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**РЕДАКЦІЙНА КОЛЕГІЯ ЗБІРНИКА НАУКОВИХ ПРАЦЬ**
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# ПОЛІТИЧНІ ПРОБЛЕМИ МІЖНАРОДНИХ ВІДНОСИН
# POLITICAL ISSUES IN INTERNATIONAL RELATIONS

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## EMERGING TECHNOLOGIES AND THE GLOBAL SOUTH IN CONTEMPORARY INTERNATIONAL RELATIONS

## НОВІ ТЕХНОЛОГІЇ ТА ГЛОБАЛЬНИЙ ПІВДЕНЬ У СУЧАСНИХ МІЖНАРОДНИХ ВІДНОСИНАХ

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***Abstract.*** *The spread of artificial intelligence (AI) systems is already reshaping how states interact in an increasingly multipolar international environment. It puts additional pressure on traditional multilateral formats, encourages great powers to rely on narrower, selective coalitions, and creates openings for countries of the Global South to advance their own agendas. For Ukraine, which operates under wartime constraints, this dynamic is directly linked to balancing security needs and external cooperation. The article examines how the diffusion of AI is changing the principles and practical rules that structure interstate behaviour, and what opportunities this creates for coordinated initiatives by Global South countries aimed at supporting political stability in the international order. The study relies on targeted qualitative content analysis of leading policy reports and academic publications from 2024–2025, structured comparison of the positions of major powers and groups of Global South states, and elements of process tracing using examples from AI policy. AI is emerging as an independent driver of rule change in international relations. Instead of slow-moving universal regimes, we increasingly observe a layered architecture: a minimal set of shared global signposts, more detailed regional regulatory solutions, and selective coalitions of states that adopt compatible standards. The Global South does not act as a single bloc, but specific states are able to propose practical standards for transparency, accountability and interoperability with relatively low coordination costs. For Ukraine, an effective approach is a "security–cooperation" strategy: joining focused coalitions in AI-related areas that matter for defence, resilience and productivity, while insisting on transparency, accountability and technical*

*interoperability in order to avoid asymmetric dependencies.*

***Keywords:*** *artificial intelligence; international relations; multipolarity; security policy; information policy; economic policy; selective coalitions; Global South; transparency; accountability; interoperability.*

***Анотація.*** *Поширення систем штучного інтелекту (ШІ) вже змінює принципи й правила взаємодії держав у багатополюсному середовищі. Воно підсилює конкуренцію підходів великих держав, стимулює перехід від універсальної багатосторонності до селективних форматів співпраці та відкриває «вікна можливостей» для країн глобального Півдня. Для України, яка діє в умовах війни, це безпосередньо пов'язано з поєднанням безпеки і зовнішньої кооперації. Метою статті стало з'ясування, як саме поширення ШІ впливає на еволюцію правил і практик міждержавної взаємодії та які можливості це створює для узгоджених ініціатив країн глобального Півдня щодо підтримання політичної стабільності міжнародного порядку. Застосовано спрямований якісний контент-аналіз аналітичних звітів і академічних публікацій 2024–2025 рр., структуроване порівняння позицій великих держав і груп країн глобального Півдня, а також елементи відстеження процесів на прикладах політик ШІ. ШІ стає самостійним драйвером переформатування міжнародних правил: замість повільних універсальних режимів формується багатошарова архітектура - мінімальні універсальні орієнтири, регіональні регуляторні рішення та селективні коаліції «сумісних» партнерів. Позиції глобального Півдня залишаються фрагментованими, але дають можливість пропонувати прикладні стандарти прозорості, підзвітності та інтероперабельності з низькою вартістю узгодження. Для України оптимальною є стратегія «безпека - співпраця»: участь у вибіркових коаліціях у сфері ШІ за умов дотримання прозорості, підзвітності та технічної сумісності рішень, із мінімізацією асиметричних залежностей.*

***Ключові слова****: штучний інтелект; міжнародні відносини; багатополюсність; політика безпеки; інформаційна політика; економічна політика; селективні коаліції; глобальний Південь; прозорість; підзвітність; інтероперабельність.*

**Introduction.** In the mid-2020s, it's becoming pretty clear that the international landscape is shifting away from the concept of universal multilateralism. We're seeing a rise in multipolarity, with major powers leaning more towards flexible, ad hoc cooperation formats. Research from top think tanks highlights a competition among various policy approaches and practices, which seems to be sidelining any single "rulebook." This is happening even as the global conversation pushes for a "renewed, fair multilateralism" that could help restore the effectiveness of collective decision-making *(Chatham House, 2025; Munich Security Conference, 2025; United Nations Secretary-General, 2025)*. In this context, technology is stepping up as a significant force for change, with the spread of artificial intelligence systems becoming a crucial dividing line in today's security policies and economic coordination *(Robinson, 2025; Zeng, 2025)*.

Artificial intelligence is transforming three interconnected areas all at once. First up is the security domain: the dual-use nature of AI technologies, along with concerns about algorithmic transparency and risk governance, brings about new demands for responsible-use principles in the military and political realms *(Zeng, 2025)*. Next, we have the information and media landscape: automated data-processing systems, generative models, and the rapid pace of information cycles are shaping agenda-setting, resilience against manipulation, and public trust in institutions. This is pushing states to refine their rules of engagement in the global information space *(Robinson, 2025; United Nations General Assembly, 2024)*. Lastly, there's economic policy: the dynamics of productivity, investments in "clean" technologies, and supply-chain management are becoming increasingly linked to data analytics and automated decision-making, which in turn alters the real incentives for cooperation between countries *(Hart, 2024)*. When you look at all these factors together, they amplify the imbalances of influence and speed up the reconfiguration of the principles that guide interactions among states *(Munich Security Conference, 2025)*.

The Global South is carving out its own unique space in the world. You can really see its growing influence as it tries to push forward its own policies on how to use and regulate AI *(Mampilly, 2025)*. However, the lack of a unified stance means these efforts often end up scattered and inconsistent. For Ukraine, the situation is quite urgent: with the ongoing war and limited resources, the focus is on aligning security goals while still leaving room for collaboration. This means steering policy towards selective ways of engaging with major powers *(Kapitonenko, 2025; Perepelytsia, 2024)*. Another layer of complexity comes from the strengthening ties between Moscow and Beijing, which shifts the balance of power and affects external support - key elements to consider when looking at the political stability of regional alliances *(Kuzio, 2024)*. Ukrainian scholars also point out that some of China's views on multipolarity could limit the political independence of middle powers, making it essential to examine these ideas closely, especially in terms of fair interaction principles *(Stafiychuk, Matviienko, & Matviienko, 2024)*.

Bringing all these observations together, the main question this article seeks to answer is: how does the rise of artificial intelligence change the principles and rules governing interactions between countries in a multipolar world? Additionally, what opportunities does it create for countries in the Global South to work together in maintaining the political stability of the international order?

**The purpose of the study.** The goal of this study is to explore how the rise of artificial intelligence technologies influences the development of principles and rules that guide interactions between countries in a multipolar world. It also aims to evaluate how countries in the Global South can work together to create initiatives that balance the strategies of major powers while promoting political stability in the international system.

**Literature review.** In recent comparative studies conducted by prominent think tanks, it's clear that major powers are shifting their focus from universal institutions to more flexible, situation-based forms of cooperation. Chatham House points out a move towards selective engagement mechanisms, while the Munich Security Report 2025 highlights a growing multipolarity and a rivalry of policy approaches that are now influencing how countries interact with one another *(Chatham House, 2025; Munich Security Conference, 2025)*. A special discussion in International Affairs raises important questions about transparency and accountability in the use of AI systems, emphasizing the need to avoid the militarization of this technology and the imbalances of power it can create *(Robinson, 2025; Zeng, 2025)*. Additionally, policy analysis emphasizes a transition from mere rhetoric to tangible actions, establishing practical guidelines for developing shared rules and procedures in related areas of public policy *(Hart, 2024)*.

Ukrainian scholarship aligns closely with these insights, placing them within a security-political framework. Political scientist Mykola Kapytonenko highlights how resource limitations among key players lead to selective coalitions and a fresh look at multilateral engagement strategies *(Kapitonenko, 2025)*. Meanwhile**,** Professor Hryhorii Perepelytsia provides a solid analytical framework for evaluating the political resilience of Ukraine's foreign policy in a fragmented landscape, where having clear principles and decision-making processes becomes even more crucial *(Perepelytsia, 2024)*. Additionally, Professor Taras Kuzio illustrates how the growing strategic partnership between Moscow and Beijing is shifting the balance of opportunities and risks, which in turn impacts cooperation with major powers and the dynamics of external support *(Kuzio, 2024)*.

The work of Professor Viktor Matviienko delves into this same area of concern. A collaborative examination of China's vision for a multipolar world reveals possible limitations on the political independence of middle powers and outlines the risks that arise from differing approaches to rules and interaction practices *(Stafiychuk, Matviienko, & Matviienko, 2024)*. Previous analyses of NATO-Russia relations offer a historical and conceptual framework that helps us understand how straying from established institutions can lead to more unpredictable and situational forms of cooperation - an insight that remains crucial in light of today's technology-driven changes *(Matviienko & Yakovenko, 2020)*.

To sum it up, international reviews set the stage for rethinking political rules in this fast-paced era of technological change - especially in the realm of artificial intelligence *(Chatham House, 2025; European Union, 2024; Munich Security Conference, 2025; Robinson, 2025; United Nations*

*General Assembly, 2024; Zeng, 2025)*. Meanwhile, Ukrainian studies provide practical analytical tools to evaluate resilience and potential strategies when engaging with major powers *(Kapitonenko, 2025; Kuzio, 2024; Matviienko & Yakovenko, 2020; Perepelytsia, 2024; Stafiychuk, Matviienko, & Matviienko, 2024)*. This blend allows us to connect a global perspective with a national one, using comparative insights to fuel further empirical research on AI as a crucial force shaping contemporary international relations.

There are two key research gaps that emerge from this discussion. First, the swift rise of AI systems hasn't been thoroughly examined as a factor that could lead to a reevaluation of the principles and rules guiding interstate relations in a multipolar world *(Munich Security Conference, 2025; Robinson, 2025; Zeng, 2025*). Second, even though Global South states are gaining more institutional influence, it's still unclear how effectively they can coordinate their responses to the competing political strategies of the great powers *(Chatham House, 2025; Mampilly, 2025)*.

**Main results of the research.** A thorough look at international reviews and expert publications reveals that the rise of artificial intelligence systems is one of the key forces transforming how countries interact in today's multipolar world. As different policy strategies compete, major powers are increasingly leaning towards more flexible and situational forms of cooperation. At the same time, the demand for agreed-upon "minimum frameworks" is outpacing what institutions can provide *(Chatham House, 2025; Munich Security Conference, 2025)*. This study highlights three significant areas of change that are influencing state behaviour: security policy, the information and media landscape, and economic policy.

In the realm of security, the dual nature of AI brings about new demands for transparency and accountability. The same algorithms that improve targeting precision or battlefield assessments can also lower the bar for using force or make it harder to manage escalation. The ongoing discussion around "militarized AI" indicates that differing views on risk and what level of automation is acceptable often shape policy decisions more than the actual technical details of the systems. Consequently, the focus shifts from the "hardware" to the processes involved: ensuring responsible use is evaluated through data management, training oversight, model validation, output reviews, and protocols for shutting down autonomous functions in sensitive situations. Practically speaking, this translates to a need for clear transparency regarding goals, testing phases, and incidents, along with specific agreements among like-minded partners that can be quickly updated without lengthy global negotiations *(Zeng, 2025)*.

The landscape of information and media is undergoing a significant transformation, largely due to the dramatic decrease in costs and the rapid pace of content creation made possible by generative models. While there are undeniable advantages, the potential for manipulation is also increasing, which threatens to undermine trust in institutions and complicate elections and crisis communications. In response to these challenges, we're starting to see a push for greater transparency and accountability: initiatives that call for documenting the origins of data, labeling AI-generated content, and implementing quick debunking strategies in critical situations. Both academic efforts focused on defining "responsible AI" and high-level political actions are playing a role here. For instance, the UN General Assembly Resolution 78/265 establishes a framework for what constitutes "safe, secure, and trustworthy" systems, providing a common language for nations aiming to reduce risks in civilian areas, including the information ecosystem. In practice, this is leading to a shared understanding of expectations around model transparency, guidelines for how public authorities should engage with platforms, and technical standards for identifying misleading audio and video content *(Robinson, 2025; United Nations General Assembly, 2024)*.

In the realm of economic policy, AI is now a litmus test for the authenticity of state strategies. External partners and investors are increasingly scrutinizing political statements, assessing them through the lens of tangible actions and budgetary decisions. Consequently, performance metrics now encompass real capital investments in digital infrastructure and computing power, as well as the necessary safeguards for AI usage in public procurement, the ability to adjust supply chains, and commitments to workforce training. The competition for establishing sensitive segments of technology value chains - and securing access to dependable energy sources - promotes selective

agreements that can be quickly negotiated and modified. This practical approach - evaluating policy based on actions rather than mere words - helps to alleviate uncertainty for businesses, simplifies cross-country policy comparisons, and fosters a common ground for coordination in both multilateral and bilateral settings *(Hart, 2024)*.

In a nutshell, AI is pushing countries to clearly define their principles of transparency and accountability while also encouraging them to work together flexibly, especially when it comes to reaching universal agreements that can be tricky. It's right at this crossroads - between "minimum frameworks" and selective formats - where we see real chances for positive initiatives from Global South nations. These are practical solutions that require little coordination and help avoid adding to the political instability in the broader context *(Chatham House, 2025; Hart, 2024; Munich Security Conference, 2025; Robinson, 2025; United Nations General Assembly, 2024).*

The rise of multipolarity, along with the swift advancement of artificial intelligence, is prompting major powers to rethink their usual ways of interacting. In the past, global institutions were the go-to places for aligning strategies, but now we're witnessing a noticeable shift towards more flexible formats with a smaller group of participants. These settings allow for quicker decision-making and more adaptable agreements in response to rapid technological changes *(Chatham House, 2025; Munich Security Conference, 2025)*. This doesn't mean we're abandoning the universal level; rather, it's about layering "fast tracks" on top of a shared foundation of rules, which helps cut down coordination costs in areas where the relevant timelines are measured in months instead of years.

The key factor driving this change is the security aspect of AI. Different views on the risks associated with autonomy - and how adversaries might act - lead to uneven expectations regarding transparency, limitations, and oversight. This situation erodes trust in large multilateral agreements and pushes countries toward forming tighter, like-minded coalitions. These groups can more readily come to consensus on testing principles, agree to avoid certain functions in sensitive situations, and establish procedures for sharing incident information *(Zeng, 2025)*. In simpler terms, the focus is shifting from rigid, universal frameworks to adaptable shared practices and protocols that can be quickly updated as new technical risks arise.

One important aspect to consider is the relationship between information and media. Generative models have made it cheaper to produce content and have sped up how quickly it spreads, which opens up new avenues for manipulation and can undermine trust in institutions. On a global scale, countries have only managed to establish a basic level of shared understanding, as seen in the UN General Assembly Resolution 78/265, which addresses safe, secure, and trustworthy AI systems. However, the nitty-gritty details - like how to label synthetic content, what transparency requirements models should have, or how to engage with platforms - are often worked out in more exclusive settings and bilateral agreements. This is where differences in political systems and regulatory capabilities can be taken into account *(Robinson, 2025; United Nations General Assembly, 2024)*. The outcome is what we might call a "mosaic of compatibility," where small groups create technical standards and processes that are then partially adapted for broader use.

The third dimension focuses on economic policy. Nowadays, external partners and investors are increasingly evaluating a state's approach to AI based on real actions: investments in infrastructure, public procurement rules that ensure the safe use of algorithms, workforce training programs, and the ability to adapt supply chains. This practical perspective creates a demand for specific cooperation tools - ranging from thematic partnerships to limited mutual recognition agreements on model assessment procedures - which are generally easier to establish and quicker to implement than broad, universal agreements *(Hart, 2024)*. It also limits the room for empty promises, as effective coordination is closely linked to budgets, productivity metrics, and specific standards.

The result is a complex structure made up of various rules and practices. At the "lower" level, there's a universal baseline of shared signposts that guide us, providing direction and broad value frameworks for civilian AI applications *(United Nations General Assembly, 2024)*. Moving up to the "middle" layer, we find regional mechanisms that establish binding requirements for large

economic areas. These mechanisms have proven effective in outlining risk tiers, system categories, and oversight procedures, becoming essential points of political compatibility for neighbouring countries and partners *(European Union, 2024)*. Finally, at the "upper" level, we see selective coalitions at work - small groups of states that pilot common interaction standards in specific areas and quickly expand successful practices through bilateral relationships or "plus" mechanisms.

When it comes to politics, this multilayering really ramps up the competition between different approaches while also opening doors for collaboration. On one side, we have various models of AI governance - ranging from those that prioritize innovation to those focused on security or human rights - which present different sets of rules and can lead to fragmentation *(Chatham House, 2025; Munich Security Conference, 2025; Robinson, 2025)*. On the flip side, the rise of strong regional hubs and club-like arrangements makes it easier to cooperate when universal processes hit a snag, gradually improving the compatibility of policies across states *(European Union, 2024; United Nations General Assembly, 2024)*.In practical terms, this means we're seeing the development of shared protocols for testing and certifying systems, agreement on basic data governance requirements, the establishment of quick channels for sharing information about incidents and "model failures," and the growth of joint research and workforce training programs *(Robinson, 2025)*.

One notable effect is the selective inclusion of partners beyond just the main great powers. To strike "fast" deals, you need reliable implementers and compatible regulatory practices. As a result, major powers create parallel offers tailored for various groups of Global South countries - ranging from technical assistance to market access - in exchange for adhering to specific transparency and accountability standards in AI deployment *(Chatham House, 2025; Mampilly, 2025)*. This is where "windows of opportunity" emerge: states that are ready to adopt clear and replicable rules can tap into resources and projects, while the great powers find new avenues to promote their preferred strategies.

When you look at it all together, the move from universal institutions to more selective cooperation isn't just a passing trend; it's a smart reaction to the fast pace of technology and the unpredictability of politics. This shift doesn't eliminate the universal level; instead, it flips the order around: smaller, more focused arrangements pop up first to test out the rules and procedures, and only after that do certain elements start to form the foundation for wider collaboration. For countries wanting to keep their options open when dealing with major players - Ukraine being one of them - this setup allows them to join practical coalitions without losing sight of their national priorities. Plus, it helps build a kind of "compatibility capital" that makes it easier to coordinate on broader, universal platforms later on *(European Union, 2024; Kapitonenko, 2025; Kuzio, 2024; Perepelytsia, 2024; United Nations General Assembly, 2024)*.

The impact of AI on the rules governing interstate interactions is quite evident in the policies of countries in the Global South, though these changes manifest in various ways. A common thread among them is the desire to merge access to technology with the need to maintain political independence; however, their priorities differ. For some governments, the focus is on development goals like digitalizing public services, boosting productivity, and promoting inclusion. In contrast, others prioritize controlling the information landscape and minimizing susceptibility to outside influences. As contemporary scholars point out, the term "Global South" primarily represents a political assertion to define one's own strategies rather than a shared geographical identity, which explains the natural diversity of viewpoints and the lack of a unified set of rules that everyone can agree on *(Mampilly, 2025)*.

In real-world scenarios, we can see three main paths taking shape. First, groups tend to come together around specific issues - like ensuring transparency in how AI is used in public services - and they establish baseline standards for data quality, auditing, and accountability. Next, partnerships based on shared capabilities - such as having access to data centers, skilled workers, and a local market - quickly kick off joint pilot projects and create templates for others to follow. Lastly, we have "bridges" that connect different regional groups, where countries of varying influence agree on fundamental compatibility principles while leaving the finer details to smaller

discussions. Each of these paths creates "windows of opportunity": nations that are ready to provide clear, replicable guidelines for AI usage in key sectors can tap into resources and expertise, while more capable partners find reliable platforms for testing and scaling their practices *(Mampilly, 2025)*.

At the same time, there are significant risks to consider: gaps in infrastructure and human resources, differing opinions on how much the state should intervene in the information landscape, and the fierce competition among major powers to establish their own standards in specific regions. For many governments, the best approach seems to be a mix of universal guidelines along with targeted bilateral or minilateral agreements, where coordination is easier and the results can be seen more quickly. *(Mampilly, 2025)*

For Ukraine, navigating through heightened security threats and limited resources, the most sensible approach is to "work together where it boosts our resilience, while keeping options open where agreement is hard to find." The "security or peace" perspective put forth in Ukrainian academic circles emphasizes the importance of prioritizing security when selecting tools and partners - not as a substitute for collaboration, but as a prerequisite for its success *(Perepelytsia, 2024)*. Additionally, the resource limitations pointed out in foreign-policy research push policy towards more selective forms of engagement: streamlined partnerships in AI sectors that directly impact defense capabilities, information resilience, and economic productivity allow for quicker alignment and clearer responsibility distribution *(Kapitonenko, 2025)*.

When we look at the geopolitical landscape, it's crucial to consider how the growing partnership between Moscow and Beijing is changing the game. This alignment increases the chances that practices - both technical and political - that clash with our values of transparency and accountability could seep into our environment *(Kuzio, 2024)*. We also face the risk of becoming overly dependent on certain technology suppliers. Meanwhile, Ukrainian experts caution that if we embrace seemingly appealing "package" solutions without solid safeguards, we might limit our ability to make independent policy decisions in the long run *(Stafiychuk, Matviienko, & Matviienko, 2024).*

From this, we can derive a set of practical guidelines. First off, it's essential to align AI projects with fundamental principles like transparency, accountability, and reproducibility in processes. Next, we should broaden participation in selective coalitions that uphold these values and adhere to compatible standards for model auditing and data governance. Additionally, we need to minimize infrastructural and contractual lock-in by diversifying our suppliers and ensuring that we have requirements in place for data portability and solution interoperability. This approach allows us to prioritize security, enhance our capacity for collaborative action with partners, and mitigate the risks that often come with politically unstable environments *(Kapitonenko, 2025; Perepelytsia, 2024; Stafiychuk, Matviienko, & Matviienko, 2024; Kuzio, 2024)*.

Taking a closer look at our findings alongside previous expectations and the global media landscape reveals that the changes we've identified align well with international reviews and academic literature, while also fine-tuning the mechanisms at play. Global reports indicate a shift from a one-size-fits-all approach to multilateralism towards more adaptable forms of interaction among major powers. This shift is attributed to competing policy strategies and the increasing coordination costs associated with large-scale agreements in a diverse environment *(Chatham House, 2025; Munich Security Conference, 2025)*. Our findings support this conclusion and introduce a technological angle: the spread of AI systems is speeding up the transition to selective agreements that can be swiftly updated to address emerging risks and practical needs. Research on international security and AI policy highlights those differences in how risks are perceived, acceptable levels of automation, and expectations around transparency and accountability have become key dividing lines among nations *(Robinson, 2025; Zeng, 2025)*. Thus, the global conversation about the structure of order intertwines with discussions on technology use principles. When institutional frameworks lag behind, we see the emergence of "micro-architectures" of rules in club and bilateral formats that gradually spread outward. Additionally, our analysis sheds light on the role of countries in the Global South: rather than forming a single "camp," what we observe are

situational coalitions where states propose targeted, practical solutions in specific sectors, effectively reducing the coordination costs for broader collaborations.

The emergence of new policy tools in the AI sector highlights a growing trend towards convergence at various levels. On a global scale, the UN General Assembly Resolution 78/265 points us in the direction of "safe, secure, and trustworthy" AI systems, providing countries with a common language of fundamental principles, expectations for transparency, and norms for risk management in civilian uses. At the regional level, we see more detailed regulations: the EU Artificial Intelligence Act introduces a risk-based framework that outlines requirements for data governance, assessment, oversight, and accountability, along with an executive structure to enforce these rules *(European Union, 2024)*. Together, these tools serve two main purposes. First, they help to lessen the "uncertainty gradient" across different jurisdictions: despite varying political systems, a shared understanding of transparency, safety, and accountability begins to take shape. Second, they offer practical "points of contact" for both major powers and Global South nations: countries can adopt specific sets of rules or procedures (like those for high-risk models or content labelling) without having to wait for the lengthy process of universal negotiations to conclude *(European Union, 2024; United Nations General Assembly, 2024)*. Our findings indicate that it's this blend of universal guidelines with more specific regional solutions that lays the groundwork for gradual alignment, paving the way for broader agreements to emerge *(Chatham House, 2025; Munich Security Conference, 2025)*.

When it comes to Ukraine, there are some practical takeaways that stem from the need for both "security and cooperation." First off, any engagement with major powers and integration groups should be built on a foundation of transparency, accountability, and clear procedures for AI projects. In real terms, partnerships need to include guidelines for data governance, model audits, thorough documentation of training and testing, and systems to disable autonomous functions in sensitive situations. This strategy not only helps minimize the chances of errors and incidents but also fosters mutual trust - something that's crucial because without it, selective coalitions can quickly turn into short-lived plans that lack any real impact *(Perepelytsia, 2024)*. Secondly, it's important to focus on "actions, not just words": joint initiatives with key partners should come with budgets, specific performance metrics, and commitments to develop infrastructure and workforce. This approach helps reduce political uncertainty, makes things more predictable for investors, and speeds up the adoption of successful practices. Lastly, it's vital to reduce risks of asymmetry in our partnerships. The growing alignment between Moscow and Beijing brings its own set of challenges, such as becoming overly reliant on certain technology suppliers and pushing for bundled solutions that might clash with our goals for transparency and accountability. Let's talk about the importance of diversification: it's all about bringing in multiple suppliers and ensuring that we have hard-coded requirements for things like interoperability, standardized data export, and clear audit conditions. Looking back at the history of NATO-Russia relations, as discussed in previous studies, serves as a reminder that watering down institutional guarantees and swapping them for "informal" agreements without proper verification can lead to instability. Even in selective formats, having clear control and feedback mechanisms is crucial. So, what do we take away from this? Here are three practical recommendations for foreign policy: (1) adopt rule-modules and procedures that promote transparency and accountability; (2) form selective coalitions focused on projects with measurable outcomes, like security, informational resilience, and productivity; (3) make sure to include interoperability requirements in all agreements to prevent technological lock-in and political dependence *(Kuzio, 2024; Perepelytsia, 2024)*.

The limitations of this study arise from both the type of data we have access to and the rapid changes happening in the AI field. To start, many official stances from major powers and groups in the Global South are still being developed, which limits our ability to verify things quantitatively and forces us to rely on qualitative policy indicators and short-term trend analysis. Additionally, global and regional frameworks often use different definitions and metrics (like risk categories and transparency standards), making direct comparisons tricky and necessitating careful normalization. Lastly, we chose not to use empirical data from field interviews or restricted documents, opting

instead for open sources and public policies. While this choice may lessen the depth of our institutional analysis, it enhances the reproducibility and transparency of our approach.

The next steps for research naturally flow from our findings. To start, we should create a comparative panel of joint AI initiatives involving Ukraine and its partners. This panel should include measurable indicators that go beyond just formal agreements, such as coordination costs, transparency metrics, the speed of scaling, and their impacts on security and productivity. Next, we need to dive into the "trust chain" in transnational data exchange: figuring out how to blend privacy-preserving principles, security needs, and interoperability in projects that cross various jurisdictions. Then, we should evaluate how the Global South can participate in rule-making through selective mechanisms: identifying which combinations of universal guidelines and club-style arrangements can reduce coordination costs while boosting the chances of sustainable implementation *(Mampilly, 2025)*. Lastly, let's enrich the Ukrainian perspective with real-world evidence: conducting surveys among public authorities, businesses, and research institutions to identify barriers and incentives for integrating transparency and accountability practices in AI projects. Over time, this approach could help shift from a purely analytical model to actionable policy roadmaps that align security priorities with the needs for innovation and collaboration.

