directly affects gross profit, operating profit, and net profit, and consequently, its prospects for further development.

The scientific literature offers a variety of approaches to evaluating the effectiveness of an individual enterprise's pricing policy. The most appropriate approach for practical application and academic research is a comprehensive one that combines financial, market, and behavioural performance indicators (Stoianenko & Kashyrskykh, 2026). However, the application of these indicators at the macro level to assess the impact of pricing policy on the performance of domestic enterprises is constrained by the limited availability of relevant data. Therefore, to evaluate the influence of pricing policy on the overall performance of domestic enterprises, net sales revenue, gross profit, and net profit were selected as the principal indicators. In our opinion, these indicators best reflect the financial outcomes of pricing policy implementation and the results of its adaptation to the challenges that Ukrainian businesses have faced in recent years.

The dynamics of the main financial performance indicators of Ukrainian enterprises during 2019–2024 are presented in *Figure 2*.

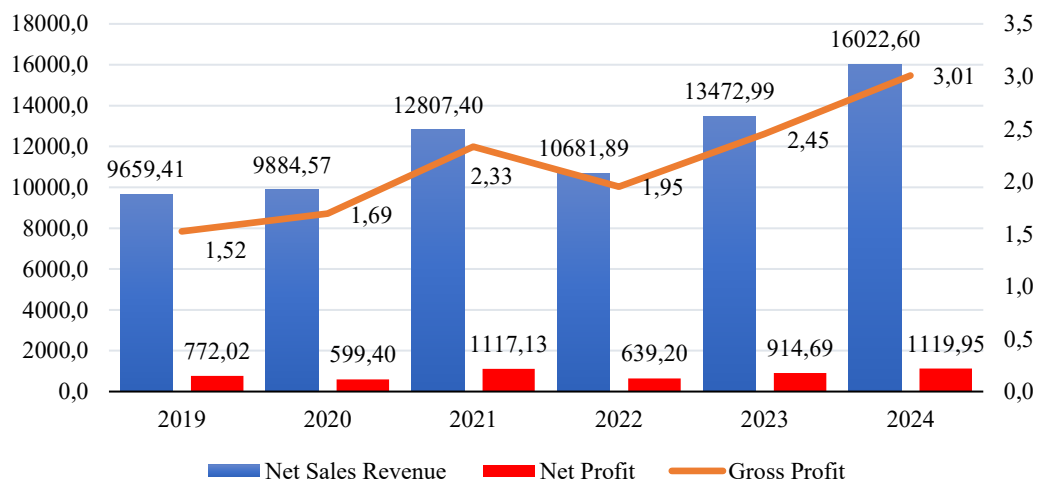


Figure 2. Financial performance of enterprises in 2019–2024, UAH billion

Source: compiled by the authors based on data from the State Statistics Service of Ukraine (n. d.).

As can be seen, despite adverse external shocks, including the COVID-19 pandemic and the full-scale invasion, Ukrainian enterprises have continued to expand their operations and successfully adapt to the new business environment. During 2019–2024, net sales revenue increased by UAH 6 363.192 billion, while gross profit in 2024 was almost twice the level recorded in 2019. The highest growth in both net sales revenue and gross profit was observed in 2021, whereas in 2022 these indicators declined, reflecting the impact of the crisis and the destabilisation of the economic environment on business activities. However, beginning in 2023, positive growth resumed as enterprises adapted to changes in both the internal and external business environment, including through pricing policy, a key instrument enabling rapid responses to market conditions and operating costs.

With regard to net profit, this indicator demonstrates greater volatility. In our opinion, although adaptive changes in pricing policy helped maintain a positive trend in gross profit, they were insufficient to offset the losses incurred by enterprises from other types of activities in 2020 and 2022.

However, the analysis of the absolute values of financial indicators does not provide a comprehensive understanding of changes in enterprise performance. The nominal growth in revenue and profit may result from inflationary processes rather than from actual improvements in business performance. Therefore, it is advisable to examine the growth rates of net sales revenue, cost of sales, gross profit, and net profit (*Figure 3*), as well as to calculate the lead coefficient to assess the efficiency of the revenue-to-cost growth ratio (Stoianenko & Kashyrskykh, 2026).



Figure 3. Growth rate dynamics of the performance indicators of Ukrainian enterprises in 2020–2024

Source: compiled by the authors based on data from the State Statistics Service of Ukraine (n. d.).

The data presented in *Figure 3* indicate that during 2020–2021, both net sales revenue and the cost of sales exhibited positive growth. However, the growth rate of cost of sales remained lower than that of net sales revenue, which positively affected gross profit growth and indicates the effectiveness of the pricing policy during this period. In contrast, 2022 was characterised by a sharp decline across all indicators due to adverse external factors. This effect was particularly evident in the growth rate of net profit, reflecting increased financial risks and rising non-operating expenses.