**Conclusions.** The rise of artificial intelligence isn't just adding another topic to the international relations discussion; it's reshaping how we create and apply principles and rules for interaction. The blend of universal guidelines and selective cooperation methods isn't just a temporary fix; it's a smart way to ensure policy alignment in a politically shaky landscape. For Ukraine, this framework offers a chance to combine a security-focused approach with involvement in initiatives that boost productivity and resilience - so long as transparency, accountability, and interoperability remain fundamental principles of collaboration.

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**THE EU SECURITY POLICY AND DEFENCE READINESS: STATE AND PROSPECTS**

**БЕЗПЕКОВА ПОЛІТИКА ТА ОБОРОННА ГОТОВНІСТЬ ЄС: СТАН ТА ПЕРСПЕКТИВИ**

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***Abstract.*** *The article examines the transformation of the European Union's security policy in the context of the emergence of new challenges, the most significant in several decades. It emphasises that, since 2022, the leadership of the European Union and the majority of its Member States have been able to fundamentally revise their internal and external policies, identifying the strengthening of defence capabilities as one of the key priorities. The article analyses the key EU legal and policy documents adopted over the past five years with the aim of pursuing a coordinated defence policy within the EU to enhance the Union's defence readiness, primarily in the short- and medium-term perspective.*

***Keywords:*** *defence budget, defence procurement, security initiatives, defence production, joint projects.*

***Анотація.*** *У статті досліджується трансформація політики безпеки ЄС у контексті появи нових викликів, найбільших за останні декілька десятиліть. Наголошується, що, починаючи з 2022 року, керівництво Євросоюзу та більшості держав-членів змогли кардинально переглянути свою внутрішню та зовнішню політику, визначивши посилення оборонних спроможностей як один з ключових пріоритетів. Проаналізовано ключові нормативно-правові документи ЄС, прийняті за останні 5 років з метою проведення узгодженої оборонної політики всередині ЄС для посилення обороноздатності союзу, у першу чергу, у коротко- та середньостроковій перспективі.*

***Ключові слова:*** *оборонний бюджет, оборонні закупівлі, безпекові ініціативи, оборонне виробництво, спільні проєкти.*

**Introduction.** Since the beginning of the Cold War and the establishment of NATO, ensuring security in Europe has been one of the key directions of United States foreign policy, regardless of which of the two political parties controlled the White House. As a result, for decades European

countries were able to build "welfare states", investing primarily in social programmes and policies and increasing the standard of living of their populations. Even the military aggressions of the Russian Federation against Georgia in 2008 and against Ukraine in 2014 did not have a significant impact on the EU's security policy.

Over the past few years, however, the situation has changed fundamentally. Russia's full-scale aggression against Ukraine in February 2022 became a clear signal for European countries that the period of relative calm, in which climate change and migration were considered the key challenges, had come to an end. The arrival in the White House of President D. Trump's administration, with its explicit position on reducing the role of the United States in ensuring Europe's security, further accelerated the emergence of a shared understanding among EU Member States of the need to rethink approaches to their own security.

Since 2022, the European Union has continued to make significant efforts to strengthen its own security and defence capabilities. In particular, a number of strategic documents have been prepared and published (the Strategic Compass, the European Defence Industrial Strategy, the White Paper on European Defence, etc.). Also, large-scale investments in domestic defence production have been launched, and the regulatory framework for cooperation in defence procurement has been further developed.

At the same time, as of the end of 2025, the European Union remains objectively unprepared for a potential large-scale military aggression. In its strategic documents and public communications, the EU has declared its intention to achieve full defence readiness by 2030. However, the growing number and increasing audacity of provocations by the Kremlin in 2025 indicate that such risks may materialise much earlier.

Against this background, it appears both timely and necessary to analyse the current state and the progress achieved in the EU's security and defence policy in the context of a rapidly deteriorating security environment.

**Literature review.** Given the relevance of the topic, the evolution of the European Union's security and defence policy, particularly in the context of Russia's full-scale aggression against Ukraine and the increasing threat of aggression against the European Union itself, has become a frequent subject of academic research by both Ukrainian and foreign scholars.

In recent years, Ukrainian researchers have analysed this issue both within a narrower institutional dimension (Moroz (2024), Zavada and Sino (2022), Dmytrenko, Dmytrenko, and Zhabinets (2025)) and in a broader context of the European Union's comprehensive actions and decisions as an institution, as well as the policies pursued by individual Member States (Shyshkin, Baran, and Berezovska-Chmil (2024), Kobets and Holubiak (2023)). The issue has also been addressed in the works of Zaitseva-Kalaur, Parashchuk, Didushyn, and Martynov.

Comprehensive changes in European defence policy in recent years have also been widely examined in foreign academic literature, predominantly by European scholars. In particular, a number of studies focus on the evolution of EU defence integration projects and the tectonic shifts in this field over the past three years (Katarina Engberg (2025), Luigi Scazzieri (2025)), as well as propose and analyse various models for further deepening defence integration within the European Union (CEPS (2025)). A significant number of publications in European academic literature are likewise devoted to changes in the EU's defence procurement policy (Tom Waldwyn (2025), Adam Vittek (2025)) and developments in the EU defence industrial domain (Juan Mejino-López, Guntram B. Wolff (2024), Jan Joel Andersson and Marina Britz (2025), Sophia Besch (2025)).

At the same time, in light of the dynamic changes in the regional security environment and the conceptual decisions adopted by the European Union and individual Member States already in 2025, it appears both timely and necessary to analyse the current state of the EU's security and defence capabilities, as well as the further directions of its defence policy.

**Theoretical framework and the methodology.** The theoretical foundation of the study is primarily based on the neorealist approach, which emphasises the growing role of security considerations, the balance of power, and perceived threats in shaping the policies of states and supranational entities. It is through the prism of neorealism that the transformation of the European

Union's strategic priorities is analysed in the context of a deteriorating security environment.

At the same time, elements of neoliberal institutionalism are partially employed to explain the mechanisms of institutional coordination and joint defence initiatives within the European Union. This approach makes it possible to elucidate the role of supranational institutions in reducing transaction costs and facilitating cooperation among EU Member States in the security and defence domain.

The study employs a combination of general scientific and specialised research methods. In particular, methods of analysis and synthesis are applied to examine strategic, legal, regulatory, and programme documents of the European Union in the field of security and defence. The comparative method is used to assess the dynamics of defence expenditures and the approaches adopted by EU Member States in the development of their defence policies.

The historical and chronological method allows for tracing the evolution of the EU's security and defence policy in the periods before and after 2022. Statistical analysis is applied to systematise and generalise data on defence budgets, financial instruments, and investment volumes. In addition, a systems approach ensures a comprehensive understanding of the interrelationship between strategic decisions, financial mechanisms, and institutional initiatives of the European Union in the context of shaping its overall defence readiness.

**Main results of the research.** For decades, following the failed attempt to establish a European Defence Community in 1954, the issue of European security was regarded as an exclusive responsibility of NATO. Defence integration among European states within the framework of what is now the European Union began only in the second half of the 1990s, with the launch of the European Security and Defence Policy (1999) and, pursuant to the Treaty of Lisbon (2009), the establishment of the Common Security and Defence Policy (CSDP) *(Kobets & Holubiak, 2023)*. The same Treaty introduced Permanent Structured Cooperation (PESCO) as a mechanism within the EU's security and defence policy aimed at ensuring closer voluntary cooperation among EU Member States in the field of defence *(European Union, n.d.; Permanent Structured Cooperation, n.d.)*.

At the same time, for a considerable period, there was little practical deepening of cooperation in the field of security and defence within the European Union. Calls by French President Emmanuel Macron to enhance the EU's "strategic autonomy" failed to gain broad support among the majority of Member States. Even projects under the PESCO framework were launched only in 2017, eight years after the formal announcement of the initiative.

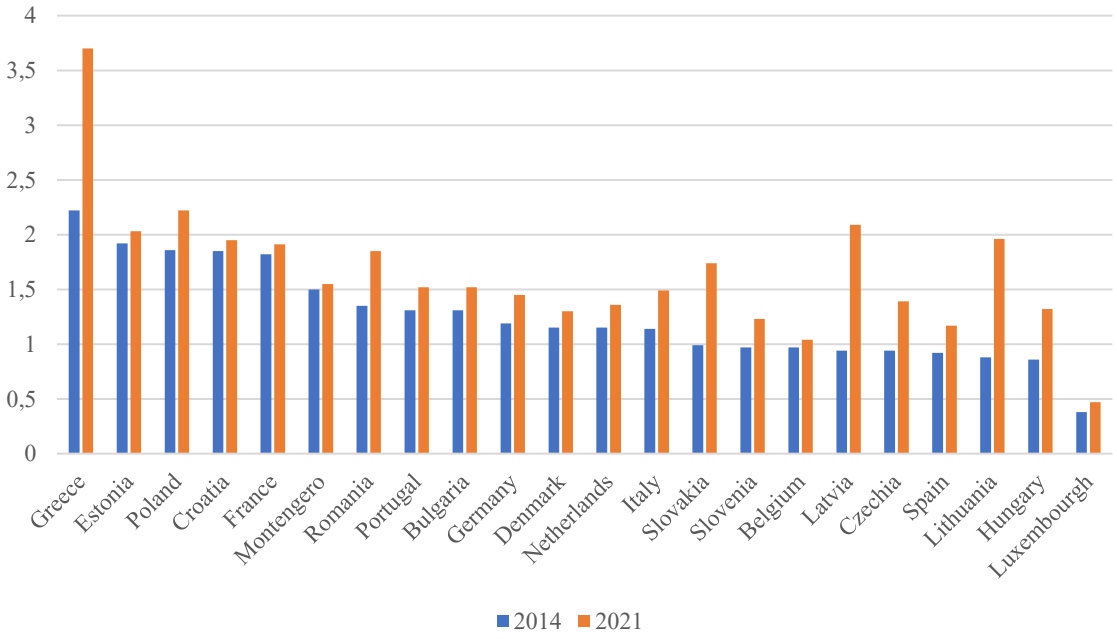
Despite the repeatedly demonstrated aggressive ambitions of the Kremlin, as well as the commitments undertaken at the NATO Wales Summit to allocate at least 2 per cent of GDP to defence, the vast majority of EU Member State governments continued to prioritise domestic public sentiment. As a result, policies aimed at increasing defence expenditures and pursuing active militarisation remained largely unpopular. For instance, as of 2021, among all countries that spent less than 2 per cent of GDP on defence in 2014, only Poland and the Baltic States had fulfilled this commitment (Figure 1).

It was only in 2021, within the framework of the adopted seven-year EU budget *(European Commission, n.d.)* and against the backdrop of increasingly threatening rhetoric and actions by the leadership of the Russian Federation, that the European Union began to establish mechanisms – primarily financial ones – aimed at deepening defence integration processes, particularly in the areas of defence production and procurement. A significant step in this regard was the establishment of the European Defence Fund (EDF) *(European Commission, n.d.)*, whose budget initially amounted to EUR 7.3 billion and was subsequently increased to EUR 8.8 billion following the mid-term review in 2024. Resources from the EDF, allocated in the form of grants, enable EU Member States to initiate and develop projects in the field of defence production, defence-related research and development (R&D), and advanced technologies.

It is also important to note the establishment in the same year of the European Peace Facility (EPF) *(Council of the European Union, n.d.)*, whose primary objective is defined as conflict prevention and the strengthening of regional and international stability. Designed to finance both

peacekeeping missions and operations (currently funding eight ongoing operations in Europe and Africa) as well as the provision of military assistance, the EPF has become one of the key instruments through which the European Union, as an international organisation, has provided military support to Ukraine. As a result, the EPF budget increased from EUR 5.69 billion to EUR 17 billion over a four-year period. As of the end of 2025, Ukraine had received EUR 6.1 billion from the EPF; at the same time, EUR 6.6 billion has remained blocked for more than a year due to Hungary's veto *(Scazzieri, 2025)*.

**Figure. 1.**
*Defence spending by EU Member States, 2014-2021*




*Source. Compiled by the author based on data from (Statista, n.d.).*
*Note. This chart presents data on EU Member States that, as of 2014, were also members of NATO and had undertaken the corresponding commitment.*

Nevertheless, as of 24 February 2022, when the Russian Federation launched its full-scale invasion of Ukraine, EU Member States were still far from a shared understanding of the future development of defence policy in the context of such a profound transformation of the security environment. For this reason, work on a key doctrinal EU document outlining a common vision of the Union's security and defence policy up to 2030 – the Strategic Compass – was significantly accelerated *(European External Action Service, n.d.)*. Published on 25 March 2022, this document effectively constituted the EU's response to Russia's unprovoked aggression against Ukraine.

The Strategic Compass is a comprehensive policy document in which the European Union clearly identified existing and potential security threats, explicitly condemning Russian aggression and designating Russia as the principal threat to European security. Given the importance of this document as the foundation of the EU's defence policy in the post-2022 period, it has been the subject of numerous analytical publications by both foreign and Ukrainian scholars. In particular, the National Institute for Strategic Studies published an analytical brief examining the content of the document and presenting its own conclusions *(Davymuka, 2022)*. It is noteworthy that the European Union has identified four priority areas for further action aimed at strengthening defence capabilities, each accompanied by a set of concrete measures for implementation:

• **ACT.**

1. Enhancing civilian and military Common Security and Defence Policy (CSDP) missions and operations by providing more robust and flexible mandates, expediting and streamlining decision-making processes, and ensuring greater financial solidarity.

2. Developing by 2025 a rapid deployment capability for EU armed forces, comprising up to 5,000 personnel across land, air, and maritime components.

3. Reforming civil and military command and control structures, promoting military mobility, and conducting regular exercises, with particular emphasis on rapid deployment forces.

• **SECURE.**

1. Strengthening intelligence capabilities, particularly through the EU Single Intelligence Analysis Capacity (SIAC).

2. Establishing a Hybrid Toolbox and Response Teams that integrate diverse instruments for the detection and response to a broad spectrum of hybrid threats.

3. Advancing the EU's cyber defence policy; enhancing the Union's presence across maritime, air, and space domains, including the expansion of Coordinated Maritime Presence to additional regions such as the Indo-Pacific, the development of an EU Space Strategy, and the promotion of interoperability across these domains.

• **INVEST.**

1. Increasing both the quantity and quality of spending on the development of defence capabilities.

2. Pursuing joint research and development of modern and advanced solutions, including naval platforms, tanks, and military aircraft.

3. Maximising the use of PESCO and the European Defence Fund to jointly develop high-tech defence capabilities, with a particular focus on innovation.

• **PARTNER.**

1. Strengthening strategic partnerships with NATO and the United Nations, while expanding cooperation with regional partners such as the OSCE, the African Union, and ASEAN.

2. Developing bilateral partnerships with key countries, including the United States, the United Kingdom, Canada, Norway, and Japan, and maintaining engagement formats with Eastern Partnership countries, the Western Balkans, the EU's southern neighbours, and Latin American states.

3. Establishing the EU Security and Defence Partnership Forum to facilitate more effective engagement with partners.

To monitor the implementation of this document, the EU High Representative for Foreign Affairs and Security Policy publishes an annual report to the Council of the European Union – the Annual Progress Report on the Implementation of the EU Strategic Compass on Security and Defence (the latest edition being March 2024) *(European External Action Service, 2024)*. The report assesses progress over the past two years very positively. For each of the priority areas, either concrete achievements have already been realised – such as the significant increases in EDF and EPF budgets, the adoption of the EU's first-ever Space Strategy, and the active ongoing programmes for the training of Ukrainian military personnel under the EU Military Assistance Mission – or notable intermediate results have been recorded in the pursuit of longer-term objectives, particularly regarding greater integration and cooperation in defence procurement and the defence industry.

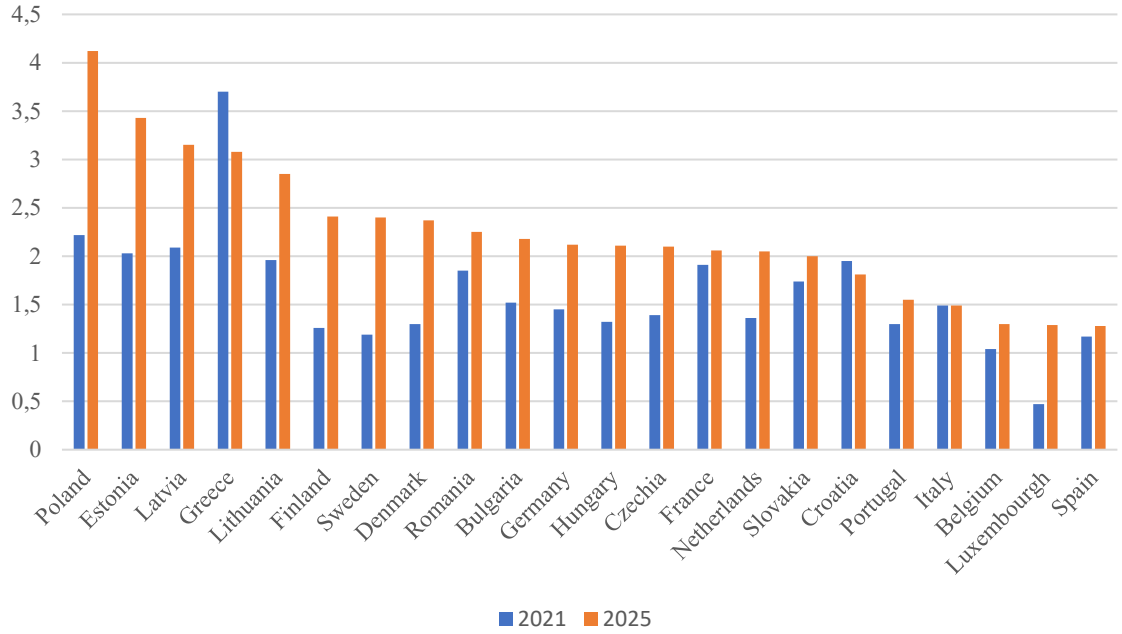
In order to assess the progress achieved by the European Union in strengthening its own defence capabilities by the end of 2025, as well as to identify the main challenges that remain, it is necessary to examine the joint initiatives of EU Member States aimed at enhancing multilateral cooperation across key areas, namely:

As noted earlier in this article, for the vast majority of EU countries, the commitment made at the 2014 NATO Summit to reach defence expenditures equivalent to 2% of GDP remained largely a political statement, rather than a plan intended for actual implementation. The onset of a full-scale conventional war in the heart of Europe, however, has had a profound impact on both domestic and foreign policies of EU governments, as well as on public sentiment within these countries.

Starting from 2022, defence expenditures of EU Member States began to increase significantly. Specifically, the total EU defence budget amounted to EUR 240 billion in 2022, rising to EUR 279 billion in 2023 (+16%), EUR 326 billion in 2024 (+36% compared to 2022), and EUR 392 billion in 2025 (+63%) *(European Parliament Research Service, 2025)*. By comparison, over

the eight-year period from 2014 to 2021, the budget had increased only from EUR 180 billion to EUR 218 billion, or by 21%. There is little doubt that this upward trend will continue into 2026.

**Figure. 2.**
*Defence expenditures of EU Member States, 2021-2025*




*Source. Compiled by the author based on data from (Statista, n.d.) .*

Analyzing the data, two main conclusions can be drawn:

- following 2022, the dynamics of defence spending among EU Member States changed significantly. Whereas prior to this period only four countries had reached the planned benchmark of 2% of GDP on defence expenditure, by 2025 the vast majority of Member States had achieved this target;

- a more pronounced divergence has emerged in spending priorities among countries from different parts of Europe. Eastern flank states of the EU have substantially increased their defence budgets, while countries directly bordering the Russian Federation have done so severalfold. In 2025, Poland became the clear leader within the EU in this regard (with 4.8% planned for 2026 *(Notes from Poland, 2025)*), though Lithuania *(Ministry of Finance of Lithuania, 2025)* and Latvia *(Ministry of Finance of Latvia, 2026)* are expected to surpass it, thereby meeting the commitment to reach 5% by 2035, adopted at the 2025 NATO Summit in The Hague.

Radical shifts in defence policy have also occurred among the EU's leading states. The Federal Chancellor of Germany, on the third day following the full-scale invasion, announced the creation of a EUR 100 billion fund to enhance Bundeswehr capabilities *(Federal Government of Germany, 2022)*. Furthermore, considering the government's plans to allocate EUR 649 billion to strengthen defence by 2030 *(NewsDesk, n.d.)*, a historic decision was taken in March 2025 to release defence expenditure from strict debt limits (previously capped at 1% of GDP) and to allow greater use of domestic borrowing for defence purposes. France has likewise sought to maintain a strong position, reaching the 2% threshold in 2024 and planning additional investments in its defence budget over the coming years *(Reuters, 2025)*.

Conversely, for Southern European countries, strengthening defence capabilities remains a lower priority. Consequently, in recent years, defence spending levels in this region (Italy, Spain, Portugal) have remained largely unchanged. This is largely due to issues related to public debt, which, for instance, stands at nearly 140% of GDP in Italy. Given that Russian aggression does not

pose an immediate threat to them, discussions on this matter continue both within the EU and NATO. Notably, Spain has been the only country to resist fully agreeing to the compromise of 3.5% direct defence spending plus 1.5% for associated costs by 2035, as adopted at the NATO Summit in The Hague *(Politico, 2025)*.

A historic yet, at the same time, logical step for the European Union, in light of increasingly provocative and threatening actions by Russia as well as the consistent policy of the Trump Administration to reduce U.S. security commitments to Europe, was the publication by the European Commission in March 2025 of the White Paper on European Defence – Readiness 2030 *(European Commission, n.d.; Orlyk, 2025)*. The White Paper essentially constitutes a continuation of the Strategic Compass, outlining the vision of the leaders of a united Europe regarding the EU's defence strategy in the context of evolving geopolitical dynamics.

In order to achieve the stated objective of full EU defence readiness by 2030, the document places particular emphasis on the EU defence plan ReArm Europe, which serves as an implementation strategy for achieving the overarching objectives of self-defence outlined in both the Strategic Compass and the White Paper. Recognizing that, despite a significant increase in defence spending (more than 31% since 2021, reaching 1.9% of the EU's aggregate GDP), European expenditures remain substantially lower than those of the United States, Russia, or China, the central goal of ReArm Europe is to mobilize approximately EUR 800 billion for defence purposes.

Under the ReArm Europe plan, the European Commission has identified five mechanisms to rapidly and significantly increase European defence spending:

- the majority of this sum (up to EUR 650 billion) is expected to be mobilized at the national level, allowing Member States to increase defence expenditure through sovereign debt. To this end, a waiver of the Stability and Growth Pact is permitted, enabling countries to increase defence spending without triggering an excessive deficit procedure; *(European Commission, 2025)*

*Note: The Stability and Growth Pact is an agreement concluded in 1997 among EU Member States on fiscal and budgetary policy, obliging countries to maintain annual budget deficits below 3% of GDP and public debt below 60% of GDP.*

- EUR 150 billion is to be mobilized through the introduction of a new financial instrument providing loans to countries for military production projects and defence procurement. This instrument has been named Security Action for Europe (SAFE), further details of which will be provided below;

- additionally, funds are expected to be raised from the European Defence Fund (EDF), the mobilization of private capital, and contributions from the European Investment Bank.

Undoubtedly, the adoption of such an ambitious plan demonstrates that the EU is prepared to act decisively and has a clear understanding of the challenges at hand. At the same time, the capacity of EU Member States to utilize sovereign debt for increased defence spending varies considerably. While Scandinavian countries and, for example, Germany – which, as noted above, has already amended its national legislation accordingly – possess sufficient fiscal space, there are numerous heavily indebted Member States (such as France and countries in Southern Europe) for which the removal of fiscal constraints provides little practical effect *(de Cordoue, 2025)*.

While increased investment and financing in defence are crucial, it is equally important to have a clear understanding of where and for what purpose resources are allocated. Therefore, it is essential to analyse the key areas of EU Member States' cooperation, namely defence procurement and the defence industry.

Within the European Union, defence procurement is governed by European Parliament and Council Directive 2009/81/EC on defence and security procurement, adopted on 13 July 2009, which establishes the rules for the procurement of weapons, ammunition, and military materials for defence purposes *(European Union, 2009)*. For a long period, a key challenge in this area was the absence of a unified policy and shared vision among EU Member States regarding the strengthening of defence. Consequently, each country conducted procurements solely based on its own national interests, without taking into account broader European security needs. This was largely the main reason behind persistent problems in the EU's defence procurement policy, such as fragmentation

and duplication, lack of standardization, and complex bureaucratic procedures *(Keystone Procurement, 2023)*.

By 2022, two primary models prevailed in EU joint defence procurement:

- procurement through the European Defence Agency (EDA), established in 2004. Although joint procurement is one of the Agency's objectives, this function had been largely underutilized for many years. In addition to the reasons mentioned above, this was also due to the activities of other agencies with similar mandates and complex regulatory frameworks, such as NATO's Support and Procurement Agency (NSPA) and the Organisation for Joint Armament Cooperation (OCCAR). The institutionalization of joint defence procurement was often further hampered by the desire of individual Member States to lobby for the interests of their domestic defence industries during contract negotiations;

- lead-nation model, in which one country conducts procurement on behalf of itself and the other participating countries in a project. In recent years, this approach has become the primary method and has been used in the implementation of all major European procurement projects, both successful and less successful. Examples of more successful initiatives include the Common Armoured Vehicle System (CAVS), launched in 2020 by Finland as the lead nation in cooperation with Denmark, Sweden, Germany, the United Kingdom, and Latvia. Less successful projects include the Franco-German Main Combat Ground System, which has made virtually no progress since 2017 *(Andersson, 2023)*, and the Franco-German-Spanish Future Combat Air System (FCAS) for sixth-generation fighter aircraft procurement *(Financial Times, 2025; Vittek, 2025)*.

As a result, the logical decisions of European governments to conduct the majority of procurements either from domestic producers or non-European suppliers (primarily the United States) led, according to the EDA's December 2021 report, to the lowest level of EU joint defence procurement since 2006, amounting to only 11% *(European Defence Agency, 2021)*.

Since February 2022, both the EU leadership and Member State governments have begun rapidly reassessing the approach to defence procurement. By July 2022, work had commenced on the European Defence Industry Reinforcement through Common Procurement Act (EDIRPA), which was ultimately adopted by the European Parliament and the Council of the European Union only in October 2023 *(European Commission, n.d.)*. Although the budget allocated for this mechanism was relatively modest, totalling EUR 300 million, the emphasis was placed squarely on conducting joint defence procurements among EU Member States. Specifically, EUR 60 million was allocated to each of five procurement projects across three key areas:

Air Defence:

1. Mistral MANPADS – 9 countries (Belgium, Denmark, Estonia, Spain, France, Cyprus, Hungary, Romania, and Slovenia);

2. IRIS-T SLM air defence system – 6 countries (Bulgaria, Germany, Estonia, Latvia, Austria, and Slovenia).

Armoured vehicles:

1. Inclusion of the aforementioned CAVS project in EDIRPA financing.

Artillery ammunition:

1. CPoA 155 mm (Collaborative Procurement of Ammunition) – 6 countries (Denmark, Croatia, Italy, Lithuania, the Netherlands, and Poland);

2. HE (high-explosive) 155 mm – 4 countries (Germany, Denmark, Estonia, and the Netherlands).

Given its limited budget, EDIRPA was designed as a temporary mechanism, operational until 2025, while the EU leadership worked on a more comprehensive and long-term framework. In March 2024, the EU published its first-ever European Defence Industrial Strategy (EDIS), alongside a proposal for the European Defence Industrial Programme (EDIP). Considering the significant shift in priorities among most European countries over the past three years regarding the importance of developing a domestic and European defence industry, and correspondingly conducting procurements from European manufacturers, the further trajectory of EU policy in this area will be analysed in the following section.