During 2023–2024, a recovery in positive growth trends can be observed. The growth rates of net sales revenue and the cost of sales were almost synchronised, indicating the continued strong dependence of financial performance on operating costs. The lead coefficient of the growth rate of net

sales revenue over the growth rate of the cost of sales exceeded 1 in 2020–2022 and again in 2024, indicating the effectiveness of pricing processes, as enterprises adapted their pricing strategies to increasing production costs.

It should also be noted that gross profit grew faster than cost of sales, which may indicate improved pricing decisions and the successful adaptation of the pricing policy to external challenges. The growth rates of net profit, in turn, demonstrate its sensitivity to changes in both operational and external macroeconomic factors.

Thus, despite the nominal increase in revenue and gross profit, enterprises continue to operate under conditions of heightened instability and significant cost dependence. The identified synchronisation between the dynamics of revenue and the cost of sales confirms the need to further investigate the impact of pricing indicators on enterprise performance through correlation analysis.

To assess the impact of pricing policy on the performance of domestic enterprises, two additional indicators were used: the Consumer Price Index (CPI), which reflects the overall level of inflation and consumers' purchasing power, and the Producer Price Index (PPI), which characterises changes in the prices of production resources. These indicators directly affect enterprise costs through the PPI, while the CPI influences selling prices and market demand. Together, they determine the financial performance of enterprises. Furthermore, the growth rates of the CPI and PPI allow assessment of the pace of inflation.

The dynamics of these indicators during 2019–2024 are presented in *Figure 4*. Their analysis enables assessment of the scale of inflationary pressure and the imbalance between consumer and producer prices, which directly affect the cost structure of enterprises and their ability to implement an adaptive pricing policy.

The dynamics of the Consumer Price Index (CPI) and the Producer Price Index (PPI) during 2020–2024 indicate an imbalance between the consumer and producer segments of the market. In 2020, inflationary pressures remained relatively moderate. In 2021, however, producer prices increased at a substantially faster rate than consumer prices, reflecting a significant rise in the cost of production resources. In 2022, inflationary pressures intensified further due to higher costs for energy, logistics, and raw materials.

The fact that producer prices grew faster than consumer prices indicates a decline in enterprises' profit margins and an increased risk of reduced profitability. During 2023–2024, the analysed indicators gradually stabilised; however, the Producer Price Index remained higher than the Consumer Price Index. Consequently, throughout the study period, a persistent gap between producer and consumer price dynamics was observed, creating additional cost pressures and complicating the implementation of a stable pricing policy.

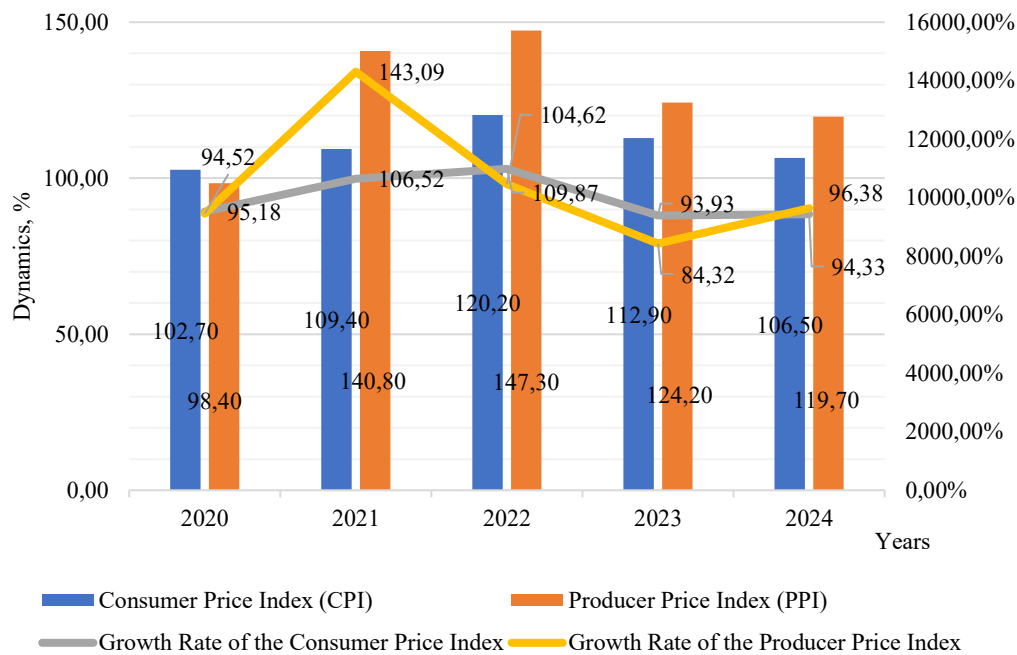


Figure 4. Dynamics of the consumer price Index (CPI) and producer price Index (PPI) in 2020–2024

Source: compiled by the authors based on data from the State Statistics Service of Ukraine (n. d.).