Regulation of matters related to the internal market falls within the competence of the Union; however, Article 346 of the Treaty on the Functioning of the European Union provides for exceptions to this rule in the field of arms and ammunition production and trade, allowing Member States to protect their essential security interests *(European Union, 2016)*. The development of the EU defence industry was further constrained by the prevailing belief among most Member States that a war in Europe was unlikely. As a result, the European defence technological and industrial base remained underfunded for years, leading to a gradual erosion of domestic capacities for the production of weapons and ammunition.

Moreover, EU Member States frequently procured defence equipment from outside the Union, even in cases where comparable European-made alternatives were available *(Maulny, 2023)*. This practice ultimately led to such a severe degradation of the European armaments sector that it proved incapable of meeting the surge in demand for weapons and ammunition following the outbreak of Russia's full-scale war against Ukraine, despite increased procurement spending by EU governments.

A vivid illustration of this structural weakness was the failure of the EU initiative to supply Ukraine with one million 155 mm artillery shells within one year (from March 2023 to March 2024) *(Reuters, 2023)*. The plan envisaged both the transfer of ammunition from existing stockpiles and the contracting of newly manufactured rounds. A total of EUR 2 billion was allocated to this project, including EUR 500 million under the Act on Supporting Ammunition Production (ASAP), adopted in July 2023 *(European Union, 2023)*. ASAP became the first EU regulatory instrument adopted after 24 February 2022 aimed at supporting the Union's defence industry, with the explicit objective of expanding EU production capacities and addressing the acute shortages of ammunition and missiles.

Through ASAP, as well as the European Peace Facility (EPF) – whose budget was increased by EUR 5.5 billion during 2023 – the EU intended to reimburse Member States for ammunition transferred directly to Ukraine, as well as for contracts related to the production and delivery of new ammunition.

Nevertheless, despite considerable efforts and strong political rhetoric, the EU failed to deliver on its stated objective. As early as November 2023, EU leadership acknowledged that the plan would not be fulfilled *(Bloomberg, 2023)*. The pledged one million rounds were ultimately delivered only in November 2024, eight months behind the original schedule *(Borrell, n.d.)*. While one of the cited reasons was the sharp increase in the price per shell – from approximately USD 2,000 per unit in 2021 to around USD 8,000 in 2023 – the core issue remained the inability of the European defence industry to generate the required production capacity, a reality that some political actors were reluctant to acknowledge *(Myroniuk & Yegoshyna, 2024)*.

Consequently, by 2023, the need arose to develop a strategic document for the development of the European defence industry, in which the European Commission and Member States would highlight the main challenges, define key objectives, and outline the pathways to achieve them. This document took the form of the European Defence Industrial Strategy (EDIS), published in March 2024 *(European Commission, 2024)*. EDIS identifies the primary priority as ensuring EU defence readiness in the context of the Russian threat by enhancing the innovation, competitiveness, and resilience of the European defence technological and industrial base through increased defence investments and improved supply chains. Emphasizing the necessity to strengthen cooperation (joint investments, procurement, and research) to achieve this priority, EDIS sets out the following requirements:

- joint defence procurement within the EU must account for at least 40% of all Member States' defence acquisitions;
- EU Member States are to allocate no less than 50% of their defence budgets to products from European companies by 2030, and at least 60% by 2035;
- the creation of legal structures for the Structures for the European Ammunition Programme (SEAP), through which groups of at least three Member States can conduct joint procurement while receiving additional funding from European sources *(Tardy & Ostanina, 2024; Kozioł, 2024)*.

Simultaneously with EDIS, the European Defence Industrial Programme (EDIP) *(Council of the European Union, n.d.)* was proposed as an implementation instrument to provide financial and regulatory support to the European defence technological and industrial base. After extensive deliberations, on 16 October 2025, the European Parliament and the Council of the EU reached political agreement on the main framework of EDIP, with formal adoption occurring on 25 November and 8 December 2025, respectively. With a budget of EUR 1.5 billion, EDIP replaces EDIRPA and ASAP and will operate until 2027, the end of the EU's current Multilateral Financial Framework. EDIP is designed to address the following primary objectives:

- accelerating Member States' production capacities;
- enhancing the resilience of supply chains;
- strengthening cooperation with the Ukrainian defence industry for mutual benefit;
- ensuring controlled availability of critical defence products, among others.

At the same time, EDIP inherits the primary limitation of EDIRPA and ASAP – the EUR 1.5 billion budget is insufficient to achieve even a portion of the set objectives. Currently, the programme's main task is to establish a clear regulatory framework for implementing joint projects, with a larger budget expected to become available following the adoption of the new EU Multilateral Financial Framework in 2027.

Simultaneously with the discussion and adoption of EDIP, the European Council, following a proposal by the European Commission, published in March 2025 the regulatory framework establishing the Security Action for Europe (SAFE) credit programme *(European Union, 2025)*. As noted earlier in this article, this new EU financial instrument, with a total volume of EUR 150 billion, is part of the EU defence plan ReArm Europe, which has an overall planned budget of up to EUR 800 billion.

The purpose of SAFE is to stimulate joint production of defence equipment within the EU. Funding is envisaged for two main areas:

1) Artillery, missiles and ammunition, armoured vehicles, precision strike systems, support and cybersecurity systems;

2) Air defence/missile defence systems, naval assets, large unmanned systems and countermeasures, artificial intelligence systems, space equipment, electronic warfare systems, and strategic supply capabilities.

Key features of the SAFE instrument include:

- joint procurement must involve at least two countries, and in addition to Member States, partner countries – including Ukraine – may also participate. To qualify for favourable loan conditions, participation of at least two Member States is required. In the initial phase (until May 2026), countries will also have the opportunity to submit individual applications;

- loan repayment terms may extend up to 45 years, with no repayment obligations during the first 10 years. Up to 15% of the loan funds may be disbursed in advance to support project initiation;

- at least 65% of the estimated value of the final product must come from European companies, or from companies within the European Free Trade Association, the European Economic Area, or Ukraine.

By September 2025, all EUR 150 billion had been allocated according to applications from 19 countries, with Poland emerging as the clear leader, receiving nearly one-quarter of the total funds (EUR 43.73 billion).

All the aforementioned initiatives and regulatory mechanisms for the development of the EU defence industry and joint procurement were adopted in record time. This urgency reflects the growing recognition, as the war continues, that strengthening defence capabilities is an immediate and pressing need. Improving the efficiency of policies in these areas is critically important for rapidly achieving such capabilities, which remains the EU's primary focus. Consequently, the final part of this article examines the key existing and planned EU defence initiatives.

For a long time, the primary mechanism for military cooperation among EU Member States was the Permanent Structured Cooperation (PESCO), already mentioned at the beginning of this article. Given that a total of 83 projects are planned under PESCO across all operational domains –

from traditional land, air, and maritime areas to cybersecurity and countering information threats – deepening multilateral cooperation within this framework could have been a logical step.

However, in recent years, European leaders have rarely referred to PESCO. In its report covering the first phase (2017–2025), the PESCO Secretariat noted that less than half of the projects had reached the implementation stage, with key achievements largely confined to cybersecurity and military mobility – important areas, but not among today's highest priorities *(European Defence Agency, 2025)*.

Consequently, the EU has actively initiated new projects, taking into account the need to respond to the most pressing threats to European security. In particular, in October 2025, the European Council approved the Defence Preparedness Roadmap to 2030 – a document outlining strategic priorities and measures aimed at strengthening the defence readiness of EU Member States by 2030 *(European Commission, 2025)*. This roadmap envisages:

- *the implementation of flagship initiatives to enhance EU defence capabilities:*

1) European Drone Defence Initiative – the creation of a multi-layered counter-UAS system encompassing detection, tracking, and neutralisation of drones, as well as the deployment of EU-owned drones for precision strikes. Project completion: 2027;

2) Eastern Flank Watch – aimed at strengthening the EU's eastern borders through integration of air defence, counter-UAS, ground and naval surveillance systems, and situational awareness tools. Project completion: 2028;

3) European Air Shield – the establishment of an integrated air and missile defence system to protect the airspace of EU Member States, fully compatible with NATO. Project completion: 2026;

4) European Space Shield – aimed at protecting EU space assets and services, including the development of Galileo, IRIS, Earth Observation, and other systems, enhancing threat countermeasures and space situational awareness. Project completion: 2026.

- *the creation of Capability Coalitions:*

1) Air and missile defence – establishment of an integrated EU air and missile defence system;

2) Strategic enablers – improvement of logistics, medical support, transport, and communications;

3) Military mobility – enhancement of EU transport networks for rapid deployment of troops and equipment;

4) Artillery systems – development of modern artillery systems, calibre standardisation, and joint ammunition production;

5) Cybersecurity, artificial intelligence, and electronic warfare;

6) Missile systems and ammunition – increased production and creation of European stockpiles;

7) UAVs and counter-UAV systems;

8) Ground combat forces – modernisation of armoured vehicles and joint development projects for new tanks and armoured personnel carriers;

9) Naval forces – development of next-generation frigates, unmanned maritime systems, and coastal defence capabilities.

A mandatory benchmark stipulates that at least 40% of procurement must be conducted jointly within the EU by the end of 2027, and by 2030, no less than 55% of defence investments should be directed toward European companies.

- *strengthening the defence-industrial base:*

1) promoting research and development, including through the EDF and the forthcoming EU Competitiveness Fund;

2) expanding defence production through joint procurement and long-term contracts;

3) retraining 200,000 workers for the defence industry by 2026.

- *support for Ukraine:*

1) integration of the Ukrainian defence industry into the European defence-industrial base;

2) financing Ukraine through frozen Russian assets;

3) establishing a drone alliance to develop UAV technologies jointly by Ukrainian and

European enterprises;

4) continuation of the EU MAM mission for training Ukrainian personnel;

5) integration of Ukraine into projects under SAFE and the Ukraine Support Initiative (USI) for joint procurement.

Overall, 2025 proved to be a breakthrough year for the EU in terms of accelerating key decisions in both legislative-regulatory and practical dimensions. Considering that the White House's position on reducing US security commitments in Europe is unlikely to change, strengthening the EU's own defence capabilities has once again become, for the first time since the Cold War, an existential issue. In the context of the rhetoric and actions of the Russian military-political leadership, this will continue to remain the case for many years to come.

**Conclusions.** A detailed analysis of the EU's strategic, regulatory, and financial activities in the field of security and defence over the past four years demonstrates profound conceptual transformations in the priorities of the Member States in both foreign and domestic policy. Since 2022, near-revolutionary decisions have been taken, primarily at the legislative and budgetary levels, aimed at enhancing military capabilities, expanding production capacities, and strengthening integration and cooperation within the EU in the implementation of joint defence projects across multiple domains. At both political and analytical levels, references to a "European Defence Union" capable of countering both hybrid and conventional threats have become increasingly frequent.

At the same time, a number of well-known challenges remain unresolved. The EU's Multiannual Financial Framework for 2021–2027 was adopted in a context where the primary challenge was the COVID-19 pandemic, and strengthening defence capabilities was not considered a priority. For decades, the security and defence sector was systematically underfunded, which has directly affected the industrial capacities of EU Member States. Since 2022, it has become evident that the full deployment of production capacities requires significantly more time—time that, under the current security environment, the EU no longer has.

Therefore, in recent years the European Union has increasingly placed emphasis on strengthening Ukraine's integration into European defence projects, primarily in the areas of joint production and technology transfer. Within the European political and expert discourse, a consensus has emerged that Ukraine's experience in developing innovative, battlefield-tested technologies should form the basis for defence industrial projects of European countries. In this context, Ukraine's inclusion in joint manufacturing projects under the EDIP and SAFE frameworks represents a logical and important step in deepening Ukraine–EU cooperation in this field.

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# GEOPOLITICAL AND GEOECONOMIC IMPLICATIONS OF PRC'S CONTROL OVER AFRICAN PORTS

# ГЕОПОЛІТИЧНІ ТА ГЕОЕКОНОМІЧНІ НАСЛІДКИ КОНТРОЛЮ КНР НАД ПОРТАМИ АФРИКИ

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***Abstract.*** *The article explores the geopolitical and geoeconomic consequences of the PRC's control over Africa's port infrastructure. The relevance of the study derives from the transformation of maritime logistics into a foundation for Beijing's economic resilience and a tool for shifting the global balance of power. The author identifies the specifics of the Chinese approach to Africa, which is based on control over maritime logistics hubs. This approach allows for the monopolization and guaranteed stability of supply chains for critical materials, grants priority access to natural resource extraction, enables influence over the continent's foreign trade, and facilitates the adaptation of commercial ports for the needs of the PLA Navy through "dual-use" infrastructure.*

*Methodologically, the study is based on a systems approach utilizing qualitative methods, including case studies, content analysis, discourse analysis, and comparative analysis. The findings demonstrate that the PRC views African ports as a tool to ensure priority access to strategic resources and to build closed logistics cycles protected from Western sanction pressure and potential blockades. It is proven that the continent's commercial ports are perceived by the PRC as potential "strategic strongpoints," which are becoming key elements in forming China's asymmetric maritime power and reshaping the security architecture in the Atlantic and Indian Oceans. It is established that the PRC is capable of altering the global balance of power by projecting military force below the threshold of formal securitization through its control over African ports.*

***Keywords:*** *geopolitics, geoeconomics, People's Republic of China (PRC), Africa, logistics infrastructure, ports, Belt and Road Initiative (BRI), Maritime Silk Road (MSR), foreign trade, export, transport corridors, critical minerals, supply chains, maritime power, power projection, strategic strongpoints, PLA (People's Liberation Army), maritime geostrategic points, Djibouti,*

*Kenya, Nigeria, Angola, Atlantic Ocean, Indian Ocean, balance of power.*

***Анотація.*** *Стаття присвячена дослідженню геополітичних та геоекономічних наслідків контролю КНР над портовою інфраструктурою Африки. Актуальність статті зумовлена трансформацією морської логістики у фундамент економічної стійкості Пекіна та інструмент зміни глобального балансу сил. Автор визначає специфіку китайського підходу до Африки, що базується на контролі над морськими логістичними вузлами, та дозволяє монополізувати та гарантувати стійкість ланцюгів постачання критичних матеріалів, ортимувати пріоритений доступ до видобутку природних ресурсів, впливати на зовнішню торгівлю країн континенту, та адаптовувати комерційні порти для потреб військово-морських сил НВАК за допомоги інфраструктури «подвійного призначення». Методологічно дослідження ґрунтується на системному підході із застосуванням якісних методів — кейс-стаді, контент-аналізу, дискурс-аналізу та компаративного аналізу. Результати роботи демонструють, що КНР сприймає порти Африки як інструмент, що забезпечує пріоритетний доступ до стратегічних ресурсів та дозволяє вибудовувати замкнені логістичні цикли, захищені від санкційного тиску Заходу та можливих блокад. Доведено, що комерційні порти континенту сприймаються КНР як потенційні «стратегічні опорні пункти», що стають ключовими елементами формування асиметричної морської могутності КНР та зміни архітектури безпеки в Атлантичному та Індійському океанах. Встановлено, що КНР здатен змінювати глобальний баланс сил, проектуючи військову силу нижче порогу формальної сек'юритизації завдяки контролю над портами Африки.*

***Ключові слова:*** *геополітика, геоекономіка, Китайська народна республіка (КНР), Африка, логістична інфраструктура, порти, «Пояс і шлях» (BRI), Морський шовковий шлях (MSR), зовнішня торгівля, експорт, транспортні коридори, критичні матеріали, ланцюги постачання, морська сила, проектування сили, стратегічні опорні пункти, НВАК, морські геостратегічні точки, Джибуті, Кенія, Нігерія, Ангола, Атлантичний океан, Індійський океан, баланс сил.*

**Introduction.** The foundation of the PRC's economic development and its gradual emergence as a superpower was built upon Deng Xiaoping's economic liberalization and the country's accession to the World Trade Organization, which facilitated its integration into the global economy. China succeeded in international markets, becoming a global manufacturing hub and the world's largest exporter, by leveraging access to cheap labor, a vast domestic market, advanced infrastructure, state-sponsored incentives and subsidies for both state-owned and private enterprises to capture new markets. These factors incentivized Western companies to relocate production to China, providing Beijing with access to modern technologies.

However, at the current stage, control over trade-critical logistics infrastructure and critical minerals plays an equally vital role in China's economic expansion. These factors become particularly significant amidst geopolitical uncertainty driven by the trade wars between China and the United States. The "Belt and Road Initiative" (BRI) serves as the umbrella platform for achieving Beijing's economic objectives abroad. A critical component of this initiative is the "Maritime Silk Road" (MSR) - maritime transport corridors connecting China to Europe, relying on the port infrastructure of Indonesia, Malaysia, India, Sri Lanka, Kenya, Djibouti, and other coastal nations. Over 80% of global trade is conducted via maritime routes, underscoring the strategic significance of ports in the contemporary world economy *(Eurasia Review, 2026)*.

African ports play a pivotal role as transit points for China's trade with Europe within the MSR framework, as well as for other transport corridors and Africa's own trade with the rest of the world. The majority of Africa's foreign trade - estimated at 84% by the MCB Group - is conducted with extra-continental states *(MCB Group, 2025).* This creates a precondition where external actors who establish control over logistics infrastructure gain significant influence over the continent's nations, which they can leverage to achieve their own geoeconomic and geopolitical objectives. For over a decade, China has been the most proactive player in this sphere.

**Purpose of the Study.** The purpose of this article is to determine the geopolitical and

geoeconomic impact of the People's Republic of China's control over African ports, their role in securing supply chains of critical materials, and in maintaining export volumes amidst tariff wars with the United States, potential sanctions, or armed escalations. Additionally, the study analyzes the strategic utilization of dual-use port infrastructure within the framework of the "Maritime Silk Road" and its influence on the expansion of China's maritime power. Special attention is paid to the challenges and prospects for the global balance of power, particularly in the context of competition between China and the U.S. in the Atlantic Ocean and the Indo-Pacific region.

**Literature Review.** The topic of the PRC's infrastructural expansion and the role of African ports within the "Maritime Silk Road" (MSR) has been the subject of numerous academic studies covering the geopolitical and geoeconomic dimensions of such activities.

Among the key works is Diego Pautasso's article, "Africa and the New Maritime Silk Road" (*Brazilian Journal of African Studies*, 2016), in which the author reveals the strategic importance of the African continent within the "Belt and Road Initiative," emphasizing the significance of port infrastructure in Egypt, Djibouti, and Kenya for controlling key maritime trade corridors. This work underscores Beijing's ambition to strengthen its global presence through maritime logistics infrastructure.

The article by Muhammad Sabil Farooq, Tongkai Yuan, Jiangang Zhu, and Nazia Feroze, "Kenya and the 21st Century Maritime Silk Road: Implications for China-Africa Relations" (*China Quarterly of International Strategic Studies*, 2018), analyzes Kenya's role as a strategic maritime hub and a key partner for the PRC in East Africa through the implementation of flagship infrastructure projects. This research highlights how Chinese investments in port infrastructure provide priority access to the natural resources of recipient countries.

The report by Peter A. Dutton, Isaac B. Kardon, and Conor M. Kennedy, "Djibouti: China's First Overseas Strategic Strongpoint" (*U.S. Naval War College*, 2020), examines the integration of the PRC's economic and military interests in Djibouti, which have transformed the country into a strategic "gateway" to African markets and resources. The authors describe how the creation of a favorable economic and political ecosystem laid the groundwork for the deployment of the first permanent overseas PLA Navy base, providing vital logistical support to protect China's global interests and allowing it to project maritime power into the Indian Ocean.

Lungani Hlongwa's study, "China's Maritime Silk Road Initiative: a quest for sea power" (*South African Journal of Military Studies*, 2020), considers the MSR as China's instrument on its path toward superpower status, emphasizing the inseparable link between control over maritime logistics and the country's economic prosperity. The author argues that Beijing utilizes logistics infrastructure as a covert yet powerful means of power projection, justifying this by combining classical maritime power theory with an analysis of critical logistics and mobility.

Overall, existing publications indicate that the "Maritime Silk Road" is perceived not merely as a commercial project but as a tool for achieving geopolitical and geoeconomic objectives. Many works describe the initiative's impact on resource access and trade with African nations. Some works note how China uses economic influence to achieve geopolitical goals and how ports facilitate power projection. At the same time, there is a lack of research concerning the synergy between PRC's control over maritime logistics and all other dimensions of China's policy in Africa and its cumulative geopolitical and geoeconomic consequences.

In this study, the author seeks to fill this gap by systematizing the reasons for China's establishment of control over African ports and examining how control over the continent's maritime logistics infrastructure promotes geoeconomic goals - specifically, the formation of a closed-loop cycle for critical materials. Furthermore, the study explores how this control allows China to influence the foreign policy of local governments and utilize commercial infrastructure for PLA Navy needs to asymmetrically expand maritime power and achieve geopolitical objectives. The novelty of this research also lies in the analysis of how China's achievements in one of the aforementioned areas enhance capabilities in others, highlighting a holistic system of influence in Africa based on port control.

**Methods.** The application of a systems approach allowed for demonstrating how control over

ports reinforces the PRC's successes across various dimensions of its engagement in Africa and how these dimensions mutually reinforce one another. This same approach highlighted that establishing control over ports is part of a holistic policy aimed at forming an extensive network of **"strategic strongpoints"**.

The author actively utilized **qualitative methods**, integrating tools such as **case studies** of ports in Kenya, Angola, Nigeria, Djibouti, and other countries as models of economic and military expansion. Furthermore, **content analysis** was applied to statistical data from the Belt and Road Initiative, the General Administration of Customs of the PRC, and Lloyd's List reports. This was complemented by a **discourse analysis** of China's primary defense documents - specifically the White Paper on Defense and "The Science of Military Strategy." Finally, **comparative analysis** was employed to examine China's port activities in East Africa versus those on the Atlantic coast, assessing their respective roles in Beijing's broader geopolitical objectives.

**Main results of the research.** As of early 2025, Chinese state-owned and private enterprises held stakes - often controlling ones - in 78 ports across 32 African countries: 35 in West Africa, 17 in East Africa, 15 in Southern Africa, and 11 in North Africa (*Africa Center for Strategic Studies*, 2025). Consequently, Beijing exerts influence over more than a third of the continent's commercial ports, effectively dominating the sector. For comparison, the PRC operates or holds stakes in only about one-tenth of the ports within the European Union (*Gresh*, 2023).

Kenya stands as one of the primary focal points of the PRC's efforts to establish control over logistics infrastructure on the continent. Kenyan ports play a vital role in the "Maritime Silk Road" and are pivotal to China's ambitions to compete with India in the Indian Ocean (*Itimoudis*, 2024). Nairobi actively secures Chinese loans and investments to fund infrastructure projects, many of which are operated by Chinese firms upon completion. A prime example is the Port of Mombasa, the linchpin of maritime logistics in East Africa.

Lamu Port in Kenya, constructed by the China Communications Construction Company (CCCC), has become one of the largest in Africa and a cornerstone of the Lamu-South Sudan-Ethiopia Transport Corridor (LAPSSET). This project - one of the continent's most massive infrastructure undertakings - includes pipelines, railways, and airports *(Woldearegay, 2025)*. While LAPSSET assists landlocked countries in stimulating trade, the logistics remain controlled by China, granting its companies prioritized access to local markets. Port investments are closely coordinated with China's efforts to ensure its companies lead the construction and modernization of inland logistics networks under Belt and Road Initiative.

China is also intensifying its presence in West Africa. Lekki Port in Nigeria, where the Chinese firm China Harbour Engineering Co. (CHEC) holds a 54% stake, has already emerged as one of the region's largest logistics hubs *(Africa Center for Strategic Studies, 2025)*. The PRC invested $1.5 billion into the construction of this deep-water port through the China Development Bank *(Bloomberg, 2025)*. Among Beijing's likely next objectives is the expansion of exports through less congested ports along the Gulf of Guinea.

The construction of new facilities is only one facet of China's logistical strategy. Other activities include securing concessions in exchange for loans, investments, or infrastructure projects. In Tanzania, for instance, the state-owned China Civil Engineering Construction Corporation is financing the $1.4 billion TAZARA railway project in exchange for a 30-year concession, granting the company control over the Port of Dar es Salaam and its revenues *(The National Interest, 2025)*.

China realizes returns of up to 1,300% on its investments in African port infrastructure, as it often gains the authority to determine service costs and other port dues *(PwC, 2018)*. This allows Beijing to flood African markets with its own goods under preferential terms, effectively stifling competitors within the domestic markets of African states. Furthermore, China derives significant profit from the handling of local exports.

China remains Africa's largest trading partner, with trade volumes growing annually, driven in part by Beijing's heavy investments in the continent's logistics infrastructure. According to data from the General Administration of Customs of the PRC, Chinese exports to African countries in 2025 amounted to $225 billion (a 25.8% increase compared to 2024). Meanwhile, African exports

to China reached $123 billion in 2025 (a 5.4% increase compared to 2024) *(South China Morning Post, 2026)*.

Consequently, the PRC expanded its trade surplus by $40 billion, rising from $62 billion to $102 billion. This export expansion is partially linked to the necessity of reorienting goods away from the American market due to ongoing tariff wars with the United States. Prospective measures by Washington and Brussels to reduce dependence on Chinese products are expected to further drive China's efforts to expand and modernize port infrastructure in Africa to facilitate exports to alternative markets.

Dependence on Chinese infrastructure, in turn, inclines African nations to support Chinese interests. Therefore, from the perspective of the PRC's geopolitical objectives and pure commercial gain, further actions by Beijing aimed at the construction, acquisition, and operational control of African ports are to be expected.

The Chinese model of providing loans collateralized by infrastructure assets also extends to African ports *(Observer Research Foundation, 2024)*. This carries a significant risk of "debt-trap diplomacy," where the continent's nations may face the loss of port ownership to China. At the same time, a significant reduction in the volume of lending for infrastructure projects has been observed since 2022, as the PRC now prioritizes direct investment and projects led by Chinese companies *(Itimoudis, 2024)*.

Under the "Belt and Road Initiative" (BRI), Chinese investments and infrastructure financing in Africa totaled $21.7 billion in 2023 *(Itimoudis, 2024),* $29.2 billion in 2024 *(One Road Group, 2025),* and reached a staggering $80 billion in 2025 *(Green Finance & Development Center, 2026)*. Africa has emerged as a primary destination for China's overseas investment in recent years.

Since the initiative's launch in 2013, China has spent $1.4 trillion on infrastructure projects abroad, with investment and financing levels increasing annually since 2020. In 2025 alone, total BRI expenditures reached $213.6 billion *(Green Finance & Development Center, 2026)*. Given the gradual slowdown of the PRC's domestic economy, increasing foreign investment is a logical strategy to secure expanded access to emerging markets, with Africa representing one of the largest and most relevant among them.

Interestingly, since 2023, new Chinese investment in African logistics infrastructure has significantly decreased. This suggests that the current level of access is deemed sufficient by Beijing. Since 2013, Chinese companies have participated in the construction or engineering of at least 55 ports across the continent *(Itimoudis, 2024)*.