In addition to examining the dynamics of absolute values and their growth rates, it is important to determine the nature of the relationships between changes in pricing indicators and enterprise performance indicators. The degree of synchronisation between their fluctuations enables assessment of the extent to which inflationary processes and changes in producer prices influence revenue generation and profitability.

To quantitatively assess the strength and direction of the relationships among the analysed indicators, correlation analysis was employed. This approach enables the determination of the strength of the statistical relationship between price indices and enterprise financial performance, as well as the substantiation of the role of pricing policy as a factor influencing enterprise performance (*Table 1*).

The data presented in *Table 1* demonstrate a strong positive relationship between the growth rates of net sales revenue, the cost of sales, and gross profit. This indicates that changes in the financial performance of enterprises during the study period were largely determined by changes in sales volumes and operating costs. With regard to the Consumer Price Index (CPI), the correlation is weak and negative, indicating the absence of a direct relationship between consumer inflation and the financial performance of enterprises. An increase in the CPI is not automatically accompanied by higher revenue or profit, suggesting that enterprises have limited ability to pass inflationary pressures on to final consumers.

Table 1

Correlation matrix of the main pricing indicators
and financial performance indicators

Growth Rate Indicators:	Net Sales Revenue, %	Cost of Sales, %	Gross Profit, %	Consumer Price Index (CPI), %	Producer Price Index (PPI), %
Net Sales Revenue, %	1	0.999116	0.979724	-0.4216	0.247019
Cost of Sales, %	0.999116	1	0.970459	-0.42511	0.224964
Gross Profit, %	0.979724	0.970459	1	-0.40217	0.337878
Consumer Price Index (CPI), %	-0.4216	-0.42511	-0.40217	1	0.678603
Producer Price Index (PPI), %	0.247019	0.224964	0.337878	0.678603	1

Source: developed by the authors.

The Producer Price Index (PPI) exhibits a moderate positive relationship with financial performance, indicating that changes in producer prices have a more pronounced impact on enterprise performance than changes in the CPI. An increase in producer prices is associated with higher revenue and operating costs; however, it does not result in a proportional increase in gross profit.

Therefore, the financial performance of enterprises is determined primarily by the internal dynamics of revenues and costs rather than by external inflationary processes. The Producer Price Index (PPI) has a stronger impact on enterprise performance than the Consumer Price Index (CPI), confirming the cost-driven nature of inflationary pressure. The weak or negative correlation between the CPI and financial performance indicates the limited ability to pass consumer price increases through to higher profitability. These findings confirm the need to develop an adaptive pricing policy focused primarily on cost management and timely responses to changes in producer prices rather than solely on consumer inflation.

3. Adaptive pricing policy as an instrument for ensuring enterprise development under conditions of economic instability

An analysis of existing scientific approaches to the interpretation of pricing policy (Stoianenko & Kashyrskykh, 2026) indicates that pricing policy has traditionally been viewed as a system of principles and methods for setting prices to achieve an enterprise's financial objectives. However, under unstable economic conditions and wartime challenges, such an interpretation fails to account for the need to continuously adjust pricing decisions in response to dynamic changes in both the external and internal operating environments.

Therefore, in our view, in addition to the active and passive pricing policies of an enterprise (Mazur, 2020), which we consider traditional pricing policies, it is advisable to provide a theoretical justification for, and

subsequently implement in the system of enterprise crisis and economic management, another type of pricing policy – adaptive pricing policy. This concept reflects a new quality of price management under conditions of heightened uncertainty.

A comparative analysis of traditional and adaptive pricing policies demonstrates fundamental differences between traditional and crisis-oriented approaches to price management (*Table 2*).

Table 2

Comparative analysis of traditional and adaptive enterprise pricing policies

Comparison criterion	Traditional pricing policy	Adaptive pricing policy
Operating Environment	Relatively stable economic environment and predictable market conditions	High economic turbulence, external shocks, and uncertainty
Primary Orientation	Profit maximisation and improvement of profitability indicators	Ensuring resilience, business survival, and the preservation of competitive positions
Time Horizon	Primarily medium- and long-term	Integration of short-, medium-, and long-term decisions
Flexibility of Pricing Decisions	Limited; prices are revised periodically	High, prompt price adjustments in response to environmental changes
Response to External Shocks	Delayed or fragmented	Rapid, systematic, and proactive
Role of Risk Analysis	Risks are considered indirectly	A risk-oriented approach is a key element
Consideration of Costs	Based on planned or standard cost	Dynamic consideration of changes in costs, logistics, and war-related losses
Relationship with Other Enterprise Policies	Partial integration with marketing and financial policies	Close integration with financial policy, crisis management, and adaptive strategy
Approach to Price Formation	Primarily cost-based or market-based	Combined approach: cost-based, market-based, and scenario-based
Customer Orientation	Focused on the average customer	Consideration of changes in purchasing power and the behaviour of different customer segments
Frequency of Price Revisions	Planned and scheduled	Non-scheduled; determined by changes in the operating environment
Expected Outcomes	Optimisation of financial performance	Enhanced adaptability, stability, and competitiveness

Source: developed by the authors.

Unlike *traditional pricing policy*, which is primarily aimed at optimising financial performance in a relatively stable environment, adaptive pricing policy operates under conditions of continuous uncertainty and risk. It involves frequent adjustments to pricing strategies, the application of a scenario-based approach, and a focus on business survival and operational stabilisation rather than solely on profit maximisation. Therefore, *adaptive pricing policy* represents an evolutionary development of traditional approaches to price management under the conditions of a crisis economy.

Accordingly, we propose defining *adaptive pricing policy* as a systematically organised enterprise activity aimed at developing, adjusting, and implementing pricing decisions to ensure a flexible response to changes in the external environment and the enterprise's internal conditions, with the objective of maintaining financial stability, competitiveness, and achieving both strategic and operational development goals.

At present, the *primary purpose* of developing and implementing an adaptive pricing policy at domestic enterprises should be to ensure their ability to operate and develop effectively under conditions of economic turbulence and wartime challenges through the flexible adjustment of prices in response to changes in the market environment, cost structures, and strategic priorities.

Based on this, the *principal objectives* of an adaptive pricing policy include: ensuring the preservation of the enterprise's financial stability and its capacity for sustainable development; maintaining competitiveness in both domestic and international markets; minimizing the adverse effects of crisis factors and external shocks on enterprise performance and operational efficiency; ensuring the stability of revenues and cash flows; and adapting pricing decisions to changes in consumers' purchasing power and effective demand.

Among the distinctive features (key characteristics) of adaptive pricing policy, the following should be highlighted:

- dynamism – the ability to promptly revise prices in response to changes in costs, demand, exchange rate fluctuations, and risk factors;
- flexibility – the application of alternative pricing strategies, price differentiation, and a scenario-based approach to pricing decisions;
- systemic nature – the integration of pricing decisions with the enterprise's financial, marketing, and crisis management policies;
- risk orientation – consideration of macroeconomic (including wartime, logistics-related, and inflationary) and regulatory risks;
- resilience orientation – prioritising the preservation of solvency and cash flows over short-term profit maximisation.

In our opinion, one of the most important characteristics of adaptive pricing policy is its integrative nature. It is shaped by the enterprise's financial, production, investment, innovation, marketing, and sales policies, which necessitate a comprehensive analysis of both internal and external factors. In particular, financial policy determines the acceptable boundaries of pricing decisions in terms of liquidity and profitability; production and investment policies influence cost levels and production capacity; innovation policy determines opportunities for creating added value; while marketing and sales policies shape product commercialisation conditions and consumer behaviour.

The effectiveness of an adaptive pricing policy directly depends on adherence to a set of fundamental principles that constitute the methodological basis for its development and implementation. Accordingly,

we propose the following key principles for the development and implementation of an adaptive pricing policy:

- *the principle of system integration*, according to which pricing policy should be developed as an integral component of the enterprise management system. Pricing decisions should be aligned with financial, production, innovation, and sales policies to ensure managerial cohesion;

- *the principle of proactivity*, which requires enterprises not only to respond to existing changes but also to anticipate potential risks and threats. The implementation of this principle involves the use of scenario analysis and forward-looking pricing decisions;

- *the principle of economic justification*, according to which adaptive pricing decisions should be based on a comprehensive analysis of costs, effective demand, the competitive environment, and the enterprise's financial capabilities;

- *the principle of flexibility*, which reflects the ability of pricing processes to respond promptly to changes in the external environment and the enterprise's internal operating conditions. Compliance with this principle enables price adjustments without undermining the overall development strategy;

- *the principle of customer orientation*, which requires consideration of consumers' price sensitivity, purchasing behaviour, and perceived product value, particularly under conditions of declining household incomes and market instability;

- *the principle of continuity*, which involves the continuous monitoring of pricing policy performance and its timely adjustment in response to changes in the external environment and internal business processes.