China switched to integrating its port infrastructure with the extractive industry. Control over export infrastructure - specifically maritime routes, through which the absolute majority of Africa's trade with extra-continental partners is conducted - translates into priority access for the PRC to the natural resources of African nations. In 2025, a record year for Beijing's investment in Africa, China financed two major deals in the energy sector: a $23 billion project to extract an additional 200,000 barrels of oil per day by 2030 in the Republic of the Congo, and the construction of an industrial park with gas processing facilities in Nigeria valued at $20 billion *(Green Finance & Development Center, 2026)*.

African ports also play a vital role in accessing critical materials, for which global demand is rapidly accelerating. The PRC controls approximately 70% of global rare earth element (REE) mining and 87% of their processing, despite China itself holding only 35% of the world's REE reserves *(AidData, 2024)*. Chinese companies are aggressively acquiring mining assets abroad, spending $32.6 billion in this sector under the Belt and Road Initiative in 2025 alone *(Green Finance & Development Center, 2026)*.

Africa is a primary target for such activities, as it holds approximately 30% of the world's proven reserves of critical materials *(UNECA, 2024)*. Of China's 166 overseas mining projects, 66 are located in Africa - more than in any other region. Chinese firms have invested $3.5 billion in copper mining in Zambia and have committed to investing an additional $5 billion by 2031. Mining in the Democratic Republic of the Congo (DRC), the world's largest cobalt producer, is almost entirely controlled by Beijing, with 24 of the 33 exporting companies being Chinese. Among the

major mining assets acquired by China in recent years are the Goulamina lithium mine in Mali and the Ngualla rare earth mine in Tanzania *(Africa Center for Strategic Studies, 2025)*. Crucially, the PRC generally refrains from building processing facilities within Africa, thereby maintaining total control over the value-creation chain.

Port infrastructure under Beijing's control guarantees the logistics of extracted critical materials, directing them to the PRC's processing plants. For instance, cobalt, lithium, and copper mined in the DRC and Zambia are transported via Chinese-financed railways to Chinese-controlled ports, including Dar es Salaam in Tanzania, Lobito in Angola (under a 20-year concession), Durban in South Africa (where Shanghai Zhenhua Heavy Industries is involved in port expansion), and Mombasa in Kenya, among others *(Africa Center for Strategic Studies, 2025)*.

Frequently, natural resource extraction by Chinese companies serves as repayment for loans used to build infrastructure, which is also constructed by Chinese firms. This occurs under so-called Resource-Backed Financing (RBF) agreements. Beijing has concluded such deals with the DRC, Angola, Ethiopia, Zimbabwe, Sudan, South Sudan, and Equatorial Guinea. These agreements often undervalue the resources, further inflating China's already significant profits. For example, the DRC's largest copper and cobalt deposit is 68% owned by Beijing in exchange for just $7 billion in infrastructure investment *(Africa Center for Strategic Studies, 2025)*.

Control over ports also helps the PRC ensure the resilience of critical material supply chains in the event of sanctions and prevents Western companies from accessing extraction or transportation. Overall, China has spent over half of the funds invested in African logistics to secure an integrated supply chain for critical materials - primarily lithium, cobalt, and copper from Zambia and the DRC, and oil from Angola. For example, Beijing financed the $1.5 billion reconstruction of the railway corridor from the cobalt belt in southern DRC to the port of Lobito *(RUSI, 2024)*. Given Beijing's significant investments in oil extraction in the Republic of the Congo and gas processing in Nigeria, similar activity is expected in these countries. Stable energy supplies will be critical in the event of U.S. and European sanctions resulting from a potential escalation regarding Taiwan.

According to Lloyd's List, Chinese companies hold stakes in, own, or operate terminals in 34 of the world's 100 busiest ports. In total, the PRC controls over 90 deep-water ports globally *(Bloomberg, 2025)*. This network allows Beijing to secure trade flows in the event of military conflict in the Indo-Pacific region, with Chinese-controlled African ports serving as a key element of this network.

Beijing also utilizes commercial ports in Africa under its control to meet the needs of the PLA Navy (PLAN). A prime example is the Doraleh Port in Djibouti, constructed by China and the UAE, which was repurposed to accommodate naval vessels almost immediately after its opening in 2017 *(Africa Center for Strategic Studies, 2025)*. The PRC negotiates the stationing or servicing of its naval vessels with continental nations that are economically and politically dependent on Chinese support.

Many of the deep-water ports constructed, expanded, or modernized by China were either modified or originally designed with a "dual-use" specification, ensuring that PLAN vessels can dock and receive necessary maintenance *(Itimoudis, 2024)*. This specifically applies to ports such as Lekki in Nigeria, Kribi in Cameroon, Bata in Equatorial Guinea, and Bagamoyo in Tanzania *(Stars and Stripes, 2025)*. While this civil-military dual specialization raises concerns among Western nations, particularly the United States, it does not yet allow for the formal classification of these sites as overseas naval bases.

These ports possess the capacity to host a significant number of PLAN ships if required. For instance, Walvis Bay in Namibia can accommodate up to eight destroyers; Luanda in Angola is capable of receiving any large Chinese warship; and Port Victoria in the Seychelles can host two Chinese corvettes *(Stars and Stripes, 2025)*. The Port of Mombasa in Kenya can accommodate two corvettes and a guided-missile destroyer while providing refueling services for any class of naval vessel *(RUSI, 2024)*.

Over the past few years, PLAN vessels have visited nearly forty African ports where Chinese companies hold stakes, spanning East, Southern, West, and North Africa. Nations that have hosted

Chinese naval vessels include South Africa, Madagascar, Tanzania, Mozambique, the Republic of the Congo, Nigeria, Gabon, Côte d'Ivoire, and Morocco *(Africa Center for Strategic Studies, 2025)*.

China's 2019 Defense White Paper discussed the development of "overseas logistics facilities" aimed at facilitating the PLAN's transition from "near-seas defense" to "far-seas protection," leveraging the infrastructure of the Belt and Road Initiative to promote the PRC's global interests *(State Council of the PRC, 2019)*. Furthermore, in the 2020 edition of *The Science of Military Strategy*, Beijing underscored the PLAN's ambition to establish a stable presence in the "two oceans" - the Pacific and the Indian *(Science of Military Strategy, 2020)*.

Ports capable of hosting the Chinese Navy fall under the Chinese strategic concept of "strategic strongpoints" (*zhanlüe zhidian*), which are essential for supporting overseas operations *(Kennedy, 2019)*. The location of the PLAN's currently sole overseas military base is strategically vital, situated on the Bab-el-Mandeb Strait, through which a significant portion of the world's oil is transported. The establishment of the base in Djibouti, combined with port investments in East Africa, is part of a holistic Chinese strategy to exert influence over maritime chokepoints and protect its sea lines of communication (SLOCs) *(Singh, 2025)*.

The military base in Djibouti, in synergy with Chinese-controlled commercial ports capable of dual-use functions, provides the PRC with the ability to deploy naval forces over great distances and influence strategically important maritime routes through the Bab-el-Mandeb, Hormuz, Malacca, and Mozambique Straits. For example, the strategic positioning of Mombasa and its refueling capabilities allow the PRC to counteract a potential blockade of the Malacca Strait by adversaries. Thus, ports controlled by Chinese companies serve as a tool for altering the regional security architecture in the Indian Ocean.

New "strategic strongpoints" are likely to emerge in West Africa, where Chinese companies hold more than half of the shares in three key ports: Kribi in Cameroon, Lekki in Nigeria, and Lomé in Togo. Additionally, due to their strategic locations and capacity to host warships, the ports of Luanda in Angola, Walvis Bay in Namibia, and Dar es Salaam in Tanzania remain highly significant for the PRC *(Africa Center for Strategic Studies, 2025)*. These potential "strategic strongpoints" provide critical access to both the Atlantic and Indian Oceans.

The PRC's significant influence over West African port infrastructure holds substantial potential to challenge U.S. dominance in the Atlantic Ocean. The capacity to utilize even a fraction of the 35 regional ports where Chinese companies hold stakes for PLAN vessel port calls and military exercises enables Beijing to influence transport corridors in the Eastern Atlantic when necessary. The expansion of PRC influence in the Indian Ocean and the Red Sea following the establishment of the PLAN military base in Djibouti underscores the threat to the United States should a Chinese base emerge in the Gulf of Guinea.

The PRC's presence in the port infrastructure of the South African Atlantic coast is particularly substantial, primarily in Angola. Beyond the deep-water Port of Luanda, China controls the ports of Lobito, Caio, and Barra do Dande *(RUSI, 2024)*. All of these facilities possess the potential to be repurposed for military objectives.

The establishment of a permanent PLAN naval base in West Africa would allow the PRC to project power across the entire Atlantic Ocean, posing a direct threat to U.S. national security. Under such a scenario, Chinese nuclear-powered submarines could potentially operate within reach of the U.S. East Coast *(RUSI, 2024)*. Evidence suggests that China has already explored options for hosting a naval base, notably in Gabon *(Center for Maritime Strategy, 2025)* and Equatorial Guinea. *(Bloomberg, 2025)*

The relatively limited U.S. military presence in the Atlantic compared to the Pacific, which has served as the primary theater for countering military threats for decades, only exacerbates the strategic risk for Washington *(Congressional Research Service, 2023)*. If the U.S. decides to expand its naval presence in the Atlantic to counter this expansion, it would be forced to redeploy forces from the Indo-Pacific, thereby shifting the balance of power in that theater in the PRC's favor.

Consequently, the emergence of a PLAN military base in West Africa would inevitably weaken the U.S. positions in maritime balance of power: either China gains the capacity to project

power across the Atlantic, or U.S. positions in the Pacific are compromised. Both scenarios would facilitate Beijing's achievement of its broader geopolitical objectives, such as securing control over Taiwan.

The U.S. maintains significantly less influence over West African port infrastructure than the PRC and would face considerable difficulties in potentially deploying its own naval forces in the Gulf of Guinea in response to Beijing's actions. For instance, despite U.S. efforts to expand access to the African market through the key regional port of Lomé in Togo, the local government opted to prioritize cooperation with Russia, signing a military agreement that, beyond joint exercises and technical support, grants the Russian Navy unimpeded access to this strategic maritime port *(Maritime Executive, 2025)*.

Admittedly, the U.S. and its NATO allies currently maintain overall naval superiority over the PRC and preserve the foundational infrastructure for both defensive and offensive operations. However, the Chinese strategy of expanding control over port infrastructure bolsters the country's maritime power by blurring traditional perceptions of sea power that rely solely on fleet size and formal naval bases.

**Conclusions.** Control over Africa's maritime logistics infrastructure plays a pivotal role in the economic development and the achievement of the PRC's geopolitical objectives at the current stage. Beijing's construction of, acquisition of stakes in, or procurement of concessions for more than one-third of Africa's commercial ports facilitate its efforts to establish control over key supply chains and the extraction of natural resources. This, in turn, grants expanded access to domestic markets, allowing them to be saturated with Chinese goods under preferential terms. Such significant economic leverage in Africa enables the PRC to expand its influence in global trade and increase the political dependence of continental nations to further its geopolitical goals.

The strategic importance of African ports continues to grow due to the trade wars between China and the United States. Beijing has already reoriented a portion of its exports, previously destined for the U.S. market, toward local African markets. In recent years, Africa has also become a primary destination for Chinese foreign investment focused on the extraction of critical materials. Port infrastructure on the continent ensures the resilience of China's supply chains for these materials in the event of international sanctions.

The reduction in expenditures on logistics infrastructure projects in Africa, and within the Belt and Road Initiative as a whole, indicates that China has established a network of the desired density at both regional and global levels. This applies equally to port infrastructure. Concurrently, as resistance to Chinese control over logistics grows within the "political West," Beijing is expected to compensate for potential asset losses in those countries by expanding its control over ports in the Global South, including Africa.

Commercial deep-water ports in Africa - constructed, expanded, or modernized by Chinese firms - are also utilized for the docking and servicing of PLAN vessels due to specific technical characteristics. African nations that are economically and politically dependent on Beijing generally do not oppose such dual-use applications.

China's defense doctrine documents indicate a transition from "near-seas defense" to "far-seas protection," relying on "overseas logistics facilities." African ports hosting or servicing PLAN vessels are essential elements of the Chinese concept of "strategic strongpoints" (*zhanlüe zhidian*), which are necessary to support operations in the Pacific and Indian Oceans, maintain control over maritime geostrategic chokepoints, and secure key trade corridors.

The PRC is already altering the regional security architecture in the Indian Ocean through its control of African ports and is actively seeking to establish "strategic strongpoints" on Africa's Atlantic coast. This would allow China to project power across the entire Atlantic Ocean. A potential expansion of China's military presence in the Atlantic would shift the global balance of power and facilitate Beijing's pursuit of its strategic objectives, such as securing control over Taiwan.

Beijing's policy regarding the control and dual-use of African ports allows the PRC to gain geopolitical advantages by acting below the threshold of formal securitization. Despite the United States maintaining superiority in conventional naval power, port control asymmetrically bolsters

Beijing's maritime strength.

The novelty of this research lies in the conceptualization of the PRC's strategy in the asymmetric development of maritime power, the formation of political influence, and the economic exploitation of counterparty nations based on the control of port logistics. However, the sustainability of this strategy will depend on Beijing's ability to withstand active countermeasures from the U.S. and the EU, including potential sanction pressure or new tariff wars. Future research should focus on analyzing the long-term viability of this model and its capacity to adapt to new geopolitical challenges, such as an escalation surrounding Taiwan or shifts in U.S. strategy in the Atlantic and Indo-Pacific regions.

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# MISTAKEN AND ACCIDENTAL WARS: RATIONALITY, UNCERTAINTY, AND STRATEGIC CHOICE IN THE ONSET OF ARMED CONFLICT

# ВІЙНА ЯК РЕЗУЛЬТАТ ПОМИЛКИ ЧИ ВИПАДКУ: РАЦІОНАЛЬНІСТЬ, НЕВИЗНАЧЕНІСТЬ ТА СТРАТЕГІЧНИЙ ВИБІР У ЗБРОЙНИХ КОНФЛІКТАХ

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***Abstract.*** *Wars are frequently characterized as accidents, mistakes, or unintended consequences of miscalculation. Such interpretations are deeply embedded in both popular discourse and classical reflections on war, where armed conflict is often portrayed as a breakdown of diplomacy or rational control. At the same time, much of contemporary international relations theory rests on the assumption that states and their leaders are broadly rational actors who seek to maximize expected utility under constraints. This creates a persistent puzzle: if war is costly, risky, and widely recognized as destructive, why do rational decision-makers repeatedly choose it?*

*This article argues that the opposition between "accidental" and "deliberate" war is analytically misleading. Rather than being the product of sheer error or irrationality, most wars emerge from strategic interaction under conditions of uncertainty, incomplete information, and political constraint. What are often described ex post as "mistaken" wars are more accurately understood as high-risk strategies whose unfavourable outcomes materialized de-facto. Conversely, wars that achieve immediate objectives may still constitute strategic errors if decision-makers systematically underestimated costs or overestimated benefits.*

*The article develops this argument by integrating rationalist bargaining theory with insights from political psychology, escalation theory, and domestic politics. It conceptualizes war as a gamble under uncertainty, where probabilities are endogenous and shaped by interaction with adaptive adversaries. It further distinguishes between mistaken wars and accidental wars, emphasizing escalation dynamics, brinkmanship, and loss of control. Finally, it examines how cognitive biases, group decision-making processes, and domestic political incentives condition leaders' willingness to accept risk. Taken together, the analysis challenges outcome-based judgments of war and offers a more nuanced framework for understanding why wars occur despite their recognized costs.*

***Key words:*** *war, rational choice, uncertainty, risk-taking, misperception, groupthink, strategic decision-making, international conflict.*

***Анотація.*** *Війни часто вважають результатом випадку, помилок або ненавмисним наслідком хибних розрахунків. Такі підходи поширені як у публічному дискурсі, так і в класичних роботах про війну, де збройний конфлікт нерідко постає як результат провалу дипломатії або втрати контролю. Водночас значна частина сучасних підходів у теорії міжнародних відносин припускають, що держави та їхні лідери в цілому є раціональними агентами, які прагнуть максимізувати очікувану виграш. Це веде до питання: якщо війна є*

*дорогою, ризикованою та руйнівною, чому раціональні лідери її обирають?*

*У цій статті стверджується, що протиставлення «випадкової» та «навмисної» війни є аналітично хибним. Більшість війн не є результатом помилок чи ірраціональних рішень, натомість вони витікають із стратегічної взаємодії в умовах невизначеності, неповної інформації та політичних обмежень. Те, що постфактум часто характеризується як «помилкова» війна, точніше було б розуміти як результат ризикованої стратегії, несприятливі наслідки якої було реалізовано. Натомість війни, що успішно досягли поставлених цілей, можуть бути стратегічними помилками, якщо політики систематично недооцінювали витрати або переоцінювали виграші.*

*У статті обгрунтовано цю думку із використанням теорії переговорів в рамках раціоналістичного підходу та політичної психології, теорії ескалації та досліджень внутрішньої політики. Війна сприймається радше як рішення в умовах невизначеності, де співвідношення ймовірностей залежить від взаємодії із суперниками, що здатні змінювати свою поведінку. Також проведено розмежування помилкових та випадкових війн, з акцентом на динаміці ескалації, балансуванні на межі війни та втраті контролю. Нарешті, досліджено як когнітивні викривлення, процеси групового мислення й внутрішньополітичні стимули впливають на готовність лідерів йти на ризик. У сукупності цей аналіз ставить під сумнів оцінки воєн, засновані лише на результатах, і пропонує більш детальну рамку для розуміння того, чому війни виникають попри усвідомлення їхньої високої ціни.*

***Ключові слова:*** *війна, раціональний вибір, невизначеність, схильність до ризику, хибні уявлення, групове мислення, стратегічне ухвалення рішень, міжнародний конфлікт.*

**Introduction.** The onset of wars poses one of the key challenges in security and conflict studies. States systemically initiate military conflicts, even when victory seems too expensive, uncertain or risky – not to mention defeat. There are a number of theories at different levels of analysis, explaining the process. One of the levels deals with decision-making: a war is seen as a result of a chain of decisions taken by (supposedly) rational actors.

A view on war from this perspective implies a deeper understanding of strategic choice political leaders face under uncertainty. They can be mistaken or gambling, but that is not enough to explain why decision to go to war are from time to time made by rational actors. To provide a better explanation, war can be presented as a response, which seems rational under certain conditions, even given its high price.

This article argues that the dichotomy between accidental and intentional war is misleading. Wars rarely emerge from pure chance, but neither are they always the result of straightforward rational calculation. Instead, wars are best understood as outcomes of strategic interaction under uncertainty, where risk, misperception, incomplete information, and institutional or psychological constraints shape decision-making. What may later be labelled a "mistake" is often a rational choice given the information, preferences, and incentives available at the time.

**The purpose of this article** is to define or expand the concepts of "mistake", "risk", "uncertainty" – key variables impacting decisions to launch a war; and demonstrate how wars are rather resulting from strategic interactions, information asymmetry and political constraints.

**Literature Review.** The question of the causes of wars is fundamental for international security studies, war studies and international relations theory. Explanations of war span multiple traditions, ranging from classical reflections on human nature and power politics to formal models of strategic interaction and psychological approaches to decision-making under uncertainty.

Classical realism provides an early framework for understanding war as an instrument of policy rather than a diplomatic failure. Hans Morgenthau emphasized that states operate in an anarchic system driven by the pursuit of power and survival, making the use of force a recurrent feature of international politics *(Morgenthau, 2005).* From this perspective, wars may be disastrous, but they are rarely accidental in a meaningful sense; they emerge from conflicting interests and power struggles under conditions of uncertainty.

Structural realism refined this logic by linking war to the distribution of power and systemic

constraints rather than to individual errors. Kenneth Waltz argued that the anarchic structure of the international system compels states to rely on self-help, generating security competition that can lead to war even in the absence of malign intentions *(Waltz, 2010).* Structural realism thus shifts attention away from mistakes toward structural pressures that make conflict recurrent. However, structural realism has difficulty explaining variation in war onset and the specific timing of conflicts, leaving room for agency, perception, and strategic choice.

Rationalist theories of war address this gap by conceptualizing war as a bargaining failure. James Fearon's seminal article argues that if war is costly and leaders are rational, states should prefer negotiated settlements that reflect the balance of power *(Fearon, 1995).* War occurs not because leaders are irrational, but because of specific mechanisms that prevent agreement, including private information with incentives to misrepresent, commitment problems, and issue indivisibilities. In this framework, wars often appear "mistaken" only in hindsight, when private information is revealed through fighting. The rationalist approach thus reframes war as an equilibrium outcome of strategic interaction under uncertainty rather than a deviation from rational behaviour.

Subsequent work has extended and refined bargaining models by incorporating dynamic interaction, learning, and endogenous shifts in power. Scholars such as Robert Powell emphasize commitment problems as a central cause of war, particularly in situations where power is shifting *(Powell, 2006).* From this perspective, preventive and preemptive wars may be rational responses to anticipated future disadvantages, even if they entail high immediate costs. This logic complicates simple judgments about error, as decisions that appear reckless ex post may have been strategically defensible ex ante.

Escalation theory further contributes to understanding how wars can emerge without a clear intention to fight. Thomas Schelling's work on brinkmanship highlights how rational actors may deliberately manipulate risk, creating situations in which outcomes are partially beyond their control *(Schelling, 1981).* In such settings, war can result from a series of rational choices that increase the probability of catastrophe without any single decision constituting a clear mistake. This insight blurs the boundary between accidental and deliberate war, suggesting that loss of control can itself be a strategic instrument.

Political psychology offers a complementary perspective by focusing on how cognitive limitations, biases, and group dynamics shape decision-making. Scholars have documented systematic patterns of overconfidence, motivated reasoning, and misperception that affect leaders' assessments of costs, probabilities, and adversary intentions *(Jervis, 1976; Kahneman, Tversky, 1979).* Irving Janis's concept of groupthink demonstrates how cohesive decision-making groups may suppress dissent, discount warning signals, and converge on flawed strategies *(Janis, 1982).* Psychological approaches do not reject rationality outright, but they highlight how bounded rationality and organizational processes can distort strategic calculations.

More recent work seeks to integrate rationalist and psychological insights rather than treating them as competing explanations *(Davis, McDermott, 2021).* Behavioral IR has expanded significantly in recent years beyond the traditional rational choice versus psychology debate, positioning itself as a platform for examining a broader set of mechanisms, including of war initiation. This implies integrated research agendas that address how individual traits, environmental contexts, and biological factors interact to shape decision-making in international relations.

**Main Results of the Research.** Wars are often described as "mistakes" or "accidents", i.e. outcomes of miscalculations, uncontrollable escalation, or unfortunate chains of events that no actor truly desired. This intuition is deeply rooted in both popular discourse and classical reflections on war, where armed conflict is associated with fate, chance, or forces beyond deliberate human control. From this perspective, wars appear as failures of diplomacy or reason, deviations from an otherwise preferable peaceful equilibrium.

At the same time, much of contemporary international relations theory rests on a different assumption: states are generally treated as rational actors. Decision-makers, acting on behalf of states, are assumed to pursue strategies that maximize expected utility and minimize costs, however

these may be defined *(Fearon 1995; Powell 2006).* If this assumption holds, war becomes less an accident and more a strategic choice, one that is difficult to reconcile with the high and well-documented costs of modern armed conflict.

This tension raises a fundamental puzzle. If war is costly, risky, and often destructive beyond initial expectations, why do rational actors still choose it? And under what conditions can wars meaningfully be described as "mistaken" or "accidental" rather than deliberate strategic decisions?

One of the least disputed claims in the international conflict studies is that war is expensive. Modern wars impose enormous human, economic, political, and reputational costs *(Bilmes, Stiglitz, 2008).* Even victorious states often suffer long-term consequences that exceed initial expectations, including economic strain, political instability, and unintended strategic commitments. This observation underpins much of the rationalist literature on war.

If states are rational and war is costly, then war should be rare. Yet history suggests otherwise. Armed conflicts persist across different times and regions. The rationalist response to this puzzle does not deny rationality but instead reframes the problem: war occurs not despite rationality, but because of it, under specific strategic conditions *(Fearon, 2018).*

From such perspective, war is not necessarily evidence of irrationality or error. Rather, it can represent a rational response to unfavourable alternatives. A state may choose war not because it expects low costs or easy victory, but because the expected costs of peace – or of accepting an opponent's demands – are perceived as even higher. In such cases, war becomes the least bad option among several undesirable alternatives.

Another consideration can also be relevant. Costs of peace, which are often neglected, can become so high that war seems a rational option. Military spendings, imposition of penalties and predation are often mentioned as main sources of peace costs *(Coe, Vaynman, 2020),* which make war attractive. When costly peace mechanisms are in place, there may be *n*o mutually preferable peaceful division of value, because any peace settlement that addresses the core of the dispute would still leave actors worse off relative to the option of conflict.

This logic complicates retrospective judgments about "mistaken" wars. A war that ends in defeat does not automatically imply that the initial decision was irrational. Conversely, a victorious war does not prove that the decision to fight was sound. Outcomes alone cannot validate or invalidate strategic choices; what matters is the information and expectations available at the time of decision-making. This point is often overlooked in historical assessments of war. With the benefit of hindsight, it is tempting to label failed wars as obvious blunders and successful ones as farsighted strategies. Yet such evaluations commit a fundamental analytical error: they substitute ex post outcomes for ex ante reasoning.

Consider two illustrative examples. In the early fifth century BCE, Athens and Sparta rejected ultimatums from the Achaemenid Empire, a power vastly superior in population and material resources. The ensuing Greco-Persian Wars imposed immense costs but ultimately preserved Greek autonomy. Was this an irrational gamble – or a rational refusal to accept a worse alternative?

By contrast, Saddam Hussein's decision to defy US demands in 2003 resulted in regime collapse, occupation, and his eventual execution. In retrospect, the imbalance of power makes this decision appear catastrophically irrational. Yet from the perspective of the Iraqi leadership, surrender carried its own existential risks, including loss of power, internal threats, and uncertain personal survival. These examples underscore a key analytical point: rationality does not guarantee success, and failure does not necessarily imply irrationality.

A more precise way to conceptualize decisions for war is to treat them as choices under uncertainty. Leaders do not know the true probability of victory, the full scale of costs, or the likely reactions of allies, adversaries, and domestic audiences. Instead, they operate with estimates, beliefs, and assumptions that may later prove inaccurate.

In this sense, war resembles a strategic gamble rather than a deterministic calculation. The expected utility of war depends on three variables that are notoriously difficult to assess: the probability of victory, the value of winning or losing, and the costs of fighting.

Unlike games of chance such as lotteries or roulette, where probabilities are fixed and known,

war involves strategic interaction with an adaptive opponent. As a result, probabilities are endogenous and constantly shifting. A state's likelihood of success depends not only on its own capabilities but also on the strategies, resolve, and learning capacity of its adversary.

This distinction is crucial. Some decisions are irrational because they have negative expected value regardless of context. Purchasing lottery tickets or playing roulette falls into this category: no sequence of wins can transform such activities into rational strategies over repeated play. By contrast, decisions about war are different. Their expected value cannot be strictly determined in advance.

Moreover, empirical evidence suggests that material power alone is a poor predictor of war outcomes *(Beckley, 2018)*. Weaker states frequently resist stronger opponents successfully, either by avoiding defeat, prolonging conflict, or imposing costs that outweigh the benefits of victory *(Arreguín-Toft, 2005)*. This empirical pattern further undermines simplistic calculations based solely on relative capabilities.

As a result, even wars with low estimated probabilities of success may be rational if the alternatives are sufficiently unattractive. Conversely, wars that appear promising may be strategically misguided if costs are underestimated or political objectives are ill-defined. This logic challenges the notion of "mistaken war" as a category defined by outcomes. A war can be both rational and unsuccessful; it can also be successful and strategically unsound.

The concept of a "mistake" in international politics is also quite complex. In everyday language, a mistake is typically understood as a wrong decision, one that leads to undesirable outcomes. In analytical terms, however, this definition is insufficient. Outcomes alone cannot determine whether a decision was mistaken, because political actors operate under uncertainty and incomplete information. A decision that leads to failure may nonetheless have been rational ex ante, while a successful outcome may result from luck rather than sound judgment.

To avoid retrospective bias, mistakes in international politics must be defined in procedural rather than outcome-based terms. From a rational-choice perspective, a decision can be considered mistaken if it had a negative expected value given the information reasonably available to the decision-maker at the time. This definition aligns with decision theory and allows for analytical consistency across cases *(Levy, 1997)*.

This distinction is critical for understanding war. Many wars labelled as "mistaken" are, upon closer inspection, better described as high-risk strategies whose unfavourable outcomes were realized ex post. Conversely, some wars that achieved their immediate objectives may still qualify as strategic errors if decision-makers systematically underestimated costs or overestimated benefits.

Historical interpretation frequently violates this principle. Analysts often project knowledge of subsequent events onto past decision-makers, judging their choices as irrational because they "should have known better." This logic is analytically flawed. Decision-makers cannot observe future contingencies; they can only act on available signals, intelligence, historical analogies, and strategic expectations.

The problem is exacerbated by the asymmetric availability of information. Leaders rarely have full access to reliable intelligence about adversaries' capabilities, intentions, or resolve. Even when such information exists, it may be filtered, distorted, or selectively presented by bureaucracies with their own incentives *(Jervis, 1976)*. As a result, decisions that appear obviously flawed in hindsight may have seemed defensible – or even prudent – at the time.

This perspective complicates the moral and analytical evaluation of war initiation. It suggests that identifying "mistaken wars" requires reconstructing the decision-making environment rather than relying on outcomes alone. The analytical task, therefore, is not to ask whether a war was lost or won, but whether the decision to fight systematically violated the decision-maker's own strategic logic.

While many wars result from deliberate strategic choices, others are commonly described as "accidental." In a broad sense, all wars are contingent events shaped by complex interactions and unpredictable developments. In a narrower analytical sense, however, accidental wars can be defined as conflicts that arise without a clear intention to fight at the outset, often through escalation

processes that gradually get out of control.

The concept of accidental war gained prominence during the Cold War, particularly in discussions of nuclear deterrence. Strategists worried about scenarios in which technical failures, false alarms, or unauthorized actions could trigger catastrophic escalation *(Schelling, 1981)*. These concerns were not merely hypothetical: several incidents involved near-launches of nuclear weapons due to misinterpreted signals or system errors *(Blair, 1993)*.

Beyond technical accidents, escalation dynamics represent a more common pathway to unintended war. Political leaders may initially pursue limited objectives, e.g. signalling resolve, or extracting concessions, without intending to initiate full-scale conflict. Yet each incremental step alters the strategic environment, raises stakes, and reduces the credibility of de-escalation.

The July Crisis of 1914 is the famous example. Decisions to issue ultimatums, mobilize forces, and reaffirm alliance commitments were taken incrementally, often defensively, yet collectively produced a situation in which backing down became politically and strategically untenable *(Jervis, 1997)*. War emerged not from a single decision but from a sequence of moves that progressively narrowed the space for compromise.

This logic is central to escalation theory. Each action intended to enhance security or bargaining leverage simultaneously increases the probability of violence. Mobilization, for example, may be defensively motivated but is often indistinguishable from preparation for attack. Once such measures are undertaken, political leaders face audience costs and reputational concerns that make reversal difficult *(Fearon, 1994)*.

Importantly, escalation does not necessarily imply loss of control. Leaders may accept increasing risks as part of a coercive strategy. Thomas Schelling famously described this as "the threat that leaves something to chance" *(Schelling, 1960)*. By deliberately creating situations where events could spiral beyond control, leaders attempt to signal resolve and shift bargaining outcomes.

From this perspective, accidental wars are rarely pure accidents. They are more accurately understood as byproducts of strategic environments in which risk-taking is incentivized, and where multiple actors simultaneously pursue brinkmanship strategies. War occurs not because leaders fail to act rationally, but because rational risk-taking by multiple actors produces unstable equilibria.

Even when leaders aim to act rationally, their decisions are filtered through cognitive processes that systematically deviate from perfect rationality. A substantial body of research in political psychology demonstrates that decision-makers rely on heuristics, analogies, and simplified mental models, particularly under conditions of stress and uncertainty *(Kahneman and Tversky, 1979; Jervis, 1976)*.

One of the most repetitive cognitive biases in the context of war is overconfidence. Leaders frequently overestimate their own capabilities and underestimate those of their adversaries. Empirical studies suggest that political leaders are particularly prone to optimism bias when contemplating the use of force, often expecting short wars, limited resistance, and manageable costs *(Johnson, 2004)*.

Closely related is the problem of misperception. States may misinterpret defensive actions as offensive preparations, especially in tense strategic environments. Such misperceptions are not random; they are often shaped by prior beliefs and ideological frameworks. Information that confirms existing expectations is more readily accepted than information that challenges them, a phenomenon known as confirmation bias *(Jervis, 1976)*.

Historical analogies play a particularly influential role. Leaders frequently justify decisions for war by invoking past successes or failures, e.g. Munich, Vietnam, or the Cold War; yet such analogies are often applied selectively or superficially. While analogical reasoning can simplify complex decisions, it also risks importing inappropriate lessons from fundamentally different contexts *(Khong, 1992)*.

These cognitive factors do not operate in isolation. They interact with institutional structures and group dynamics, amplifying their effects. Decision-making bodies that are insulated from external criticism or alternative viewpoints are especially vulnerable to distorted assessments of risk and feasibility. These dynamics are explored in greater detail further below, with an emphasis on

group decision-making and the phenomenon of groupthink.

While rationalist models typically treat states as unitary actors, decisions about war are made by individuals operating within small groups. This introduces an additional layer of complexity into the analysis of conflict onset. Even when national interests are clearly defined and information is available, the social dynamics of decision-making bodies can systematically distort strategic assessments. One of the most influential concepts capturing this phenomenon is groupthink.

The concept of groupthink was introduced by Irving Janis to describe a mode of thinking in highly cohesive groups where the desire for unanimity overrides the motivation to appraise alternative courses of action realistically *(Janis, 1982).* Under conditions of groupthink, decision-making groups display a characteristic set of symptoms: illusions of invulnerability, collective rationalization, belief in the inherent morality of the group's position, stereotyped views of the adversary, pressure on dissenters, self-censorship, and an illusion of unanimity.

In the context of international security, these dynamics are particularly dangerous. Decisions about war are often taken under time pressure, high uncertainty, and perceived external threat—precisely the conditions under which groupthink is most likely to emerge. Moreover, national security decision-making is frequently insulated from external criticism, reinforcing informational closure and conformity.

Empirical studies suggest that groupthink has played a role in several major foreign policy failures. Janis's own analysis of the Bay of Pigs invasion demonstrated how the Kennedy administration discounted warning signals, suppressed dissenting views, and overestimated the likelihood of success *(Janis, 1982).* Subsequent scholarship has identified similar dynamics in the escalation of the Vietnam War, the Israeli decision-making prior to the 1973 Yom Kippur War, and the US invasion of Iraq in 2003 *(Khong, 1992; Badie, 2010).*

Groupthink does not imply irrationality in a psychological sense. Rather, it reflects bounded rationality operating within social constraints. Individuals may privately harbour doubts yet refrain from voicing them due to career incentives, loyalty norms, or fear of exclusion. As a result, policy outcomes reflect not the aggregation of independent judgments but the reinforcement of a dominant narrative.

Importantly, groupthink interacts with the rationalist mechanisms discussed earlier. It can exacerbate private information problems by filtering intelligence, intensify commitment problems by framing concessions as weakness, and harden perceptions of issue indivisibility. In this sense, group decision-making failures are not an alternative explanation to rationalist theories of war but a complementary one, specifying how rational incentives are processed, or sometimes distorted, within real-world institutions.

A second major departure from unitary rational actor models lies in the domestic political causes of war. Leaders do not merely act of the basis of national interests; they operate within political systems that reward certain decisions and discourage others. These domestic incentives can significantly shape risk preferences and strategic choices *(Renshon, Yarhi-Milo, Kertzer, 2023).*

An influential line of research focuses on political survival. According to selectorate theory, leaders are primarily concerned with maintaining the support of a winning coalition whose size and composition vary across regimes *(Siverson, R., Bueno de Mesquita, B. (2017).* In systems where leaders rely on narrow coalitions, they may be more willing to engage in risky foreign policies, including war, if such actions help maintain elite loyalty or divert attention from domestic problems.

Diversionary war theory similarly posits that leaders facing domestic unrest, economic downturns, or declining legitimacy may use external conflict to rally public support and consolidate power. While empirical evidence for diversionary motives is mixed, there is substantial support for the claim that domestic vulnerability increases leaders' willingness to accept higher levels of risk *(Theiler, 2017).*

Domestic politics also influence perceptions of the costs of backing down. Audience cost theory argues that leaders who make public threats incur domestic political penalties if they fail to follow through, thereby increasing the risk of escalation during crises. Although the empirical robustness of audience costs remains debated, the broader point stands: domestic political

constraints shape bargaining behaviour and limit leaders' space for manoeuvre.

Regime type further conditions risk-taking behaviour. Democratic leaders, accountable to broader electorates, may be more cautious about initiating wars but also more selective, choosing conflicts they expect to win. Autocratic leaders, by contrast, may be less constrained by public opinion but more sensitive to elite threats, leading to different patterns of escalation and commitment.

Crucially, domestic incentives can transform objectively unfavourable wars into subjectively rational choices. When personal survival, regime stability, or ideological legitimacy are at stake, leaders may rationally prefer war to negotiated outcomes that threaten their political position. In such cases, what appears as strategic folly from an external perspective may be consistent with the internal logic of political survival.

**Conclusions.** The persistence of war in an era where its costs are widely recognized remains one of the central puzzles of international relations theory. This article has argued that the puzzle cannot be resolved by attributing war solely to error, irrationality, or chance. Instead, war emerges from the interaction of rational strategic incentives, uncertainty, domestic political constraints, group decision-making dynamics, and structural features of the international system.

Rationalist explanations highlight why bargaining fails even when peaceful settlements exist. Psychological and organizational factors explain how information is filtered and preferences distorted. Domestic politics clarify why leaders may accept risks that appear excessive from a national welfare perspective.

Taken together, these perspectives suggest that war is neither an aberration nor an inevitability. It is a contingent outcome produced by identifiable mechanisms operating under specific conditions. Understanding these mechanisms does not eliminate war, but it sharpens our ability to recognize when the risk of conflict is rising, and why seemingly avoidable wars continue to occur.

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**INTERNATIONAL HUMAN RIGHTS LAW AND INTERNATIONAL HUMANITARIAN LAW IN THE ERA OF ARTIFICIAL INTELLIGENCE**

**МІЖНАРОДНЕ ПРАВО ПРАВ ЛЮДИНИ ТА МІЖНАРОДНЕ ГУМАНІТАРНЕ ПРАВО В ЕПОХУ ШТУЧНОГО ІНТЕЛЕКТУ**

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***Abstract.*** *The rapid development and application of artificial intelligence raise fundamental questions for both International Human Rights Law and International Humanitarian Law, particularly regarding accountability, transparency, human control, the protection of fundamental rights, and the principles governing the conduct of warfare. The global regulatory mechanism for AI remains fragmented and underdeveloped, creating legal uncertainty and potential accountability gaps. The purpose of this article is to analyze the main risks AI poses to human rights and to the rules governing armed conflicts, and to consider the main regulatory frameworks in these spheres from an international legal standpoint.*

*The authors conclude that there is no single universal treaty governing the protection of human rights in the era of AI. At the universal level, the risks and benefits of AI for human rights have been the subject of reports by various UN bodies, including the Human Rights Council, the Office of the High Commissioner for Human Rights, and UNESCO. The UN General Assembly, UNESCO, and other universal international organizations adopted relevant resolutions and recommendations, but these instruments constitute soft law and do not have binding force. The first legally binding document in the sphere of AI and human rights – the Framework Convention on Artificial Intelligence, Human Rights, Democracy and the Rule of Law – is a regional treaty and has several drawbacks. Although the European Court of Human Rights has dealt with cases related to data*

*protection and digital technologies that may violate the right to privacy, it has not had the opportunity to analyze the direct effects of AI on human rights in those cases. The Artificial Intelligence Act adopted by the European Union is not an instrument specifically addressing human rights. On the other hand, this Regulation imposes obligations (including sanctions) on AI providers and establishes the structure of implementing and control bodies at the EU and national levels of Member States, which ensure the provision of a safe and ethically healthy environment, thereby creating the preconditions for the protection of human rights.*

*Lethal autonomous weapon systems that can select and attack targets without human intervention pose serious challenges for International Humanitarian Law. The use of LAWS may breach its main principles: distinction, military necessity, proportionality, precautions in attack, and humanity. The author concludes that there is no single universal treaty governing the conduct of warfare in the era of AI. The UN General Assembly adopted a special resolution on this matter; the Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapons Systems within the Convention on Certain Conventional Weapons adopted a set of eleven guiding principles, but they constitute soft law and do not have binding force for states. Meanwhile, some organizations called for a new international treaty that would set out specific prohibitions and restrictions on LAWS. It is a matter for future negotiations between states and within international organizations on whether to adopt a new legally binding instrument on such weapons and, if so, in what form. In any case, the current legal framework – conventions and protocols, which are the main sources of International Humanitarian Law – is not enough to govern new weapons developed through AI technologies.*

***Keywords**: artificial intelligence, international law, human rights, lethal autonomous weapon systems, international human rights law, international humanitarian law.*

***Анотація.** Стрімка розробка та використання штучного інтелекту порушує фундаментальні питання як для міжнародного права прав людини, так і для міжнародного гуманітарного права, зокрема щодо відповідальності, прозорості, людського контролю та захисту основоположних прав, а також принципів, що регулюють ведення війни. Глобальний механізм регулювання у сфері ШІ залишається фрагментованим і недостатньо розвиненим, що створює правову невизначеність і потенційні прогалини у притягненні до відповідальності. Метою цієї статті є аналіз основних ризиків, які ШІ становить для прав людини та для норм, що регулюють збройні конфлікти, а також розглянути ключові регуляторні рамки у цих сферах з точки зору міжнародного права.*

*Автори доходять висновку, що не існує єдиного універсального договору, який би регулював захист прав людини в епоху ШІ. На універсальному рівні ризики та переваги ШІ для прав людини були предметом доповідей різних органів ООН, зокрема Ради ООН з прав людини, Управління Верховного комісара ООН з прав людини та ЮНЕСКО. Генеральна Асамблея ООН, ЮНЕСКО та інші універсальні міжнародні організації відповідні резолюцій і рекомендацій, однак ці інструменти мають характер «м'якого права» і не є юридично обов'язковими. Перший юридично обов'язковий документ у сфері ШІ та прав людини – Рамкова конвенція про штучний інтелект, права людини, демократію та верховенство права – є регіональним договором і має низку недоліків. Хоча Європейський суд з прав людини розглядав справи, пов'язані із захистом даних і цифровими технологіями, які можуть порушувати право на приватність, він не мав можливості проаналізувати безпосередній вплив ШІ на права людини у цих справах. Акт Європейського Союзу про штучний інтелект не є інструментом, спеціально спрямованим на захист прав людини. З іншого боку, цей Регламент покладає обов'язки (включно із санкціями) на постачальників систем штучного інтелекту та встановлює структуру органів імплементації й контролю на рівні ЄС і національному рівні держав-членів, які забезпечують створення безпечного та етично здорового середовища, тим самим формуючи передумови для захисту прав людини.*

*Летальні автономні системи озброєння, здатні обирати та уражати цілі без втручання людини, становлять серйозні виклики для міжнародного гуманітарного права.*

*Використання таких систем може порушувати його основні принципи: розрізнення, військової необхідності, пропорційності, застосування запобіжних заходів під час нападу та гуманності. Автор доходить висновку, що не існує єдиного універсального договору, який би регулював ведення війни в епоху ШІ. Генеральна Асамблея ООН ухвалила спеціальну резолюцію з цього питання; Група урядових експертів з новітніх технологій у сфері летальних автономних систем озброєння в рамках Конвенції про певні види звичайної зброї ухвалила одинадцять керівних принципів, однак вони мають характер «м'якого права» і не є юридично обов'язковими для держав. Водночас деякі організації закликали до укладення нового міжнародного договору, який би встановлював конкретні заборони та обмеження щодо такої новітньої зброї. Питання про те, чи буде ухвалено новий юридично обов'язковий міжнародний інструмент щодо летальних автономних систем озброєння і в якій формі, є предметом майбутніх переговорів між державами та в межах міжнародних організацій. У будь-якому разі чинна правова база – конвенції та протоколи, які є основними джерелами міжнародного гуманітарного права, – є недостатньою для регулювання нових видів озброєнь, розроблених із використанням технологій штучного інтелекту.*

***Ключові слова**: штучний інтелект, міжнародне право, права людини, летальні автономні системи озброєнь, міжнародне право прав людини, міжнародне гуманітарне право.*

**Introduction**. The rapid integration of artificial intelligence (hereinafter – AI) into military, law enforcement, administrative, and surveillance systems is profoundly transforming the way power is exercised by states and non-state actors. These technological developments raise fundamental questions for both International Human Rights Law and International Humanitarian Law, particularly regarding accountability, transparency, human control, and the protection of fundamental rights and the principles governing the conduct of warfare. As AI systems increasingly influence decisions affecting life, liberty, privacy, and bodily integrity, existing legal frameworks are being tested in unprecedented ways. The relevance of this topic is further underscored by the growing use of AI in armed conflict, including in targeting, intelligence analysis, autonomous and semi-autonomous weapons systems, and information operations. These developments challenge core International Humanitarian Law principles, such as distinction, proportionality, and precaution, while also raising concerns under International Human Rights Law regarding the right to life, due process, non-discrimination, and the right to effective remedies. The interaction between these two branches of modern International Law in AI-enabled contexts, therefore, requires renewed doctrinal and practical analysis.

Moreover, the global regulatory mechanism for AI remains fragmented and underdeveloped, creating legal uncertainty and potential accountability gaps. Scholarly examination of how existing international legal norms apply to AI technologies is essential to ensure that technological innovation does not outpace legal safeguards. This topic is thus highly relevant to advancing legal certainty, protecting human dignity, and developing responsible governance frameworks for AI in both peacetime and armed conflict.

**The purpose of the study.** The purpose of this article is to analyze the main risks AI poses to human rights and the rules governing armed conflicts, and to consider the main regulatory frameworks in these spheres from an international legal standpoint.

**Literature review.** To conduct thorough research on the stated problem, we used the papers of various foreign authors. There are some scientific works dedicated to the issue of the regulation of AI by International Human Rights Law (Balcerzak M., Druzin B., Boute A., Ramsden M., Dulka A., Fowowe A.I., Gellers J.C., Gunkel D., Leslie D., Burr Ch., Aitken Mh., Cowls J., Katell M., Briggs M., McGregor L., Murray D., Ng V., Morawska E.H., Tu X., de Castro e Silva B., Craig, P., De Búrca, G., Hogan, L., Lasek-Markey, M.) as well as by International Humanitarian and Criminal Law (Badhan D., Jagota R., Davison N., Humble K., Nasu H., Ojha Y., Perrin B., Szpak A.). We used these works in the current paper to outline the main issues regarding the relationships between AI technologies and International Law in the spheres of human rights and armed conflicts. Unlike

the majority of scientific research on these topics, we analysed the full spectrum of major problems related to the regulation of AI technologies under International Human Rights Law, International Humanitarian Law, and International Criminal Law.

**Main results of the research.** The first area of concern is the effect of AI technologies on human rights. The protection of human rights and human dignity in the face of technological innovations pertains to the so-called 'fourth generation' of human rights (*Gellers, & Gunkel, 2023*). Although AI offers numerous benefits for humans and their rights, it also poses significant risks. Here, we provide just a few such examples. First, there may be cases where a system is filled with biased information, leading to algorithmic discrimination that affects certain vulnerable groups. In addition, when forecasting is carried out using AI, the relevant algorithms may fail to account for discriminatory factors (such as gender, age, and ethnicity) and thus may reinforce existing injustices or create new ones (*Leslie et al., 2021*). Second, the gathering, handling, evaluation, and application of users' biometric, behavioural, and genetic information may lead to the risk of constant and intrusive monitoring, creating serious dangers for privacy and data protection, as the highly sensitive and individualized data involved may allow individuals' most private aspects to be disclosed, misused, or otherwise exploited (*Tu, & de Castro e Silva, 2025*). Third, the rapid integration of artificial intelligence into criminal justice systems across numerous countries, particularly through tools designed to evaluate risk and predict the probability of criminal activity by individuals or in specific locations, offers notable operational benefits while simultaneously raising serious concerns about potential infringements on personal freedom and the right to individual liberty (*Fowowe, 2021*). Also, judicial decisions supported or informed by AI may negatively affect the judiciary's rulemaking and decisional independence (*Leslie et al., 2021, p. 15)*.

Due to the potential risks and possible harm to human rights and even some threat to the whole humankind posed by AI, some scholars argue that there is an international legal obligation on states under the right to life within international human rights law to proactively take regulatory action to mitigate the potential existential risk of AI, based on the precautionary principle (*Druzin, Boute, & Ramsden, 2025*). The principle holds that, in situations with the potential for significant harm, even in the absence of full scientific certainty, preventive measures should not be postponed if delayed action may result in irreversible consequences (*Druzin, Boute, & Ramsden, 2025*). Such measures may include, *inter alia*: (1) adoption of *ex ante* regulation, when states may introduce binding legal frameworks that regulate AI systems before their deployment, especially if such systems may pose a certain risk for human rights in some sensitive areas; (2) adoption of moratoria or bans, when risks to human rights are particularly serious or irreversible; (3) elaboration of Human Rights Impact Assessment mechanism which are usually enforced before the deployment of AI; (4) creation of independent oversight bodies to audit the impacts of AI on human rights and intervene where risks emerge; (5) development of the accountability schems and remedies which help the victims of human rights violations to access to complaint mechanisms, judicial or administrative remedies, and enforce their right to challenge AI-based decisions.

Other authors, like Dulka A., proposed some frameworks to regulate AI in relation to human rights, namely: (1) areas where AI can be used with little concern; (2) areas where AI can be used with appropriate measures of caution and constraint; (3) high risk areas where the major costs might still be outweighed by the potential benefits; and (4) areas where the use of AI is never appropriate and must be prohibited by national and international law (*Dulka, 2023*). In this last sense, there must be some 'red lines' which can't be overcome, and law is to become a safeguard in relation to such prohibited spheres which infringe fundamental human rights and undermine the very concept of human dignity. For example, a state may prohibit decisions made exclusively on the basis of an algorithm, without the possibility of human intervention (*McGregor, Murray, & Ng, 2019, p. 337*).

Under international human rights law, states are required to establish preventive legal and institutional structures, ensure supervision and control, impose responsibility for violations, and guarantee effective remedies, while also – through the doctrine of due diligence – obliging public authorities to shield individuals and communities from rights-related harms caused not only by state conduct but also by private actors, including commercial entities (*McGregor, Murray, & Ng, 2019,*

*p. 311-312*). This rule applies to all activities within a state's jurisdiction or under its control related to the use of AI.

At the universal level, the risks and benefits of AI for human rights have been the subject of reports by various UN bodies, including the Human Rights Council, the Office of the High Commissioner for Human Rights, and UNESCO (*Balcerzak, 2024, p. 7-15*). The UN General Assembly Resolution A/78/L.49 'Seizing the opportunities of safe, secure and trustworthy artificial intelligence systems for sustainable development' (2024) emphasizes that human rights and fundamental freedoms must be respected, protected and promoted throughout the life cycle of artificial intelligence systems, and calls upon all Member States and other stakeholders to refrain from or cease the use of artificial intelligence systems that are impossible to operate in compliance with international human rights law (*The UN General Assembly. Resolution A/78/L.49*). UNESCO Recommendation on the Ethics of Artificial Intelligence (2021) refers to some basic fundamental values of the International Human Rights Law, namely safety, non-discrimination, sustainability, right to privacy and data protection, transparency, etc. (*UNESCO. Recommendation*). Some monitoring treaty bodies of the UN system issued a number of general comments, e.g., General Recommendation No. 36 (2020) of the Committee on the Elimination of Racial Discrimination on preventing and combating racial profiling by law enforcement officials, which refers to the risk of algorithmic biases (*Balcerzak, 2024, p. 16*).

One of the first legally binding documents in the sphere of AI and human rights – the Framework Convention on Artificial Intelligence, Human Rights, Democracy and the Rule of Law – was adopted in 2024 within the Council of Europe. Negotiators considered several options for such a regional instrument: from a new additional protocol to the European Convention on Human Rights, or amending other Council of Europe treaties (like the Budapest Convention on Cybercrime or Revised Convention for Data Protection) to a non-binding legal act (*Leslie, et al., 2021, p. 27-29*). The Framework Convention relies on other human rights documents, which are of a general nature (the Universal Declaration of Human Rights, and the European Convention on Human Rights) as well as more specific ones (like the Convention for the Protection of Individuals with regard to Automatic Processing of Personal Data and its protocols). The Convention outlines general obligations of states, including the protection of human rights, the integrity of democratic processes, and respect for the rule of law. It also stipulates specific principles governing activities throughout the lifecycle of artificial intelligence systems.

This Convention, unlike the EU Artificial Intelligence Act, primarily applies to the public sector. The application of its rules to the private sector is within the discretion of states. Another prominent feature of the instrument is that matters relating to national defence fall outside its scope. The exclusion of 'national defence or national security' is justified based on Article 1(d) of the Statute of the Council of Europe, according to which, '[m]atters relating to national defence do not fall within the competence of the Council of Europe' (*Morawska, 2024, p. 41*). We should note that, according to the case law of the European Court of Human Rights (hereinafter – ECHR), a state may restrict certain human rights on grounds of national security, but it must strike a fair balance between the two; furthermore, its margin of appreciation will be very limited in this case.

The ECHR has dealt with a number of cases related to data protection and digital technologies that may violate the right to privacy, but most do not concern AI as such. For example, *Glukhin v. Russia* (2023) concerned the use of facial recognition technology and mass video surveillance by the Russian authorities (*European Court of Human Rights, 2025, p. 10*). Though such systems often rely on algorithmic and AI-based processing, however, the Court did not analyse AI as a separate legal category. It ruled that the state had breached the rights to respect for private life and to freedom of assembly. In other cases, the Court addressed algorithmic, automated, and data-driven technologies, particularly in the contexts of surveillance, biometric identification, and large-scale data processing: *S. and Marper v. the United Kingdom* (2008), *Catt v. the United Kingdom* (2019), *Breyer v. Germany* (2020), *Big Brother Watch and Others v. the United Kingdom* (2021). Thus, the ECHR has not had the opportunity to analyze the effects of AI on human rights in its case law directly.