Compliance with these principles creates the necessary preconditions for developing an effective adaptive pricing policy that ensures enterprise stability under uncertainty.

Thus, adaptive pricing policy constitutes an important instrument for implementing adaptive enterprise management, aimed at enhancing enterprise resilience and competitiveness in an unstable economic environment. Its principal functions are presented in *Figure 5*.

The tasks that should be implemented in the process of applying an adaptive pricing policy at an enterprise include the following:

- analysis of demand sensitivity to price changes;
- prompt adjustment of price levels and tactical pricing approaches;
- alignment of pricing decisions with the overall adaptive management strategy;

- evaluation of the effectiveness of implemented pricing decisions.

The main mechanisms for implementing an adaptive pricing policy that ensure the achievement of its primary goal and key objectives may include:

- *differentiated pricing*, which takes into account customer segment characteristics and regional demand differences. This approach enables enterprises to adjust prices depending on customers' purchasing power and

changes in market conditions (Shevchenko & Hanzhala, 2024; Krasovska, et al., 2025);

- *dynamic pricing*, which involves the regular real-time adjustment of prices based on changes in costs, demand, and competitor behaviour. This mechanism is particularly effective in crisis conditions and under fluctuations in logistics costs (Krasovska et al., 2025; Ponomarenko I. & Ponomarenko D., 2025);

- *forecast-based pricing models*, which integrate analytics data and digital tools to predict demand, sales volumes, and optimise profitability. The use of big data and artificial intelligence enables enterprises to respond quickly to economic shocks and changes in consumer demand (Vasylytsova & Hasiuk, 2023; Hasanah & Rino, 2025; Lange, et al., 2025).

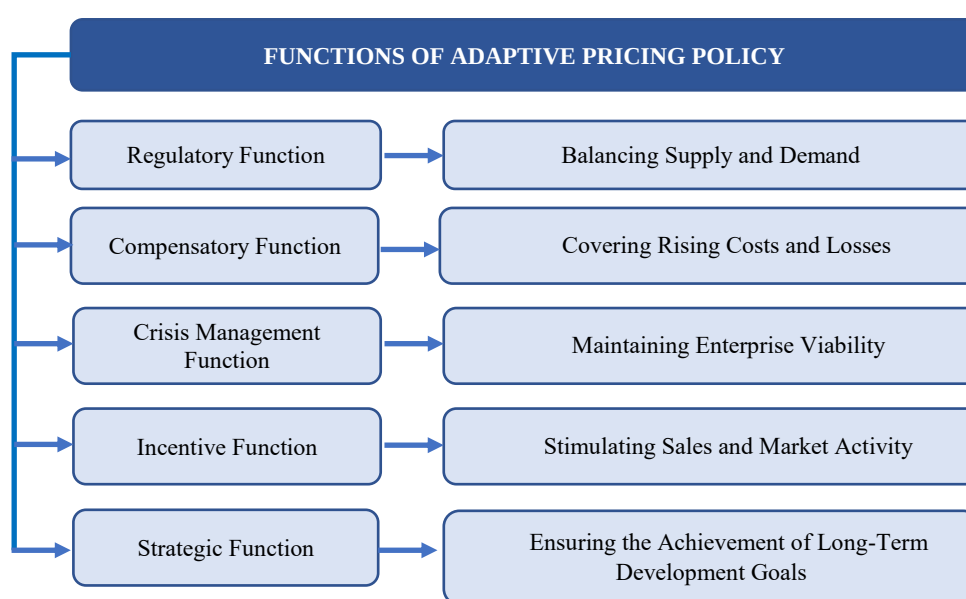


Figure 5. Functions of the adaptive pricing policy of the enterprise

Source: developed by the authors.

As can be seen, an adaptive pricing policy should be based on the application of flexible strategies that enable enterprises to respond promptly to changes in both the external and internal environments. The core principle of such strategies is the combination of demand forecasting, cost assessment, and competitive analysis to formulate optimal pricing decisions (Krasovska et al., 2025). At the same time, adaptive pricing serves not only as a profitability tool but also as a mechanism for maintaining financial stability and competitive advantages under conditions of turbulence and wartime challenges (Shevchenko & Hanzhala, 2024).

A key factor in the effectiveness of adaptive pricing is the use of digital tools and analytical platforms. Pricing simulation software, demand management systems, and analytical dashboards enable enterprises to rapidly assess market conditions and make informed managerial decisions

(Vasyltsova & Hasiuk, 2023; Ponomarenko I. & Ponomarenko D., 2025). Through the integration of such tools, pricing policy becomes an active element of adaptive management capable of minimising risks and ensuring financial stability even under significant external shocks.