The Artificial Intelligence Act adopted by the European Union in 2024 is not an instrument specifically addressing human rights, though it refers to ensuring a high level of fundamental rights as enshrined in the Charter of Fundamental Rights of the European Union, including the right to human dignity, respect for private and family life, protection of personal data, freedom of expression and information, freedom of assembly and of association, the right to non-discrimination, the right to education, consumer protection, workers' rights, the rights of persons with disabilities, gender equality, intellectual property rights, the right to an effective remedy and to a fair trial, the right of defence and the presumption of innocence, the right to good administration and the rights of children (*Regulation (EU)*). It acknowledges that AI may pose risks and infringe fundamental rights protected by Union law (*Regulation (EU)*). The Act provides that any regulatory framework for AI must be developed in accordance with EU values, the fundamental rights and freedoms, and that AI technology should be human-centric (*Regulation (EU)*). The Act is considered complementary to other EU legislation on data protection, consumer protection, fundamental rights, employment, protection of workers, and product safety (*Regulation (EU)*).

Despite the fact that EU Artificial Intelligence Act has met with a number of critical reactions both from the side of academia, as well as from the side of NGOs (mostly due its rife loopholes), it is necessary to bear in mind that it is a first attempt to regulate the operation of the AI and to limit its intervention into the different spheres, including the field of human rights. Hogan L. stresses: "As the first legislative framework globally to impose outright prohibitions on the specific AI applications deemed incompatible with fundamental rights and EU values, it establishes a significant precedent" (*Hogan, 2024, p. 10*). The Act classifies the risk under certain categories (unacceptable risk, high risk, limited risk, and minimal risk) and determines the level of the posed threats, including those that are related to fundamental rights. The Regulation states *expressis verbis* that its norms are not applicable for AI systems used for military and national security purposes or pure scientific research and development (Art. 2.3 and Art. 2.6) (*Regulation (EU)*).

To the advantages of this instrument undoubtedly belongs the fact that it establishes its own institutional structure of different bodies on the European and national level of the Member States, which should support the implementation and enforcement of the provisions of the Act. The mentioned implementation and control mechanism is supplemented by substantial penalties, which ensure that the provisions of the Regulation will not be "toothless" and that the norms of the Act will be duly respected. The same refers to the chosen legal form of this instrument, which was adopted as a regulation, in other words, as an act, which under its own nature should be binding in its entirety and directly applicable in all Member States of the Union (*Craig, & De Búrca, p. 139-140*).

In contrast to this Regulation, another relevant EU document, European Declaration on Digital Rights and Principles for the Digital Decade (2023) (*European Declaration*) is focused exclusively on the area of fundamental rights, which stems from the digital transformation, including the usage of Artificial Intelligence. Especially Article 8 states that: "Artificial intelligence should serve as a tool for people, with the ultimate aim of increasing human well-being" and formulates the principle that during the usage of AI it is necessary to: "e) providing for safeguards and taking appropriate action, including by promoting trustworthy standards, to ensure that artificial intelligence and digital systems are, at all times, safe and used in full respect for fundamental rights; f) taking measures to ensure that research in artificial intelligence respects the highest ethical standards and relevant EU law" (Art. 9) (*European Declaration*).

Despite the fact that this document, as a political declaration, currently has no legal effect, it nevertheless has great potential and capacity to become, in the future, a nucleus for a binding catalogue of Digital Rights and thus to follow the destiny of the Charter of Fundamental Rights of the EU. If so, some of the improvements are necessary, including the widening of the list of digital rights (*Šišková, 2024, p. 59*) and the introduction of its own control and enforcement mechanisms. In all the cases, it can serve as one of the sources of inspiration for the global regulation of human rights in the age of Artificial Intelligence.

Another area of concern is the application of so-called lethal autonomous weapon systems

(hereinafter – LAWS) developed with the help of AI in armed conflicts. There are several definitions of the LAWS provided by expert reports, scientific literature, and documents of international organizations. For example, Davison N. stipulates that an autonomous weapon system is 'any weapon system with autonomy in its critical functions – that is, a weapon system that can select (search for, detect, identify, track or select) and attack (use force against, neutralize, damage or destroy) targets without human intervention' (*Davison, 2017, p. 5*). In its position paper, the International Committee of the Red Cross argues that 'Autonomous weapon systems select and apply force to targets without human intervention. After initial activation or launch by a person, an autonomous weapon system self-initiates or triggers a strike in response to information from the environment received through sensors and on the basis of a generalized "target profile". This means that the user does not choose, or even know, the specific target(s) and the precise timing and/or location of the resulting application(s) of force' (*ICRC position*). Some authors differentiate between remotely operated and autonomous unmanned vehicles: remotely operated vehicles, as such, usually do not pose challenges for International Law; by contrast, autonomous weapons raise particular difficulties when it comes to making nuanced, context-dependent judgments (*Ojha, 2025, p. 39*).

LAWS pose serious challenges for both International Human Rights Law and International Humanitarian Law. The scientific literature highlights the following key risks. First, autonomous weapons are likely unable to properly determine a person's status (combatant, civilian, *hors de combat*), to classify an object as civilian or military, to assess whether an 'attack' at a given moment is necessary to achieve a military advantage, and whether such an advantage outweighs the damage inflicted in the course of the attack on civilians and civilian objects. Thus, the use of LAWS may breach the main principles of International Humanitarian Law: distinction, military necessity, proportionality, precautions in attack, and humanity. Second, there is uncertainty about who will be responsible – individuals or the state – for violations of International Humanitarian Law resulting from the improper use of LAWS. Third, there is always the possibility of the misuse of the LAWS by terrorists, the integration of LAWS into weapons of mass destruction delivery systems, or unauthorized interference with algorithms or command-and-control systems. That's why additional mechanisms of International Criminal law must be applied in order to combat relevant crimes.

A certain level of human control and involvement in the operation of autonomous weapons is essential for attributing individual criminal responsibility for war crimes and for determining the international responsibility of states for internationally wrongful acts. Key components of human control encompass, among other factors, the foreseeability and dependability of the weapons system in its intended operational context; the capacity for human operators to intervene at all stages of the system's lifecycle, including development, activation, and actual use; sufficient knowledge and information regarding the weapon's capabilities and the environment in which it is deployed; and accountability for actions performed by the autonomous system. Human control must be present during every stage of the application of LAWS: during its development, deployment, and use.

Some authors argue that if a lethal autonomous weapons system perpetrates a war crime, for example, launching an indiscriminate attack within the meaning of Article 8(2)(b)(iv) of the Rome Statute, the question of criminal attribution becomes highly contested (*Badhan, & Jagota, 2025, p. 84-85*). Responsibility may potentially rest with various actors, including the software developer who created the algorithm, the military commander who authorized or deployed the system, or the manufacturer involved in its production (*Badhan, & Jagota, 2025, p. 84-85*). Individuals who design or deploy LAWS may lack the knowledge or intent for criminal responsibility where the system independently selects and engages targets after activation; however, responsibility would clearly arise where a programmer deliberately codes the system to operate contrary to International Humanitarian Law or where a commander deploys a weapon that is inherently incapable of lawful use in the given operational context. It must be noted that, under the Policy on Cyber-Enabled Crimes of the Rome Statute (2025), the Office of the Prosecutor considers that any decision to deploy or use AI technologies must comply with existing obligations under International Humanitarian Law and International Human Rights Law (*Office of the Prosecutor, 2025, p. 15*).

Under the general rules of international law on state responsibility, a state may incur

responsibility for the breaches of International Humanitarian Law committed by its armed forces through the use of autonomous weapon systems. Besides, under Article 36 of the Additional Protocol I to the Geneva Conventions, 'in the study, development, acquisition or adoption of a new weapon, means or method of warfare, a High Contracting Party is under an obligation to determine whether its employment would, in some or all circumstances, be prohibited by this Protocol or by any other rule of international law applicable to the High Contracting Party' (*Protocol Additional*). Thus, a state will be held responsible if an LAWS is deployed without having undergone sufficient testing or legal review in advance. Nonetheless, some authors underline the problem of the possibility of applying this provision to weapons developed with AI. For example, Nasu H. stipulates that given the dual-use nature of AI technology, many applications of AI may not qualify as 'weapons' or 'means of warfare' for the purpose of this legal review obligation (*Nasu, 2019, p. 11*).

Bearing the above mentioned difficulties in mind, different scholars have proposed alternative approaches to accountability for LAWS: (1) a **strict liability** model, under which states or manufacturers would be held accountable for failures or malfunctions of such systems, without requiring proof of intent; (2) a **distributed responsibility** framework that allocates legal responsibility among multiple participants according to their involvement at different stages of the autonomous weapons system's lifecycle (*Badhan, & Jagota, 2025, p. 85*).

It must be noted that under the current framework of International Humanitarian Law, the use of some LAWS is to be prohibited completely, namely in situations where such systems cannot meet core requirements of customary and treaty rules of International Humanitarian Law, such as distinction, proportionality, and precaution; where their design renders them inherently indiscriminate or likely to inflict superfluous injury or unnecessary suffering; or where they are directed against civilians or civilian objects (*Perrin, 2025*). Prohibition must also be imposed where their effects cannot be reasonably predicted or controlled, where they operate without sufficient human oversight or judgment in light of the specific context, or where their deployment is intended or foreseeably leads to widespread, long-term, and severe damage to the natural environment (*Perrin, 2025*).

In December 2024, the UN General Assembly adopted resolution A/RES/79/62 called 'Lethal autonomous weapons systems', which encouraged states and international organizations to participate in the work of the Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapons Systems (*The UN General Assembly. Resolution A/RES/79/62*). This resolution refers to the initiative being realized within the Convention on Certain Conventional Weapons. At an informal meeting of the High Contracting Parties to the Convention in 2013, the Group of Governmental Experts was granted an open-ended mandate to develop an operational and normative framework governing the use of emerging technologies in LAWS (*Humble, 2023*). This process ultimately led, in 2019, to the Group's set of eleven guiding principles addressing the development, deployment, and use of such systems (*Humble, 2023*).

The principles reaffirm the full applicability of International Humanitarian Law to all weapons and stress the necessity of maintaining meaningful human responsibility and control throughout the entire life cycle of such systems. They emphasize states' obligations to ensure accountability, conduct legal reviews of new weapons, and integrate risk assessment, security, and safeguard measures into the development and deployment of new weapons, including LAWS. The principles caution against anthropomorphizing autonomous systems and underscore the need to balance military necessity with humanitarian considerations. It should be emphasized in this regard that weapons are merely material tools and lack legal personality or independent agency; International Humanitarian Law assigns rights and duties to states and individuals, not to technological systems; accordingly, describing LAWS using concepts such as 'autonomy', 'intelligence', 'self-awareness', or 'decision-making' risks creating a misleading impression about their actual nature and capacities (*Szpak, 2024, p. 290*).

Meanwhile, the United Nations Secretary-General and the President of the International Committee of the Red Cross called for a new international treaty that would set out specific

prohibitions and restrictions on LAWS (*Perrin, 2025*). Many states proposed a moratorium on the use of all LAWS or a ban on their use; however, the Group of Governmental Experts indicates a need to adopt regulations that determine the rules under which LAWS may be legally used, rather than imposing a ban (*Szpak, 2024, p. 292*). It is a matter for future negotiations between states and within international organizations to decide whether to adopt a new legally binding instrument on LAWS and in what form (for example, as a separate convention or an additional protocol to the Convention on Certain Conventional Weapons).

**Conclusions**. AI offers numerous benefits for humans and their rights; meanwhile, it also poses significant risks. Due to the potential risks and possible harm to human rights (such as the right to privacy, fair trial, freedom from discrimination, etc.) and even some threat to the whole humankind posed by AI, some scholars argue that there is an international legal obligation on states under the right to life within international human rights law to proactively take regulatory action to mitigate the potential existential risk of AI based on the precautionary principle. In any case, there must be some 'red lines' which can't be overcome, and the law is to become a safeguard in relation to such prohibited spheres which infringe fundamental human rights and undermine the very concept of human dignity. Under International Human Rights Law, states are required to establish preventive legal and institutional structures, ensure supervision and control, impose responsibility for violations, and guarantee effective remedies for any harm inflicted by the use of AI technologies.

There is no single universal treaty governing the protection of human rights in the era of AI. At the universal level, the risks and benefits of AI for human rights have been the subject of reports by various UN bodies, including the Human Rights Council, the Office of the High Commissioner for Human Rights, and UNESCO. The UN General Assembly, UNESCO, and other universal international organizations adopted some resolutions and recommendations, but these instruments constitute soft law and do not have binding force. The first legally binding document in the sphere of AI and human rights – the Framework Convention on Artificial Intelligence, Human Rights, Democracy and the Rule of Law – is a regional treaty and has several drawbacks, namely, it primarily applies to the public sector and doesn't address the matters relating to national defence. Although the European Court of Human Rights has dealt with cases related to data protection and digital technologies that may violate the right to privacy, it has not had the opportunity to analyze the direct effects of AI on human rights in those cases.

The Artificial Intelligence Act adopted by the European Union belongs to secondary legislation of the EU and is not an instrument specifically addressing human rights. On the other hand, this Regulation imposes obligations (including sanctions) on AI providers and establishes the structure of implementing and control bodies at the EU and national levels of Member States, which ensure the provision of a safe and ethically healthy environment, thereby creating the preconditions for the protection of human rights. As such, its norms could partly serve as a certain model for the global regulation of these matters. Another EU document, the European Declaration on Digital Rights and Principles (2023), is focused directly on the human rights area; nevertheless, due to its non-binding character, it cannot protect the rights of individuals but could be used as a source of inspiration for the regulation of these issues at the level of International Law.

Lethal autonomous weapon systems that can select and attack targets without human intervention pose serious challenges for International Humanitarian Law. The use of LAWS may breach its main principles: distinction, military necessity, proportionality, precautions in attack, and humanity. A certain level of human control and involvement in the operation of autonomous weapons is essential for attributing individual criminal responsibility for war crimes and for determining the international responsibility of states for internationally wrongful acts. Responsibility may potentially rest with various actors, including the software developer who created the algorithm, the military commander who authorized or deployed the system, the manufacturer involved in its production, and the state itself. Under the general rules of international law on state responsibility, a state may incur responsibility for the breaches of International Humanitarian Law committed by its armed forces through the use of autonomous weapon systems, as well as for the use of LAWS deployed without having undergone sufficient testing or legal review

in advance. Under the current framework of International Humanitarian Law, the use of some LAWS is to be prohibited completely, namely in situations where such systems cannot meet core requirements of customary and treaty rules of International Humanitarian Law.

There is no single universal treaty governing the conduct of warfare in the era of AI. The UN General Assembly adopted a special resolution on this matter; the Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapons Systems within the Convention on Certain Conventional Weapons adopted a set of eleven guiding principles, but they constitute soft law and do not have binding force for states. Meanwhile, the United Nations Secretary-General and the President of the International Committee of the Red Cross called for a new international treaty setting out specific prohibitions and restrictions on LAWS. It is a matter for future negotiations between states and within international organizations to decide whether to adopt a new legally binding instrument on LAWS and in what form (for example, as a separate convention or an additional protocol to the Convention on Certain Conventional Weapons). In any case, the current legal framework – conventions and protocols, which are the main sources of International Humanitarian Law – is not sufficient to govern new weapons developed through AI technologies, and the new globally recognized rules, including the effective control mechanism, must be urgently elaborated. This appeal is extremely pressing, especially in the light of Russian aggression against Ukraine and the deterioration of the entire political and security climate in the world.

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# NATO'S STRATEGIC ADAPTATION IN THE ERA OF SYSTEMIC RIVALRY: FROM COLLECTIVE SECURITY TO MULTI-DOMAIN DEFENSE

# СТРАТЕГІЧНА АДАПТАЦІЯ НАТО В ЕПОХУ СИСТЕМНОЇ КОНКУРЕНЦІЇ: ВІД КОЛЕКТИВНОЇ БЕЗПЕКИ ДО БАГАТОДОМЕННОЇ ОБОРОНИ

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***Abstract.*** *The article examines NATO's institutional and strategic transformation in the context of the transition from a liberal post–Cold War order to an era of renewed systemic rivalry. It analyzes how the Alliance has shifted from a crisis-management and cooperative security paradigm toward a deterrence-centered strategy focused on collective defense, forward deployment, and multi-domain operational integration. Particular attention is devoted to NATO's 2022 Strategic Concept, enlargement dynamics following Finland's and Sweden's accession, increased defense spending commitments, and the institutionalization of cyber, space, and resilience policies. The study argues that NATO's recalibration reflects broader structural changes within the contemporary international security system, marked by the erosion of unipolarity, the resurgence of territorial revisionism, and the expansion of competition into hybrid and technological domains. The Alliance's evolution demonstrates institutional resilience under systemic pressure and highlights its growing role as both a military alliance and a platform for security governance in a competitive multipolar environment.*

***Key words:*** *NATO, systemic rivalry, collective defense, deterrence, multi-domain security, international security system, resilience.*

***Анотація.*** ***У*** *статті досліджується інституційна та стратегічна трансформація НАТО в контексті переходу від ліберального постбіполярного порядку, що сформувався після завершення «холодної війни», до епохи відновленого системного суперництва. Аналізується, яким чином Альянс здійснив перехід від парадигми кризового менеджменту та кооперативної безпеки до стратегії, зорієнтованої на стримування, з акцентом на колективну оборону, передове розгортання сил та багатодоменну операційну інтеграцію. Особливу увагу приділено Стратегічній концепції НАТО 2022 року, динаміці розширення*

*після приєднання Фінляндії та Швеції, зростанню зобов'язань щодо оборонних видатків, а також інституціоналізації політик у сферах кіберпростору, космосу та стійкості.*

*У статті визначено, що стратегічна рекалібрація НАТО відображає ширші структурні зміни в сучасній системі міжнародної безпеки, позначені ерозією однополярності, відродженням територіального ревізіонізму та поширенням конкуренції на гібридні й технологічні виміри. Еволюція Альянсу демонструє інституційну стійкість в умовах системного тиску та підкреслює його зростаючу роль як військово-політичного союзу і водночас платформи безпекового врядування в конкурентному багатополярному середовищі.*

***Ключові слова:*** *НАТО, системне суперництво, колективна оборона, стримування, багатодоменна безпека, система міжнародної безпеки, стійкість.*

**Introduction.** Since its founding in 1949, NATO has undergone multiple strategic transformations in response to shifts in the international security environment. During the Cold War, the Alliance's primary purpose centered on collective territorial defense against the Soviet Union. Following the end of the bipolar era, NATO redefined itself as a collective security organization operating through crisis management and cooperative mechanisms within the broader liberal international order. However, the resurgence of geopolitical rivalry, territorial revisionism, and systemic competition among major powers has fundamentally altered the strategic landscape. The Russian annexation of Crimea in 2014 and the full-scale invasion of Ukraine in 2022, combined with intensifying technological and economic competition with China, have accelerated NATO's strategic recalibration.

Under these conditions, the study of NATO's institutional and strategic adaptation acquires particular significance for understanding the transformation of the modern international security system. The Alliance's recalibration—manifested in renewed deterrence policies, expansion into cyber, space, and hybrid domains, and the strengthening of its political coordination functions—reflects deeper structural shifts from a predominantly liberal security order toward a more competitive and multipolar configuration. Consequently, analyzing NATO's evolution provides important insight into the resilience, flexibility, and changing functions of security institutions amid systemic rivalry and global power rebalancing.

**The purpose of this article** is to examine how NATO is adapting institutionally and strategically to the reemergence of systemic rivalry and to assess what this transformation reveals about the evolution of the contemporary international security system. Specifically, the study analyzes NATO's shift from a post–Cold War crisis-management framework toward renewed deterrence, multi-domain operational integration, and expanded governance functions in areas such as cyber defense and resilience

**Literature review.** Scholarship on NATO's evolution reflects broader debates about alliance durability and systemic transformation. Early post–Cold War analyses emphasized the structural stability of U.S.-led unipolarity *(Wohlforth, 1999)* and questioned NATO's continued relevance after the Soviet collapse. Rather than dissolving, the Alliance reoriented toward crisis management and cooperative security, codified in the 1999 Strategic Concept *(NATO, 1999)* and operationalized through missions such as Afghanistan *(Rynning, 2015).* Liberal institutionalist scholars interpret enlargement and partnership mechanisms as instruments of norm diffusion and order-building *(Keohane, 1984; Schimmelfennig, 2003),* while *Ikenberry (2018)* situates NATO within the architecture of the liberal international order. In contrast, realist perspectives *(Waltz, 1979; Walt, 1987; Mearsheimer, 2001)* emphasize balance-of-power dynamics and threat perception as enduring drivers of alliance behavior.

Following Russia's aggression against Ukraine, a new wave of research reassesses NATO's strategic recalibration. The 2022 Strategic Concept re-centered deterrence and collective defense *(NATO, 2022),* reflecting what Brands (2022) describes as a renewed era of great-power rivalry. Freedman (2023) and Fiott (2023) analyze the return of high-intensity warfare and its implications for European deterrence, while Smith (2023) and Sloan (2023) examine alliance cohesion,

resilience, and political adaptation in the post-2022 environment. Rynning (2024) frames the war in Ukraine as a structural inflection point in NATO's historical trajectory. Together, this literature underscores NATO's transformation from a crisis-management institution to a deterrence-centered, multi-domain security actor, though fewer studies systematically connect this adaptation to the broader transition from liberal unipolarity to competitive multipolarity—an analytical gap this paper addresses.

**Main results of the research.** The end of the Cold War produced what many scholars characterized as a unipolar moment dominated by the United States *(Wohlforth, 1999).* In this environment, NATO's traditional adversary had dissolved, raising questions about the Alliance's continued relevance. Rather than disbanding, NATO reinvented itself as a crisis-management actor engaged in out-of-area operations, particularly in the Balkans during the 1990s. Interventions in Bosnia and Herzegovina and Kosovo marked a significant departure from strictly territorial defense.

These operations reflected a normative shift toward liberal interventionism and the stabilization of fragile states. NATO's 1999 Strategic Concept emphasized crisis response and cooperative security as central tasks *(NATO, 1999).* The Alliance framed security as indivisible and increasingly globalized, thereby expanding its functional mandate beyond Article 5 collective defense.

The attacks of September 11, 2001, further entrenched NATO's expeditionary orientation. For the first time, Article 5 was invoked in response to a terrorist attack on the United States. NATO assumed command of the International Security Assistance Force (ISAF) in Afghanistan in 2003, engaging in prolonged counterinsurgency and stabilization efforts *(Rynning, 2015).* These missions reinforced NATO's identity as a crisis-management institution operating far beyond its traditional geographic boundaries.

Yet such operations also exposed limitations in alliance cohesion, burden-sharing, and strategic clarity. Divergent national caveats and uneven contributions complicated operational effectiveness. The Afghanistan experience, in particular, raised questions about NATO's capacity to conduct long-term stabilization missions amid political fatigue and shifting priorities.

Alongside crisis management, NATO pursued cooperative security through partnership frameworks such as the Partnership for Peace and the NATO-Russia Council. Enlargement toward Central and Eastern Europe was framed as consolidating democratic governance and embedding former Warsaw Pact states within a liberal institutional order *(Schimmelfennig, 2003).* During this period, NATO functioned as both a military alliance and a political community, reinforcing norms of democracy and civilian control of the military.

This post–Cold War phase reflected an institutional optimism consistent with liberal institutionalist expectations that security cooperation could mitigate traditional power politics *(Keohane, 1984).* However, this cooperative paradigm increasingly confronted structural and geopolitical constraints.

By the late 2000s and early 2010s, the foundations of the liberal international order began to erode. Economic crises, domestic populism, and geopolitical revisionism undermined the post–Cold War consensus. Scholars have argued that liberal hegemony generated countervailing pressures from rising and resurgent powers dissatisfied with Western dominance *(Ikenberry, 2018).*

Russia's assertiveness and China's growing influence challenged assumptions of linear liberal convergence. The international system began to exhibit characteristics of competitive multipolarity, marked by renewed great-power rivalry and contested norms.

Russia's annexation of Crimea in 2014 constituted a watershed moment. It violated core principles of territorial sovereignty and demonstrated the reemergence of conventional interstate conflict in Europe. The 2022 invasion of Ukraine further underscored the return of high-intensity warfare and large-scale mobilization. These developments re-centered NATO's attention on deterrence and collective defense *(Beaumont, Wilhelmsen, Gjerde, 2024).*

The reemergence of territorial revisionism undermined earlier expectations that interstate war in Europe had become obsolete. It also revealed the limitations of cooperative security arrangements, including the NATO-Russia Council, which proved insufficient to prevent

confrontation.

Systemic rivalry increasingly unfolds across technological and hybrid domains. Cyber operations, disinformation campaigns, election interference, and economic coercion have blurred the boundaries between war and peace. Gray-zone tactics complicate traditional deterrence models by operating below the threshold of armed attack *(Marsh, 2024).*

Moreover, emerging technologies—including artificial intelligence, space capabilities, and advanced missile systems—have transformed military competition. The diffusion of dual-use technologies has intensified the strategic significance of critical infrastructure, supply chains, and digital networks. Security is no longer confined to territorial defense but extends into societal resilience.

In response to Russian aggression, NATO has undertaken a substantial strategic reorientation. The 2014 Wales Summit introduced the Readiness Action Plan, enhancing rapid deployment capabilities and establishing the Enhanced Forward Presence in Eastern Europe. The 2022 Strategic Concept explicitly identifies Russia as the most significant and direct threat to Allied security *(NATO, 2022).* This shift marks a return to deterrence-centered strategy. NATO has increased forward-deployed forces, strengthened command structures, and expanded high-readiness formations. The emphasis on credible deterrence reflects recognition that crisis management alone is insufficient in an era of systemic rivalry.

NATO enlargement has regained geopolitical salience. The accession of Finland in 2023 and Sweden in 2024 significantly alters the strategic balance in Northern Europe. Enlargement demonstrates both the continued attractiveness of NATO membership and the Alliance's adaptive capacity *(Black, Kleberg, & Silfversten, 2024).* At the same time, enlargement reinforces Russia's perception of encirclement, contributing to intensified security dilemmas. This dynamic illustrates the complex interplay between institutional expansion and geopolitical contestation.

Burden-sharing has long been a contentious issue within NATO. The 2014 pledge to move toward spending 2% of GDP on defense has gained renewed urgency. In the wake of Russia's invasion of Ukraine, several member states have substantially increased defense budgets, signaling a re-prioritization of hard power. Enhanced spending supports modernization, interoperability, and force readiness. It also reflects recognition that credible deterrence requires sustained material commitments, not merely rhetorical solidarity *(NATO, 2025).*

NATO's adaptation extends beyond conventional forces. In 2016, cyberspace was recognized as an operational domain, followed by space in 2019. These steps institutionalize multi-domain integration, enabling coordinated responses across land, sea, air, cyber, and space. The Alliance has established structures such as the Cooperative Cyber Defence Centre of Excellence and enhanced intelligence-sharing mechanisms. This multidimensional approach acknowledges that contemporary threats traverse physical and digital boundaries *(Gilli, Gilli, & Grgić, 2025).*

NATO increasingly operates as a governance platform facilitating coordination among member states and partners. While Article 5 remains central, many contemporary challenges—such as cyberattacks and disinformation—require collective consultation rather than immediate military response. Through standardized planning processes and political consultations, NATO shapes national policies and harmonizes threat assessments. This governance function enhances institutional resilience amid complex systemic competition.