The implementation of an adaptive pricing policy should combine strategic and operational approaches. The strategic level ensures alignment of pricing decisions with the enterprise's long-term development goals, competitive strategy, and risk profile. The tactical level focuses on operational responses to changes in costs, demand, exchange rates, supply conditions, and competitors' actions. Their combination ensures managerial flexibility, enhances the enterprise's adaptive capacity, and enables the achievement of the primary goal of adaptive pricing policy – maintaining competitiveness, financial stability, and sustainable development under conditions of economic turbulence and external challenges.

Thus, the implementation of an adaptive pricing policy allows businesses not only to respond promptly to market changes but also to create the prerequisites for long-term development while maintaining a balance between economic efficiency and adaptive capacity.

Conclusions

The assessment of the interrelationship between prices, performance outcomes, and operational efficiency makes it possible to identify the key factors underlying enterprise development under conditions of wartime challenges and prolonged economic instability. The results of the analysis of the impact of pricing policy on the performance of Ukrainian enterprises during 2019–2024 demonstrate that, in recent years, businesses have actively adapted to external shocks to ensure survival under highly uncertain and risky conditions, including through pricing policy. This confirms the hypothesis that an enterprise's pricing policy, when implemented as an instrument of adaptive management, positively affects performance indicators, competitiveness, and financial stability in a volatile economic environment.

It has been established that, under conditions of economic instability, pricing policy performs the function of balancing internal enterprise capabilities with external market constraints and represents one of the most flexible operational instruments within the adaptive management mechanism, alongside financial, production, marketing, sales, innovation, and investment policies.

Unlike traditional pricing policy, which is focused on optimising financial results in a stable environment, an adaptive pricing policy enables enterprises to respond rapidly to external and internal changes by integrating pricing decisions into crisis management and strategic decision-making systems. Adaptive pricing enables enterprises to respond promptly to fluctuations in demand, changes in cost structures, competitive actions, and macroeconomic shocks.

Further research in the field of effective pricing should be directed toward the development of theoretical and methodological foundations of adaptive pricing policy and their integration into the practical activities of domestic enterprises. This will enable enterprises to ensure financial stability, build sustainable competitive advantages, and maintain stable cash flows even during periods of economic turbulence, while effectively responding to external challenges.

REFERENCES / СПИСОК ВИКОРИСТАНИХ ДЖЕРЕЛ

- Adams, J.J., Fang, M., Liu, Z., & Wang, Y. (2025). The rise of AI pricing: Trends, driving forces, and implications for firm performance (Working Paper № 2024-33). *Federal Reserve Bank of San Francisco*. <https://doi.org/10.24148/wp2024-33>
- | | |
|---|--|
| Buniak, N. M. (2022). Features of adaptive enterprise management under crisis conditions. <i>Problems of Systemic Approach in Economics</i> , 2(88), 56–61. http://www.psae-jml.nau.in.ua/journal/2_88_2022_ukr/9.pdf | Буняк, Н. М. (2022). Особливості адаптивного управління підприємством в умовах кризових явищ. <i>Проблеми системного підходу в економіці</i> . 2(88), 56–61. http://www.psae-jml.nau.in.ua/journal/2_88_2022_ukr/9.pdf |
|---|--|
- Elmehdi, E., Laraqui, S., & Jarreau, B. (2025). Adapting Global Business Models to Disruptive Innovation and Market Dynamics: A Framework for Modern Times. *Journal of Organizational Management Studies*, (2025), Article ID 223981. <https://doi.org/10.5171/2025.223981>
- Hasanah, U. Y., & Rino, R. (2025). Pricing and adaptation strategies in market dynamics: a systematic literature review. *Electronic Journal of Education, Social Economics and Technology*, 6(1), 577–588. <https://www.ejeset.saintispub.com/ejeset/article/view/497/0>
- Hurzhyi, N., Rozovyk, I., Kharchenko, T., Kobets, S. P., & Komandrovskaya, V. (2025). The role of adaptive management in ensuring enterprises' sustainable development. *Theoretical and Practical Research in Economic Fields*, 16(1), 245–257. <https://journals.aserspublishing.eu/tpref/article/view/8792>
- | | |
|--|--|
| Khalina, V., & Kolbasynskyi, Yu. (2024). Theoretical foundations of adaptive enterprise management. <i>Economy and Society</i> , (63). https://doi.org/10.32782/2524-0072/2024-63-127 | Халіна, В., & Колбасинський, Ю. (2024). Теоретичне підґрунтя адаптивного управління підприємством. <i>Економіка та суспільство</i> , (63). https://doi.org/10.32782/2524-0072/2024-63-127 |
|--|--|
- | | |
|--|---|
| Krasovska, O. Yu., Lorych, V. V., & Shevchenko, V. M. (2025). Crisis scenarios in marketing: Adaptation of pricing strategies and management decisions under sanctions. <i>Actual Problems of Sustainable Development</i> , 2(4), 51–59. https://doi.org/10.60022/2(4)-6S | Красовська, О. Ю., Лорич, В. В., & Шевченко, В. М. (2025). Кризові сценарії у маркетингу: адаптація цінових стратегій та управлінських рішень в умовах санкцій. <i>Актуальні проблеми сталого розвитку</i> , 2(4), 51–59. https://doi.org/10.60022/2(4)-6S |
|--|---|
- Lange, F., Dreessen, L., & Schlosser, R. (2025). Reinforcement learning versus data-driven dynamic programming: A comparison for finite horizon dynamic pricing markets. *Journal of Revenue and Pricing Management*, (24), 584–600. <https://doi.org/10.1057/s41272-025-00519-8>
- | | |
|--|--|
| Lunova, T. (2025). Adaptation of marketing pricing strategies to the specifics of national markets. <i>Economy and Society</i> , (78). https://doi.org/10.32782/2524-0072/2025-78-123 | Луньова, Т. (2025). Адаптація маркетингових стратегій ціноутворення до особливостей національних ринків. <i>Економіка та суспільство</i> , (78). https://doi.org/10.32782/2524-0072/2025-78-123 |
|--|--|
- Malik, F. S., & Terzidis, O. (2025). Thriving in turbulence: resilience and strategic adaptation in global business. *Review of Managerial Science*. <https://doi.org/10.1007/s11846-025-00940-8>
- | | |
|---|--|
| Mazur, O. (2020). Price policy as a basis of price management. <i>Conference proceedings</i> (pp. 674–676). Lesya Ukrainka Volyn National University. https://dspace.onu.edu.ua/items/4750ecb0-312d-4578-b05a-5a03bda6b385 | Мазур, О. (2020). Цінова політика як базис цінового менеджменту. <i>Матеріали конференції</i> (с. 674–676). Волинський національний університет ім. Лесі Українки. https://dspace.onu.edu.ua/items/4750ecb0-312d-4578-b05a-5a03bda6b385 |
|---|--|

Neubert, M. (2022). A systematic literature review of dynamic pricing strategies. *International Business Research*, 15(4), 1–14. <https://doi.org/10.5539/IBR.V15N4P1>

Piletska, S. T., & Korytko, T. Yu. (2018). System of adaptive enterprise management in a changing external environment. *Business Inform*, (12), 435–440. https://www.business-inform.net/annotated-catalogue/?year=2018&abstract=2018_12_0&lang=ua&stqa=62

Пілецька, С. Т., & Коритько, Т. Ю. (2018). Система адаптивного управління підприємством в умовах мінливого зовнішнього середовища. *Бізнес Інформ*, (12), 435–440. https://www.business-inform.net/annotated-catalogue/?year=2018&abstract=2018_12_0&lang=ua&stqa=62

Ponomarenko, I., & Ponomarenko, D. (2025). Dynamic pricing in marketing. *Scientia fructuosa*, 161(3), 74–89. [https://doi.org/10.31617/1.2025\(161\)05](https://doi.org/10.31617/1.2025(161)05)

Пономаренко, І., & Пономаренко, Д. (2025). Динамічне ціноутворення у маркетингу. *Scientia fructuosa*, 161(3), 74–89. [https://doi.org/10.31617/1.2025\(161\)05](https://doi.org/10.31617/1.2025(161)05)

Roll, O., & Geerties, J. L. (2025). Unlocking value-based pricing: The moderating roles of pricing capabilities and contingency factors in B2B markets: An empirical approach. *Journal of Revenue and Pricing Management*, (24), 232–253. <https://doi.org/10.1057/s41272-025-00530-z>

Serhienko, O. A., Samus, P. O., & Sosnov, I. I. (2025). Development of an adaptive pricing strategy at early stages of startup development. *Biznes Inform*, (3), 164–174. <https://doi.org/10.32983/2222-4459-2025-3-164-174>

Сергієнко, О. А., Самусь, П. О., & Соснов, І. І. (2025). Розробка стратегії адаптивного ціноутворення на ранніх стадіях розвитку стартапів. *Бізнес Інформ*, (3), 164–174. <https://doi.org/10.32983/2222-4459-2025-3-164-174>

Shandova, N. V., & Yakovliev, O. V. (2025). Adaptive management of competitiveness of industrial enterprises under economic instability. *Economic Horizons*, 4(33), 52–61. <https://eh.udpu.edu.ua/article/view/341267>