Cyber defense represents a critical area of institutional innovation. NATO's Cyber Defence Pledge encourages members to strengthen national capabilities and integrate cyber considerations into defense planning. The Alliance also provides mechanisms for information-sharing and coordinated response. This integration reflects recognition that cyber threats can undermine societal stability without crossing traditional thresholds of armed attack. By embedding cyber resilience within alliance structures, NATO expands its security mandate into the digital domain *(NATO, 2016).*

Modern systemic rivalry targets civilian infrastructure and societal cohesion. NATO has revived baseline requirements for civil preparedness, addressing energy security, transportation networks, and supply chain resilience. The concept of "resilience" has become central to alliance

discourse. This emphasis broadens NATO's functional scope beyond military operations to encompass societal defense. The Alliance thereby acts as a coordinator of national resilience strategies, reinforcing the interdependence between military and civilian security.

NATO has also strengthened ties with Indo-Pacific partners, including Australia, Japan, South Korea, and New Zealand. Although NATO remains a Euro-Atlantic alliance, these partnerships reflect recognition of the global dimensions of systemic rivalry, particularly regarding China. Such cooperation illustrates NATO's evolving role as a node within a broader network of like-minded states. Rather than transforming into a global alliance, NATO functions as a hub for strategic coordination across regions.

NATO's adaptation demonstrates institutional resilience amid systemic change. Contrary to predictions of obsolescence, the Alliance has recalibrated its mission and capabilities. This resilience challenges realist expectations that alliances dissipate in the absence of immediate threats. However, adaptation also reflects fragmentation within the broader international order. The shift from cooperative security to deterrence underscores the erosion of shared norms and the reemergence of competitive blocs.

In a multipolar environment, alliances serve as mechanisms for balancing and coordination. NATO's renewed cohesion following Russia's invasion of Ukraine suggests that external threats can mitigate internal divisions. Yet long-term unity will depend on sustained political will and equitable burden-sharing. The Alliance's evolution highlights the enduring relevance of institutionalized cooperation in managing systemic rivalry. NATO functions not merely as a military coalition but as a framework for aligning strategic priorities among diverse democratic states.

Looking forward, NATO faces several potential trajectories. One scenario involves continued consolidation around deterrence and resilience, reinforcing transatlantic unity. Another entails strain arising from domestic political shifts or divergent threat perceptions. The trajectory of U.S. engagement will remain pivotal. Technological transformation will further shape alliance adaptation. Integration of emerging technologies and protection of critical infrastructure will test NATO's governance capacity. The Alliance's ability to balance deterrence with crisis management and partnership-building will influence the evolution of the international security system.

**Conclusions.** NATO's institutional and strategic adaptation to systemic rivalry reflects a significant transformation in its role and functions. The Alliance has shifted from a post–Cold War crisis-management organization to one centered on deterrence, broadened its scope into multi-domain security governance, and increasingly operates as a platform for coordinating responses to hybrid and technological competition.

These developments point to wider structural changes in the international system. The weakening of the liberal security order and the resurgence of great-power rivalry have compelled NATO to reemphasize collective defense while innovating in the domains of cyber, space, and societal resilience. Such adaptation demonstrates the continued relevance of alliances in managing systemic competition, even as the global order moves toward a more competitive multipolar configuration.

From a theoretical perspective, this case illustrates the capacity of institutions to evolve under structural pressure. Rather than fragmenting, NATO has redefined its core purpose and expanded its governance functions. Further research may explore patterns of alliance adaptation in comparative perspective and assess the long-term sustainability of multi-domain deterrence within an increasingly contested international environment.

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# CONFLICT-OF-LAW REGULATION OF THE ISSUANCE, PLACEMENT AND CIRCULATION OF CRYPTOASSETS AS AN INTRUMENT FOR RAISING CAPITAL IN INTERNATIONAL PRIVATE LAW

# КОЛІЗІЙНО-ПРАВОВЕ РЕГУЛЮВАННЯ ВИПУСКУ, РОЗМІЩЕННЯ ТА ОБІГУ КРИПТОАКТИВІВ ЯК ІНСТРУМЕНТУ ЗАЛУЧЕННЯ КАПІТАЛУ В МІЖНАРОДНОМУ ПРИВАТНОМУ ПРАВІ

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***Abstract.*** *The purpose of the study is to analyse the regulatory and legal acts of states, as well as the works of organisations and scholars, for the purposes of determining approaches to the applicable law to cryptoassets in legal relations with a foreign element or the possibility of choosing a special law at the discretion of the parties. The main issue of the study is the lack of a generally accepted approach in modern private international law to considering the applicable law to legal relations involving cryptoassets in the presence of a foreign element. Due to the ongoing integration of cryptoassets into international finances, there is an urgent need to define the conflict of laws rules that shall be applied to cryptoassets. The study analyses conflict-of-law rules that are either proposed by various researchers, soft law acts, works of legal organisations, or determined by courts as precedents in countries with Anglo-Saxon legal systems. Therefore, the author has unified such approaches to develop a single hierarchical system of conflict-of-law rules that can be applied to cryptoassets and will serve as a proposal for implementation into Ukrainian legislation in the future. It has been determined that the main principle in establishing the applicable law is the autonomy of the parties' will, which allows the parties to independently choose any law, except in cases where cryptoassets are to be stored with a cryptoasset service provider in relation to custody and administration of cryptoassets on behalf of customers. At the same time, the applicable law regarding the placement of cryptoassets and their circulation has also been separately analysed and proposed. In addition, it has been confirmed that no law applies to the issuance of cryptoassets, since the actual issuance of cryptoassets is a technical process that is not subject to regulation and has no legal aspect.*

***Keywords:*** *cryptoassets, issuance, placement, circulation, conflict of laws, autonomy of the parties, cryptoasset service provider.*

***Анотація.*** *Метою дослідження є аналіз нормативно-правових актів держав, а також праць організацій та науковців для визначення підходів щодо застосовного права до криптоактивів у правовідносинах із іноземним елементом або наявності можливості обрати спеціальне право за бажанням сторін. Основна проблематика дослідження полягає у відсутності у сучасному міжнародному приватному праві загальноприйнятного підходу щодо визначення застосовного права до правовідносин із криптоактивами за наявності іноземного елемента. У зв'язку із постійною інтеграцією криптоактивів у міжнародні фінанси, виникає нагальна потреба окреслити колізійні прив'язки, які слід застосовувати щодо криптоактивів. У досліджені проаналізовано колізійні прив'язки, які або пропонуються різноманітними дослідниками, актами м'якого права, роботами правових організацій, або визначених судами у якості прецедентів у державах англо-саксонської системи права. Таким чином, автором було уніфіковано зазначені підходи для вироблення єдиної ієрархічної системи колізійних прив'язок, які можуть застосовуватися до криптоактивів та слугуватимуть пропозицією щодо імплементації в українське законодавство у майбутньому. Визначено, що основним принципом при встановленні застосовного права є автономія волі сторін, яка дозволяє сторонам самостійно обрати будь-яке право, окрім випадку, коли передбачається зберігання криптоактивів у постачальника послуг зі зберігання криптоактивів. При цьому також окремо проаналізовано та запропоновано застосовне право у зв'язку з розміщенням криптоактивів та їх обігом. Окрім цього, підтверджено, що до випуску криптоактивів не застосовується жодне право, оскільки їх фактичний випуск є технічним процесом, який не піддається регулювання та щодо якого відсутній юридичний аспект.*

***Ключові слова:*** *криптоактиви, випуск, розміщення, обіг, колізійні прив'язки, автономія волі сторін, постачальник послуг зі зберігання криптоактивів.*

**Introduction.** The integration of cryptoassets into the financial system is becoming increasingly important. However, the pace of introducing legal regulations governing cryptoassets is excessively slow, which is already resulting in number of problems that needs to be resolved. One of the issues is the law that should be applied in legal relations involving cryptoassets with the existence of a foreign element. There are many variables in this regard, such as the decentralised network on which it is issued, placed, and circulated, the issuer of the cryptoasset, and the parties to the transaction involving the cryptoasset. Since there is an urgent need to understand which law shall be applied to cryptoassets, for this purpose this study was conducted.

**The purpose of the article** is to examine the approaches proposed by scholars or legal organisations, soft law acts, and case law of Anglo-Saxon legal family countries in order to develop a hierarchical system of conflict-of-law rules regarding applicable law that can be implemented in Ukrainian legislation.

**Literature review.** In addition to the legislation of countries and the case law of Anglo-Saxon countries, among the authors of specialised literature on determining the applicable law to legal relations involving cryptoassets, the following can be highlighted: O.I. Vygovskyy, V.I. Lehenko, Barbara M. Goodstein, Adam C. Wolk, Andrew Dickonson, Pascal Favrod-Coune, Kévin BeletChapter, and Lehmann Matthias. In addition, the UNIDROIT Principles on Digital Assets and Private Law were examined as one of the main fundamental works on the proposed conflict of laws rules.

**Main results of the research.** Currently, private international law does not offer generally accepted conflict-of-law rules that apply to cryptoassets as a whole for the purposes of determining the applicable law in the presence of a foreign element or the desire of the parties to the transaction to choose a specific law for it. In this regard, it would be advisable to examine the proposed ideas of conflict-of-law rules for general cryptoassets or the approaches of different states, and if they cannot be directly applied to the subject of the study, to adapt the most rational ideas.

From a technical point of view, cryptoassets and securities are different in nature, but their

legal nature has many similar aspects, so at first glance it would be advisable to apply traditional conflict-of-law rules typical for direct and indirect ownership of securities. However, as noted by Vygovskyy O. I., given the accounting of cryptoassets in a decentralised network based on blockchain, they lose their relevance due to problems with localisation in space and determining the lex situs for cryptoassets, i.e. the relevance of determining the situs for an intangible asset, which is complicated by the special place of accounting for cryptoassets *(Vygovskyy, 2020)*.

To this end, it is necessary to review a number of regulatory acts of various institutions and states in order to examine the conflict-of-law rules they propose for application, and then systematise them and identify those that are most efficient for the general circulation of cryptoassets in general, as well as applicable to the issuance, placement and circulation of cryptoassets for the purpose of raising capital.

***UNIDROIT Principles on Digital Assets and Private Law 2023***

This document considers digital assets in a broad sense as electronic records that can be controlled. On a practical level, this includes cryptoassets. It should be noted that it considers digital assets only in relation to issues of choice of law and does not address issues of jurisdiction or the subject matter of the dispute. The UNIDROIT Principles provide that the main conflict-of-law rule for determining the applicable law for cryptoassets is the autonomy of the parties' will *(UNIDROIT Principles on Digital Assets and Private Law, 2023)*.

The autonomy of the parties' will, or lex voluntatis, is in fact one of the main conflict-of-law rules, which in fact embodies the main features of private international law, so it is foreseeable that it is proposed for application in property relations concerning cryptoassets in the aforementioned document *(Pokachalova, 2016)*.

At the same time, the chosen law must be explicitly stated in the cryptoasset *(UNIDROIT Principles on Digital Assets and Private Law, 2023)*. In this context, it is quite problematic to determine how this rule should be specified, given the nature of cryptoassets: whether in the cryptoasset's whitepaper, on its official website, or in the program code.

Nevertheless, the document in question is soft law, so states can adapt the provision independently. In our opinion, the autonomy of choice of applicable law lies in the possibility, for instance, for an issuer or a person making an offer for the initial purchase of a cryptoasset to determine which law will apply to property relations regarding cryptoassets in the process of their circulation.

It is also noteworthy that, in addition to indicating the applicable law, it is permissible to specify the special UNIDROIT Principles on Digital Assets and Private Law 2023 that will apply to it (the "**Principles**"). In our opinion, the application of the Principles may be permitted in such a case, but only to the extent that they do not conflict with the applicable law. If, over time, the applicable law includes provisions that conflict with the Principles, the provisions of the applicable law will prevail.

Nevertheless, the Principles provide for other conflict-of-law rules. If the applicable law is not specified for a cryptoasset, then the law that is explicitly specified for the decentralised network on which the cryptoasset operates applies (and certain Principles are additionally applied, as in the first case). This approach is generally problematic, as there are currently few decentralised networks that directly or indirectly determine the law to which they are subject (for example, Bitcoin or Ethereum do not have such a connection).

If the above approaches cannot be used, the law of the issuer's personal law is chosen (i.e., the citizenship of the natural person issuer or the place of registration of the legal entity issuer).

However, frequently the identity of the issuer of a cryptoasset remains unknown, since the cryptoasset has been created by an anonymous person. In this case, the Principles provide two options for application.

In the first option, the legislator of a particular state may independently determine that its law should apply to property relations involving cryptoassets, supplemented by the Principles (if the legislation does not cover certain issues). For issues not covered by the legislation and the Principles, special rules of private international law of that state are to be applied.

At the same time, second option provides for the direct application of the Principles in accordance with the legislation of a particular state, and in cases not covered by the Principles, the special rules of private international law of that state are applied.

In our opinion, allowing a state to independently determine that certain provisions regarding cryptoassets should be regulated by its legislation is dangerous in terms of the fragmentation of the legislation of different states, when situations arise in relations with a foreign element where some legal relations will be subject to the jurisdiction of several states (or certain rules will be governed by the Principles, while others will be governed by the legislation of another state).

In addition, the Principles provide for a specific conflict of laws rule in the form of the law governing the custody of cryptoassets. In other words, in relationships where a customers' cryptoassets are stored by a cryptoasset service provider, the law governing the contract for the provision of cryptoasset custody and administration services by that service provider applies to these property relations. In other words, the parties to such an agreement may independently choose the applicable law. If this is not provided for, the law of the place of registration of the service provider shall apply *(UNIDROIT Principles on Digital Assets and Private Law, 2023)*. However, in this situation it is rather advisable to constantly apply the law of the place of registration of the service provider, given the necessity for the states to introduce regulations to be followed by the service providers in order to secure cryptoassets of the customers. It is mostly an issue of providing a detailed regulation of the general cryptoassets circulation, therefore, the possibility to choose the law independently may prevent states from their primary function to regulate cryptoasset service providers, which are registered in such states.

As we can see, the Principles provide for a fairly consistent structure for the application of conflict-of-law rules to determine the applicable law. At the same time, there is a separate conflict-of-law rule in relation to the custody of cryptoassets with the relevant service providers.

However, in general terms, without custody, these rules do not resolve the problem constantly, since if it is impossible to apply the three main approaches, it is assumed that states will be able to independently determine in their legislation that certain issues will be governed by the provisions of their legislation, and in other cases – by the Principles or the rules of private international law of that state. As already mentioned, such an approach can only complicate the determination of law due to competition between different jurisdictions that will determine the relevant provisions in their legislation.

***The United States of America***

In 2022, the Uniform Commercial Code of the United States of America was amended by introducing in Article 12 the concept of a controllable electronic records as a record stored in an electronic medium that can be subject to control. Based on this concept, it also includes cryptoassets, which are not explicitly mentioned.

Thus, according to the amendments, there are five consecutive links to a controlled electronic record:

1) the jurisdiction explicitly specified in the cryptoasset;
2) the jurisdiction explicitly specified in the decentralised network on which the cryptoasset operates;
3) the law of jurisdiction explicitly specified in the cryptoasset;
4) the law of jurisdiction explicitly specified in the decentralised network on which the cryptoasset operates; or
5) the jurisdiction of the District of Columbia, Washington.

On the one hand, paragraphs 1 and 3, as well as 2 and 4, are synonymous. However, in our opinion, the issue lies in the peculiarities of the legislation of the United States of America, where each state has its own legislation. In this regard, such clarification is provided for a more prudent choice of applicable law in cases where particular jurisdiction or law of this jurisdiction is applied. As a result, the Uniform Commercial Code of the United States offers conflict-of-law rules that are applied sequentially if the previous one is not applicable *(Uniform Commercial Code Amendments, 2022; Wilkie Farr & Gallagher LLP, 2024)*.

In fact, a similar approach to autonomy of will is found in the Principles, whose developers probably incorporated some ideas from the amendments to the Uniform Commercial Code.

The last conflict-of-law rule is also peculiar. If it is not possible to identify the applicable law or jurisdiction, the law of Washington, District of Columbia, as a neutral jurisdiction, will apply. Therefore, it is clear that the provisions of the Code were focused on the United States, not other countries *(Goodstein & Wolk, n.d.)*.

In any case, the Uniform Commercial Code is a soft law act and serves more as a set of recommendations for states on how to implement the provisions. Nevertheless, at the time of writing, 25 US states have already adopted, and 13 are in the process of adopting, provisions on controllable electronic records, including in the context of conflict of laws *(UCC, 2022)*.

***England and Wales***

Although English law does not currently provide for statutory conflict-of-law rules governing property relations in the context of cryptoassets, the High Court of England and Wales has repeatedly confirmed the right of domicile (personal law of a person), indicating that the lex situs of a cryptoasset is the permanent place of residence of the natural person or the place of registration of the legal entity that owns it.

Notably, a similar approach was proposed by Andrew Dickinson in 2019 *(Dickinson, 2019)* and subsequently confirmed in a number of decisions by the High Court of England and Wales. In particular, in the cases of Ion Science v. Unknown Persons in 2020 *(Ion Science Ltd v Persons Unknown and others, 2020)* and Fetch.ai v. Unknown Persons in 2021 *(Fetch.ai Ltd v Persons Unknown Category A, 2021)*.

These cases make it clear that in property disputes where a person is the owner of a certain cryptoasset, the personal law of that person applies. Accordingly, English law was used in these two cases.

However, in a later case, Tulip Trading Limited v Wladimir van der Laan et al. in 2022, the High Court of England and Wales changed its position, noting that in property relations, it is necessary to determine not the permanent residence of the individual/place of registration of the legal entity owning the cryptoassets, but rather the right of temporary residence of the individual or the temporary main activity of the legal entity that owns the cryptoassets *(Tulip Trading Limited v Wladimir van der Laan and ors, 2022)*.

***Switzerland***

Switzerland offers a rather complex structure of legislation related to cryptoassets. In its concept, they are referred to as tokens and are not directly mentioned in the legislation on conflicts of law. Nevertheless, researchers note that the rules of Article 145a of the Swiss Federal Act on Private International Law of 1987 ("**Swiss Federal Act**"), as amended, apply to them, although it mainly concerns securities in the form of tokens, as well as tokens linked to assets (e.g., stablecoins) *(Federal Act on Private International Law of 18 December 1987, n.d.; Favrod-Coune, Belet, 2023; Lehmann, 2024)*.

The provisions of the law stipulate that the issuer may independently specify the law that will apply to the token. In other words, in this case, the autonomy of the parties' will is assumed.

If no law is chosen, the law of the place of registration of the legal entity (issuer) applies. If it is impossible to determine such law, the main place of activity of the legal entity law applies.

At the same time, if a dispute arises, where several persons claim their rights to a token (i.e., a token linked to an asset), the law of the location of the assets embodied in the token will apply in accordance with Swiss Federal Act. However, this is a specific conflict of laws rule, which probably applies to a specific individualised asset whose location can actually be determined. For example, certain agricultural goods in a specific warehouse, the rights to which were embodied in the form of tokens.

***Liechtenstein***

In 2021, the Act on Tokens and Trusted Technology Service Providers ("**Liechtenstein Act**") came into force in Liechtenstein. Liechtenstein Act does not provide for direct conflict of laws provisions regarding cryptoassets, but it does have localisation provisions aimed at determining

Liechtenstein law as the law applicable to tokens (cryptoassets) *(Vygovskyy, Lehenko, 2024)*.

It should be noted that Liechtenstein Act directly regulates cryptoassets and providers of services related to cryptoassets, although it uses the terms tokens and trust technology service providers for this purpose.

The application of Liechtenstein law is permissible in two cases:

1) if the cryptoassets are created or put into circulation by a service provider with its headquarters or place of registration in Liechtenstein; or

2) the parties expressly state that the provisions of Liechtenstein law apply to their property relations with cryptoassets in transactions *(Token and TT Service Provider Act, 2019)*.

As we can see, Liechtenstein Act offers two localisation links: the law of the place of registration of the legal entity-issuer or the location of the executive management body of the legal entity.

However, if the parties wish, they may independently choose Liechtenstein law. In other words, the principle of autonomy of the parties' will applies.

***Singapore***

Singaporean law does not provide for conflict of laws rules for determining the applicable law in property relations involving cryptoassets on a statutory level. However, precedent is also a source of law in Singapore. Accordingly, in 2024, in the case of Cheong Jun Yoong v Three Arrows Capital Ltd *(Cheong Jun Yoong v Three Arrows Capital Ltd and others, 2024)*, the High Court of Singapore analysed the precedents of English law mentioned above in section "*England and Wales"*, in particular Ion Science v. Unknown Persons 2020 *(Ion Science Ltd v Persons Unknown and others, 2020)*, Fetch.ai v. Unknown Persons 2021 *(Fetch.ai Ltd v Persons Unknown Category A, 2021)* and Tulip Trading Limited v. Wladimir van der Laan et al 2022 *(Tulip Trading Limited v Wladimir van der Laan and ors, 2022)*.

As a result, the court concluded that the most appropriate conflict of laws rule is rather not the personal law of the owner of the cryptoasset, but the personal law of the person who controls and owns the cryptoasset. This position was taken by the plaintiff Cheong Jun Yoong, who argued that the asset "*is best manifested through control over it*", an opinion that was supported by the court *(Cheong Jun Yoong v Three Arrows Capital Ltd and others, 2024)*.

Therefore, considering the positions of various jurisdictions in the context of cryptoassets, we can identify seven general approaches that are proposed in numerous sources:

1) the principle of autonomy of will with regard to cryptoassets (where the applicable law is embodied in the cryptoasset);
2) the principle of autonomy of will with regard to decentralised networks;
3) the principle of autonomy of will of the parties;
4) the personal law of the issuer;
5) the personal law of the cryptoasset service provider in relation to custody and administration of cryptoassets on behalf of customers;
6) the personal law of the person or entity who owns the cryptoasset; and
7) the personal law of the person or entity who controls the cryptoasset *(Lehmann, 2024)*.

In many cases, more than one conflict-of-law rule is used, depending on the situation. Given the variety of different approaches and the impossibility of implementing a single "ideal" conflict of laws rule, we can conclude that the most effective option is to create a system that would provide for the application of the next conflict of laws rule if the previous one is not applicable due to certain circumstances.

It should be noted that, in our opinion, the principle of autonomy of will of the parties could be the most acceptable option for regulating property relations. Nevertheless, in most cases, in particular in the Principles, as well as in the Uniform Commercial Code of the United States, autonomy of will addresses precisely the possibility of specifying, when issuing a cryptoasset, a specific law that will apply to virtually all property relations.

In this case, we rely on the autonomy of will of the issuer of the cryptoasset to specify the

applicable law or, if the cryptoasset is created on the basis of the Proof-of-Work consensus algorithm, the developer of the cryptoasset *(What is Proof-of-Work (PoW) with Simple Words?, 2023)*. The possibility of applying the applicable law by the parties of transactions with cryptoassets independently is provided for exclusively in the relevant law of Liechtenstein, which states that its legislation applies if the parties have expressly chosen its law.

As Matthias Lehmann points out, the autonomy of the issuer (developer) in applying the applicable law carries a high risk that third parties who will use cryptoassets and carry out transactions with them will not be aware of the law specified by the issuer (developer). Specifying the law in the program code or providing a reference to official sources of information about the cryptoasset could solve this issue, but in any case, it is insufficient for general user information. In addition, he also emphasises the contradiction of this approach with the "libertarian and anti-state philosophy underlying blockchain", which provides for the free use of cryptoassets *(Lehmann, 2024)*. The same can be referenced to the principle of autonomy of will with regard to a decentralised network.

In view of this, priority should be given first and foremost to the autonomy of will in the independent choice of applicable law by the parties to a transaction involving cryptoassets, and only then to cryptoassets and decentralised networks.

Considering the above, in our opinion, the general hierarchy of conflict of laws in relation to property relations with cryptoassets should be as follows:

1) The principle of autonomy of the parties' will

It is important that the parties to a transaction have the opportunity to choose the applicable law themselves, however, the parties must specify it explicitly and clearly in advance, otherwise this principle will not apply.

2) The principle of autonomy of the issuer's (developer's) will

If the parties have not specified which law they wish to apply, the principle of autonomy of the issuer's (developer's) will may be used, which directly specifies the applicable law for the cryptoasset. States may independently determine what constitutes confirmation of the choice of law, but in our opinion, it is sufficient to indicate this in the program code of the cryptoasset and/or in official sources of information about it. For example, in a whitepaper (if available).

3) The principle of autonomy of will with regard to a decentralised network

If no applicable law has been determined for the cryptoasset, preference should be given to the autonomy of the decentralised network on which the cryptoasset operates. The rules for determining such law are similar to the autonomy of the issuer (developer).

4) Personal law of the issuer (the person making the offer)

If the three previous rules cannot be applied, it would be advisable to use the issuer's personal law. In our opinion, the most appropriate approach for legal entities is to apply the place of registration of the legal entity, and for individuals – their nationality as the most stable legal construct in property relations, including those relating to cryptoassets.

In this context, it is worth noting that when placing a cryptoasset for the purpose of raising capital, the greatest degree of responsibility lies with the person making the offer to purchase the cryptoasset to buyers. In view of this, such cryptoassets should be subject to the personal law of the person making the offer, i.e. their place of registration.

5) Personal law of the cryptoasset owner

The United Kingdom and Singapore have fairly similar precedents regarding cryptoassets, which refer to the personal law of the owner of the cryptoasset (the person who controls the cryptoasset). However, under normal circumstances, the Singapore approach should be relied upon, as one of the manifestations of ownership of a cryptoasset is the ability to dispose of it, i.e. to control it using private keys *(Private Key: What It Is, How It Works, and Best Ways to Store, 2025)*.

In the case of legal disputes in which an owner who has lost control over a cryptoasset wishes to regain control over it, the general personal law of the owner of the cryptoasset (without taking control into account) should be followed.

Similarly to the fourth conflict of laws rule, the personal law for a legal entity should be

determined by the place of registration of that entity, and for a natural person, by their nationality.

In our opinion, this structure of conflict of laws rules will contribute to the overall regulation of cryptoasset circulation.

However, it should be noted that it is also necessary to identify a special conflict of laws rule for the personal law of a cryptoassets service provider involved in the custody and administration of cryptoassets on behalf of customers. Since generally the relevant service providers can only perform their functions in the form of legal entities, the law of the place of registration of such legal entities will apply, rather than the general conflict of laws rules proposed above.

**Conclusions.** Having defined the conflict of laws rules applicable to property relations concerning cryptoassets in general, we can conclude to what extent they can be applied to cryptoassets that are issued and placed for the purpose of raising capital.

With regard to the actual issuance of cryptoassets, we do not observe any legal issues, since the issuance of cryptoassets is a purely technical aspect that cannot be regulated.

The situation is different with the placement of cryptoassets. Since the placement must be carried out by a person making an offer in a particular country, a rule should be introduced to apply the law of the authority where the whitepaper and marketing communications are registered.

In other words, the placement will take place in accordance with the law of the state to whose regulatory authority all necessary documents are submitted for the purpose of admitting the cryptoasset to placement.

However, with regard to the further circulation of cryptoassets after their placement, the hierarchy of general rules for cryptoassets that we have already proposed will apply:

1) The principle of autonomy of the parties' will;
2) The principle of autonomy of the issuer's (developer's) will;
3) The principle of autonomy of will with regard to a decentralised network;
4) The personal law of the issues (the person making the offer); or
5) The personal law of the owner of the cryptoasset;

Finally, the personal law of the service provider related to the custody and administration of cryptoassets on behalf of customers will also serve as a special conflict-of-law rule for such particular case.