Шандова, Н. В., & Яковлєв, О. В. (2025). Адаптивне управління конкурентоспроможністю промислових підприємств в умовах економічної нестабільності. *Економічні горизонти*, 4(33), 52–61. <https://eh.udpu.edu.ua/article/view/341267>

Shevchenko, N., & Hanzhala, I. (2024). Adaptation of enterprise pricing strategies to crisis challenges based on marketing research. *Herald of Khmelnytskyi National University. Economic Sciences*, 326(1), 273–279. <https://doi.org/10.31891/2307-5740-2024-326-43>

Шевченко, Н., & Ганжала, І. (2024). Адаптація цінових стратегій підприємств до кризових викликів на основі маркетингових досліджень. *Herald of Khmelnytskyi National University. Economic Sciences*, 32(1), 273–279. <https://doi.org/10.31891/2307-5740-2024-326-43>

State Statistics Service of Ukraine. (n. d.). Official website. <https://stat.gov.ua/uk>

Державна служба статистики України. (б. д.). Офіційний сайт. <https://stat.gov.ua/uk>

Stoianenko, I. V., & Kashyrskykh, Y. Y. (2026). Evaluation of the effectiveness of enterprise pricing policy under economic turbulence and wartime challenges. *Efficient Economy*, (1). <https://doi.org/10.32702/2307-2105.2026.1.104>

Стояненко, І. В., & Каширських, Є. Ю. (2026). Оцінка ефективності цінової політики підприємства в умовах економічної турбулентності та викликів воєнного часу. *Ефективна економіка*, (1). <https://doi.org/10.32702/2307-2105.2026.1.104>

Tahat, I. (2023). Pricing strategy and firms' profitability. *SocioEconomic Challenges*, 7(4), 124–132. [https://doi.org/10.61093/sec.7\(4\).124-132.2023](https://doi.org/10.61093/sec.7(4).124-132.2023)

Tokmakova, I. V., & Lytvynova, T. S. (2015). Adaptive management of the development of domestic enterprises. *Bulletin of Transport Economics and Industry*, (49), 212–216. http://nbuv.gov.ua/UJRN/Vetp_2015_49_43

Токмакова, І. В., & Литвинова, Т. С. (2015). Адаптивне управління розвитком вітчизняних підприємств. *Вісник економіки транспорту і промисловості*, (49), 212–216. http://nbuv.gov.ua/UJRN/Vetp_2015_49_43

Vasytsova, S. O., & Hasiuk, M. O. (2023). Digitalization of pricing methods as a tool for enterprise adaptability. *Bulletin of the National Technical University "KhPI". Economic Sciences*, (5), 71–74. <https://repository.kpi.kharkov.ua/entities/publication/438f7827-8caa-4246-9008-60d6992d7057>

Васильцова, С., & Гасюк, М. (2023). Цифровізація методів ціноутворення для визначення оптимальної ціни. *Вісник Національного технічного університету "Харківський політехнічний інститут" (економічні науки)*, (5), 71–74. <https://repository.kpi.kharkov.ua/entities/publication/n/438f7827-8caa-4246-9008-60d6992d7057>

Wulandari, P. (2025). Adaptive management in the era of technological disruption: Organizational strategies for facing global uncertainty. *Optima: Indonesian Journal of Contemporary Management and Accounting*, 1(1), 15–27. <https://ojsap.com/index.php/optima/article/view/11>

Yang, N., & Zhang, R. (2022). Comparative statics analysis of an inventory management model with dynamic pricing, market environment fluctuation, and delayed differentiation. *Production and Operations Management*, 31(1), 341–357. <https://doi.org/10.1111/poms.13538>

Conflict of interest. The authors certify that they have no financial or non-financial interest in the subject matter or materials discussed in this manuscript; the authors have no association with state bodies, any organisations, or commercial entities having a financial interest in or financial conflict with the subject matter or research presented in the manuscript. Given that one of the authors is affiliated with the institution that publishes this journal, which may cause potential conflict or suspicion of bias and therefore the final decision to publish this article (including the reviewers and editors) is made by the members of the Editorial Board who are not the employees of this institution.

The authors received no direct funding for this study.

Stoianenko, I., & Kondratiuk, O. (2026). Adaptive pricing policy in enterprise management. *Scientia fructuosa*, 4(168), 198–216. [http://doi.org/10.31617/1.2026\(168\)13](http://doi.org/10.31617/1.2026(168)13)

Received by the editorial office 19.02.2026.

The article has been revised 25.03.2026.

Accepted for printing 25.04.2026.

Published online 07.09.2026.