As a result, we have presented structured conflict-of-law rules that can be used to resolve issues of applicable law in property relations involving cryptoassets with and, separately, in relation to the placement of cryptoassets for the purpose of raising capital and their subsequent circulation with the existence of foreign element (or when the parties wish to apply special law).

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**THE CURRENT STATE OF COOPERATION BETWEEN CHINA AND PAKISTAN IN THE FIELD OF SPACE EXPLORATION**

**АКТУАЛЬНИЙ СТАН СПІВПРАЦІ КИТАЮ ТА ПАКИСТАНУ В СФЕРІ ДОСЛІДЖЕННЯ КОСМІЧНОГО ПРОСТОРУ**

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***Abstract.*** *The article analyzes the cooperation between China and Pakistan in the field of space research at the present stage from the perspective of the dynamic development of a comprehensive partnership between the two countries. The paper identifies the main institutions of both countries responsible for space cooperation and the level of their interaction in the exchange of experience and technological developments. The study contains examples of relations between the private and public sectors of the Chinese and Pakistani economies in the field of space technology. In combination with an institutional and systemic approach, methods of analysis, content analysis, and comparison were used to study space issues in relations between China and Pakistan. China remains the main base for launches of Pakistani orbital satellites, which indicates a certain imbalance in the level of infrastructure development. Meanwhile, 2026 has every chance of becoming a period of another breakthrough in the space dimension of the China-Pakistan partnership.*

***Keywords:*** *Space Silk Road, China-Pakistan space cooperation, SUPARCO, CNSA, lunar exploration, satellite launch, space station.*

***Анотація.*** *У статті аналізується співпраця між Китаєм і Пакистаном у галузі космічних досліджень на сучасному етапі з точки зору динамічного розвитку всебічного партнерства між двома країнами. У роботі визначено основні установи обох країн, відповідальні за космічну співпрацю, та рівень їх взаємодії в обміні досвідом і технологічними розробками. Дослідження містить приклади відносин між приватним і державним секторами економік Китаю та Пакистану в галузі космічних технологій. У поєднанні з інституційним та системним підходом для вивчення космічних питань у відносинах між Китаєм і Пакистаном були використані методи аналізу, контент-аналізу та порівняння. Китай залишається основною базою для запусків пакистанських*

*орбітальних супутників, що свідчить про певний дисбаланс у рівні розвитку інфраструктури. Водночас 2026 рік має всі шанси стати періодом чергового прориву в космічному вимірі партнерства між Китаєм і Пакистаном.*

***Ключові слова**: Космічний шовковий шлях, Китайсько-пакистанська співпраця в сфері космосу, SUPARCO, CNSA, освоєння Місяця, запуск супутника, космічна станція.*

**Introduction.** The current state of relations between China and Pakistan is characterized by the rapid development of economic, political, and military partnerships. At the same time, both countries are doing significant work on technical and scientific development in the field of space research and exploration. China's global project, the New Silk Road or One Belt, One Road, gave rise to the Silk Road of Health during the COVID-19 pandemic, which involved cooperation with partners aimed at combating the consequences of the large-scale spread of the disease. Today, there is another branch of progress in this comprehensive project, namely the Space Silk Road, under which China is strengthening cooperation with other countries in the field of space exploration, including Pakistan. The results and achievements of this cooperation are already finding practical application, including in another project that was born as part of the Belt and Road Initiative, namely the China-Pakistan Economic Corridor.

**Purpose of the Study.** The article aims to examine the current state of cooperation between China and Pakistan in the field of space exploration, review the main structural units of both countries involved in this field, and the achievements that have been made in the process of interaction.

**Literature Review.** The structured research by Hassan Mujtaba and Dr. Usman W. Chohan, specialists at the Centre for Aerospace & Security Studies in Pakistan, serves as valuable literature in terms of substantive analysis of Chinese-Pakistani cooperation. Arooj Fatima Kazmi devotes considerable attention to Pakistan's progress in the space industry in her article "Pak-China Space Cooperation: Why it Fuels, Not Hinders, Pakistan's Space Autonomy," links this process, among other things, to the successful partnership with China and logically concludes that the joint lunar mission of both countries has the potential to become another milestone in the evolution of Pakistan's scientific and technical movement toward space exploration. The material by Chinese researchers Kuang-Ho Yeh and Ni Guihua was selected for the study as one of the works describing the connection between the Belt and Road Initiative and space cooperation between China and Pakistan.

**Methodology.** The heterogeneity of interactions between the public and private sectors and individual institutions established to work on space research in both countries became a prerequisite for applying a structural approach and institutional analysis, which primarily concerned Pakistan's Space and Upper Atmosphere Research Commission and China's National Space Administration. Content analysis was used to identify statements made by political and scientific figures as a description of the “rhetorical” side of Chinese-Pakistani cooperation in the field of space.

**Main Results of the Research.** Cooperation between China and Pakistan in the space sector has now taken on a more formal status following the establishment of the Space Silk Road initiative. Kuang-Ho Yeh and Ni Guihua claim that the Space Silk Road initiative began to take shape in 2014 and aims to identify prospects for the development of space exploration in countries participating in the One Belt, One Road project. Additionally, according to these scientists, it should promote cooperation between partner countries within the infrastructure project in matters of improving space technologies *(Kuang-Ho, Ni, 2023)*.

One of the main elements of the Space Silk Road is the gradual improvement of the BeiDou satellite system. Mohamad Zreik, a researcher at the Middle East Political and Economic Institute in Bucharest, in article defines the Space Silk Road as a logical element of the One Belt, One Road project *(Zreik, 2025).* He compares these processes to the logic that if, as part of the development of trade infrastructure, China creates momentum for the economies of the countries with which it works within the framework of the initiative, then space cooperation enables partners to improve their own space strategies.

For example, the importance of BeiDou satellites for Pakistan lies in the ability to obtain up-to-date images of agricultural areas *(CGTN, 2023)*, assess surface water levels, and obtain a tool for timely forecasting of natural disasters. Given the unstable climate situation in Pakistan and understanding the importance of agriculture for this country, the space sector can be identified as one of high value and relevance. The low level of urbanization and the inaccessibility of settlements in Pakistan are to some extent due to the country's complex landscape and necessitate the search for new tools to establish television, radio, and network communications across as much of the country as possible. In this regard, the Space Silk Road similarly serves as a tool for resolving the pressing complex issue of communications within the country.

Another researcher at the Centre for Aerospace and Security Studies, Ramsha Shahid, notes in her analysis of the development of the space sector in Pakistan that cooperation with China under the auspices of the China-Pakistan Economic Corridor project has also led to increased structural interaction between the two countries in the field of space research *(Shahid, 2023)*. Among other things, this led to the establishment of a direct partnership between Pakistan's Space and Upper Atmosphere Research Commission (SUPARCO) and China's National Space Administration (CNSA) in 2019.

The researcher also noted that the dominance of the private sector in Pakistan's space sector is currently promising, as it makes investing in potential projects much easier, thus creating a basis for future grants. For comparison, a researcher at the Area Study Centre for Africa, North and South America, Quaid-i-Azam University in Islamabad provides figures on the distribution of the private sector in China's space industry as of 2022. They were divided into four groups, which included: 14 companies that were linked to the public sector; 9 companies that had ties to the Chinese Academy of Sciences; the third group had 42 companies that did not receive any funding at all; and the last group included 13 companies that were involved only in communications satellites and were funded by the private sector *(Kalhoro, 2022).* At the same time, state-owned enterprises play an important role in China's aerospace sector and cooperation with partners, as the state-owned China Great Wall Industry Corporation (CGWIC) was involved in the design of communications satellites for Pakistan.

Another important institution within which China and Pakistan are gaining experience in cooperation in space exploration is the Asia-Pacific Space Cooperation Organization (APSCO). The organization was founded in 2008 with the aim of advancing cooperation in space technology and its peaceful application. Its membership includes a number of countries from different regions of the world: Bangladesh, China, Iran, Mongolia, Peru, Thailand, and Turkey *(Pollpeter, Anderson, Wilson, Yang, 2015).* The organization pays particular attention to cooperation between technical institutions that specialize in or actively participate in the development of space technologies, strategies, and general space research. On November 16, 2022, a memorandum of understanding was signed between APSCO and Hong Kong Aerospace Technology Group Limited (HKATG) *(Space News, 2022).* It should be noted that at the time of signing the memorandum, the head of APSCO was Jose Antonio Garcia Morgan, who also held the position of head of the Peruvian Space Agency. This, in turn, may serve as an example of cooperation between China and Pakistan on a global scale. On January 23, 2026, an APSCO delegation led by the organization's Secretary General Jiang Hui visited the Harbin Institute of Technology (HIT) and held a series of discussions on the institute's current achievements and prospects in the field of space research, noting the importance of international cooperation and the exchange of best practices *(HIT, 2026).*

With regard to lunar exploration, in 2022 China invited its partners in the Asia-Pacific region to participate with their own satellite projects, and as a result, Pakistan was accepted with its own satellite, iCUBE-Q. During the preparation process for the launch of this satellite, namely in 2023, Pakistan joined the work of the Chinese international lunar research station. Finally, Pakistan's lunar satellite iCUBE-Q was launched as part of China's Chang'e 6 lunar mission on May 4, 2024. Both countries had their own tasks in this mission: while China's Change 6 took on the task of directly collecting samples from the moon's surface, iCUBE-Q, equipped with two optical cameras, photographed the moon's surface, both as a separate object and in conjunction with the sun. The

Chinese National Space Administration assessed the mission as a complete success, with detailed images of craters and the moon's surface meeting the project's expectations. The images obtained were handed over by the Chinese side to the Pakistan embassy in China *(Chaudhary, 2024).*

On May 30, 2024, China launched a Long March-3B rocket into space, carrying the Pakistani satellite Paksat MM1 *(CGTN, 2024).* This satellite was designed as part of the Digital Pakistan initiative, and its main function is to provide Internet coverage to remote regions of the country *(MOFA, 2024).* However, M. M. Afnan, an expert at the University of Management and Technology Lahore, argues that the orbit assigned to the satellite intersects with the orbital path of Indian satellites, which in turn could lead to potential tensions in the region *(Afnan, 2024).*

For Pakistan, 2025 was not only a period of escalation with neighboring India and Afghanistan, but also a time of intensified cooperation with other countries in the field of space exploration. On January 14, in cooperation with technical institutes and organizations in the United States and Turkey, the PAUSAT-1 satellite was launched from the United States. On January 17, 2025, Pakistan launched its first domestically produced satellite, PRSC-EO1, from China. According to Shayan Jani, a researcher at the Centre for Aerospace and Security Studies (CASS), it is important to note that Pakistan is focusing on cooperation in the space sector not only with China, but also with the United States. He added that space remains a promising area for Pakistan in both civil and military terms .

Discussions on space cooperation between China and Pakistan remain relevant for ministerial-level dialogue. Commenting on China's Space Day celebrations on April 24, 2025, Amjad Ali, a senior official at the Space and Upper Atmosphere Research Commission of Pakistan, praised the work of the China National Space Administration, noting that the organization remains a leader in its field. Separately, on the importance of structural cooperation for both countries, he affirmed that «the CNSA-SUPARCO partnership strengthens intercultural dialogue, diplomacy, and peaceful cooperation, proving that shared dreams can unite peoples among the stars» .

On April 22, 2025, a similar meeting took place between the Prime Minister of Pakistan and the head of the Chinese space technology company Galaxy Space. The meeting included discussions with the Pakistan Space Agency and the Ministry of Information Technology and Telecommunications, which are actively involved in space exploration and development projects .

In August 2025, Shan Zhongde, head of the China National Nuclear Corporation and the China National Space Administration, met with Ahsan Iqbal, Pakistan's Minister of Planning and Development. In addition to nuclear energy issues, the parties discussed urgent achievements and plans in the field of space exploration. The Pakistani official noted that, in cooperation with China, Pakistan is making progress in various areas and outlined short- and long-term plans, including the launch of a Pakistani astronaut to the Chinese international space station in 2026 and the launch of a mission to the Moon in 2035 . For his part, the Chinese representative emphasized that China and Pakistan are equally satisfied with the progress of strategic relations, which are gradually becoming interdependent.

An additional example of cooperation between China and Pakistan in the satellite sector, which is also aimed at improving work on the China-Pakistan Economic Corridor, is the launch of the Kuaizhou 1A rocket on July 31, 2025, which carried a remote-controlled satellite *(China Daily, 2025).* Pakistan's Space and Upper Atmosphere Research Commission noted that the satellite's latest optical equipment has enabled more detailed observation of meteorological conditions and is a supporting factor in the development of joint projects between China and Pakistan.

On October 19, 2025, China launched its first Hyperspectral Satellite (HS-1), which is expected to advance the collection of data on meteorological conditions and the overall state of the environment. Commenting on the launch of the satellite, Pakistan's Minister of Foreign Affairs noted the high level of professionalism of the Chinese and Pakistani scientific and technical teams involved in the satellite project *(PMPUN, 2025).* Special emphasis was placed on the importance of launching the satellite for further improvement of the CPEC infrastructure project *(Ukrinform, 2025).*

Pakistan's fundamental strategy for space exploration today is “Space Vision 2040,” also

known as Vision 2047, which declares the intention to launch 11 satellites of various specializations and to launch a Pakistani cosmonaut under the auspices of a joint mission in cooperation with China *(Yasmin, Malik, Mustafa, 2023).* With regard to the regulatory framework for cooperation between China and Pakistan in space, it is worth noting Pakistan's National Space Strategy, the latest edition of which was published in 2024. Paragraph 4.7, "International Cooperation and Collaboration" of the "Thrust Areas" section states that Pakistan will use all possible instruments of bilateral and multilateral cooperation to further space exploration, improve existing technologies, and exchange information with its partners in this field *(SUPARCO, 2024).* A year earlier, in 2023, the Pakistani government published the "Space Policy of Pakistan," which outlined the main objectives of the future space exploration strategy, including the promotion of joint ventures and projects with international partners for missions and research initiatives *(MOFA, 2023).*

China's latest relevant document, or white paper, on space was published in 2022 and focused mainly on achievements in the period 2016-2021 *(The state council of PRC, 2022).* Nevertheless, it outlined the main goals for the next five years in terms of space exploration, namely: the introduction of new technologies, intensification of research on the Moon's poles, and the development of infrastructure for further launches. A separate point was made about achievements in the space sector, where attention was paid to cooperation with Pakistan, in particular joint satellite launches. Among the official documents published by the China National Space Administration, the announcement of a competition for a project to join the Chinese mission to launch an orbital module to Mars stands out in particular *(CNSA, 2025).* The section describing international cooperation within the framework of this mission proclaims openness to the global community and the intention to cooperate with institutions in other countries, so it is quite likely that in the near future we will see a Pakistani proposal for a joint launch of a module to Mars.

Arooj Fatima Kazmi, a researcher at the Pakistani Strategic Vision Institute, notes in her analysis that cooperation with China in space exploration is important for Pakistan and does not make it dependent on China, as it gives the country a choice of which partner to intensify cooperation with in a particular field. Moreover, he notes the importance of the planned Chinese-Pakistani mission to the Moon in 2028, which could further strengthen Pakistan's status as China's strategic partner in space *(Kazmi, 2025).* Another example of China's positioning as Pakistan's partner in space is the first Pakistani astronaut, Namira Salim. In his response to Xinhua on November 22, 2023, he noted that China remains Pakistan's main partner in helping to improve its space program, while highlighting previous experience in sharing technology and expertise in other areas *(Xinhua Silk Road Information Center, 2023).*

At the same time, researchers at the Pakistani Center for Aerospace and Security Studies noted that Sino-Pakistani cooperation in space contains a certain number of contradictions that could weaken the overall potential for cooperation *(Mujtaba, Chohan, 2021).* In addition to Pakistan's underdeveloped cooperation base, there were also concerns about the potential deterioration of relations with the United States and European countries, as China's main competitors, and the prospect of falling into a debt trap resulting from the uneven development of partners in the space sector.

Nowadays, the training and dispatch of a Pakistani astronaut to the Chinese international space station remains a pressing issue. On February 28, 2025, Pakistan and China reached a final agreement on sending a Pakistani representative to the space station *(Radio Pakistan, 2025).* The head of Pakistan's space agency noted that this flight will aim to strengthen the scientific potential of countries and gain experience in space exploration for future generations. For his part, Pakistan's Minister of Information and Broadcasting Attaullah Tarar expressed hope that the cosmonaut's flight would take place within a year, adding that the Pakistani government pays regular attention to the field of space research *(The Nation, 2025).*

On February 7, 2026, the media department of the Pakistani Armed Forces announced that two candidates would be selected to undergo six months of training at the Chinese Astronaut Training Center, but only one astronaut would be admitted to the mission *(Arab News, 2026).* As part of the mission, the selected candidate will conduct scientific research and assume the duties of

a crew member of the Tiangong space station *(Muslim Network, 2026)*.

**Conclusions.** Based on the information presented above, it can be concluded that cooperation between China and Pakistan in the space sector is quite active and stable in its dynamics. A technological partnership has been established between the two countries, which promotes further exploration of space among scientific communities. The experience gained from joint work between space agencies, organizations, and agencies of both countries is also an important indicator, giving the "space" aspect of cooperation between China and Pakistan synonymity with other areas of cooperation. At present, we do not see any examples of political escalation in the region due to space incidents and organizational conflicts. However, given the dynamic turbulence in the global political arena, it is possible that such incidents could occur in the future.

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# CHARACTERISTICS OF THE QUALIFICATION OF THE CRIME OF ILLEGAL ACQUISITION OR DISCLOSURE OF INFORMATION CONSTITUTING A COMMERCIAL SECRET WITHIN THE SYSTEM OF CRIMES CAUSING UNFAIR COMPETITION

# ХАРАКТЕРИСТИКА КВАЛІФІКАЦІЇ ЗЛОЧИНУ НЕЗАКОННОГО ОТРИМАННЯ АБО РОЗГОЛОШЕННЯ ІНФОРМАЦІЇ, ЩО СТАНОВИТЬ КОМЕРЦІЙНУ ТАЄМНИЦЮ, У СИСТЕМІ ЗЛОЧИНІВ, ЯКІ СПРИЧИНЯЮТЬ НЕДОБРОСОВІСНУ КОНКУРЕНЦІЮ

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***Abstract:*** *Although the phenomenon of "crimes causing unfair competition" is not explicitly expressed in the criminal legislation of many countries, this concept, which is included in the legislation of certain countries, including the Republic of Turkey, defines the scope of crimes related to unfair competition. In this context, there has arisen a need to classify the chapter of "crimes causing unfair competition" within the criminal law provisions on crimes in the field of economic activity and to determine the range of crimes that belong to this group.*

*In the chapter on crimes in the field of economic activity in the Special Part of the Criminal Code of the Republic of Azerbaijan, the crime of illegal acquisition or disclosure of information constituting a commercial secret is particularly distinguished. Market participants protect information that has economic value related to their commercial activities and possesses confidentiality characteristics by establishing a commercial secret regime for it in one form or another. Actions aimed at acquiring such information by other competing market participants through various means can cause significant harm to the subjects to whom the commercial secret belongs. The qualification and the analysis of the criminal-legal characteristics of the crime of illegal acquisition or disclosure of information constituting a commercial secret, as one of the acts causing unfair competition, is one of the pressing issues of modern criminal law.*

*This article examines the place of the concept of "unfair competition" as a legal category in competition law and criminal law, the understanding of the concept of "commercial secret" in the legislation of different countries, the historical roots of this concept, the determination of the range of information constituting a commercial secret, the place and criminal-legal characteristics of the crime of illegal acquisition or disclosure of information constituting a commercial secret in the criminal legislation of the Republic of Azerbaijan and other countries, the objective elements of this crime as expressed in the relevant legal norms, as well as the shortcomings in the way this act is formulated in criminal law. The article also provides proposals for amendments to the relevant criminal law provisions.*

***Keywords:*** *commercial secret, unfair competition, industrial espionage, document theft*

***Анотація:*** *Хоча явище «злочинів, що спричиняють недобросовісну конкуренцію» явно не відображене в кримінальному законодавстві багатьох країн, ця концепція, яка закріплена в законодавстві окремих країн, зокрема Турецької Республіки, визначає коло злочинів, пов'язаних із недобросовісною конкуренцією. У цьому контексті виникла потреба класифікувати розділ «злочини, що спричиняють недобросовісну конкуренцію» у кримінальному законодавстві щодо злочинів у сфері економічної діяльності та визначити перелік злочинів, що належать до цієї групи.*

*У розділі про злочини у сфері економічної діяльності Особливої частини Кримінального кодексу Республіки Азербайджан особливо виділяється злочин незаконного отримання або розголошення інформації, що становить комерційну таємницю. Суб'єкти ринку захищають інформацію, що має економічну цінність для їхньої комерційної діяльності та має конфіденційний характер, шляхом встановлення для неї режиму комерційної таємниці в тій чи іншій формі. Дії, спрямовані на отримання такої інформації іншими конкуруючими суб'єктами ринку різними способами, можуть завдати значної шкоди суб'єктам, яким належить комерційна таємниця. Кваліфікація та аналіз кримінально-правових ознак злочину незаконного отримання або розголошення інформації, що становить комерційну таємницю, як одного з діянь, що спричиняють недобросовісну конкуренцію, є одним із актуальних питань сучасного кримінального права.*

*У статті розглянуто місце поняття «недобросовісна конкуренція» як правової категорії в законодавстві про конкуренцію та кримінальному законодавстві, розуміння поняття «комерційна таємниця» в законодавстві різних країн, історичні витоки цього поняття, визначення кола інформації, що становить комерційну таємницю, місце та кримінально-правові ознаки злочину незаконного отримання або розголошення інформації, що становить комерційну таємницю, у кримінальному законодавстві Республіки Азербайджан та інших країн, об'єктивні ознаки цього злочину, як вони закріплені в відповідних правових нормах, а також недоліки у формулюванні цього діяння в кримінальному законодавстві. У статті також наведено пропозиції щодо внесення змін до відповідних норм кримінального права.*

***Ключові слова:*** *комерційна таємниця, недобросовісна конкуренція, промислове шпигунство, крадіжка документів*

**Introduction.** The qualification of the crime of illegal acquisition or disclosure of information constituting a commercial secret, as set out in the chapter on crimes in the field of economic activity in the Criminal Legislation of the Republic of Azerbaijan, is one of the current issues in criminal law, including in the theory of criminal law.

According to Article 202 of the Criminal Code of the Republic of Azerbaijan, the illegal acquisition or disclosure of information constituting a commercial or banking secret gives rise to criminal liability when committed under the conditions specified in the provisions of that Article *(Azərbaycan Respublikasının Cinayət Məcəlləsi, 2025).*

This crime is one of the innovations in the criminal legislation of the Republic of Azerbaijan. In a market economy, each business entity can suffer significant harm if its technical and production-related information, which is unique to it, is illegally obtained and used by competing business entities. In this regard, the inclusion in criminal legislation of provisions establishing criminal liability for acts of illegal acquisition and disclosure of information constituting a commercial secret is an important step in protecting the interests of market participants *(Azərbaycan Respublikasının Cinayət Məcəlləsinin Kommentariyası, 2023).*

**The purpose of this article** is to analyze the criminal-law characteristics of the act of unlawfully obtaining and disclosing commercial secrets as one of the crimes causing unfair competition, to introduce and interpret the concept of "crimes causing unfair competition" into the criminal legislation of Azerbaijan on the basis of a comparative analysis of Azerbaijani and Turkish legislation, and to propose relevant amendments to the criminal legislation by identifying and explaining the shortcomings of the criminal act under consideration.

**Literature review.** Since the mentioned act is one of the innovations of the criminal legislation of the Republic of Azerbaijan and the definition of "crimes causing unfair competition" does not exist in Azerbaijani criminal legislation, no research has been conducted in Azerbaijani criminal law doctrine regarding these acts. Therefore, this topic is a novelty not only for criminal legislation but also for the Azerbaijani criminal law doctrine. From this perspective, the normative and doctrinal interpretation of the crime of unlawful acquisition and disclosure of commercial secrets, as well as the analysis of existing problems in this field, constitutes an important object of research for Azerbaijani criminal legislation.

In contrast to Azerbaijani criminal doctrine, this issue has been widely studied in Turkish legal doctrine, and a number of scholarly works have been written in this field. As an example, reference can be made to Hüseyin Aydın's scholarly work *"Türk Ticaret Kanunu'nda Haksız Rekabet Suçları"* (2008). In this work, the author separately examined, for each crime, issues such as the subject, legal object, subjective aspect, unlawfulness, special forms of manifestation of the crime, the victim, and prosecution, and also studied the general characteristics of crimes causing unfair competition.

In addition, in Esin Esen's dissertation titled *"TTK'da Düzenlenen Haksız Rekabet Suçları"* (2023), civil law and criminal law were analyzed together. Due to the adoption of provisions on unfair competition from Swiss law, comparative scholarly research in this field was conducted with regard to Turkish and Swiss law, and, taking into account the wide geographical impact of unfair competition, regulations of international law were also addressed.

In the scholarly work titled *"TTK Md. 62/I-b, c, d Kapsamında Haksız Rekabet Suçları"* (2019), Ozan Can Özbalçık analyzed the criminal-law characteristics of crimes of unfair competition contained in the Turkish Commercial Code, including acts aimed at the disclosure or acquisition of trade secrets.

In the article authored by Kayıhan İçel, titled *"Ticari Sır, Bankacılık Sırrı veya Müşteri Sırrı Niteliğindeki Bilgi veya Belgelerin Açıklanması Suçları – Bu Tür Sırlarla İlgili Bilgi İstenmesinin Sınırları"* (2010), the issue of the protection of commercial secrets, banking secrets, and customer secrets by criminal law norms was examined. First, the provisions existing in Turkish legislation were analyzed and some of them were criticized; subsequently, the draft law regulating this issue was interpreted, and the positive and negative aspects of that draft were analyzed.

**Main Results of the Research.** Before beginning the analysis of the criminal-law characteristics of the act under consideration, it is essential to clarify the concept of "commercial secret" as an economic and legal category. According to the definition of commercial secret in legislation, a commercial secret refers to information related to the production, technological, managerial, financial, or other activities of legal and natural persons, which may harm their lawful interests if disclosed without the owner's consent *("Kommersiya sirri haqqında" Azərbaycan Respublikasının Qanunu, 2001).*

Although Article 55 of the Turkish Commercial Code lists "disclosing or inducing others to obtain commercial secrets" among acts causing unfair competition, the Code does not provide a specific definition of commercial secret. Instead, the concept is addressed in Article 62 of the Code together with production secrets. One notable point regarding the concept of commercial secret is that neither legislation nor doctrine provides a clear definition; the difficulty of defining the concept is noted, and its content is generally determined by listing its elements *(Türk Ticaret Kanunu, 2011).*

As a legal category, the initial foundations of the concept of "commercial secret" were formed in 1868 in the case of *Peabody v. Norfolk* in Massachusetts, USA. Over time, this concept spread to other states and was later regulated by a law intended to be in force in all states in 1979. The court concluded that an employee or any third party's illegal acquisition and use of production secrets belonging to an employer constitutes unfair competition. This case laid the doctrinal foundation for the concept of commercial secret, which later found its place in legislation and judicial practice *(Chan, 2024).*

In American law, this concept has been developed extensively. It has been noted that intellectual property objects such as brands, models, patents, and licenses can be protected as trade secrets, as well as all matters of economic value within an enterprise that may be valuable in the

future. The economic nature of a trade secret is characterized by its protection as an object of property rights *(Özbalçık, 2019).*

Different legal regulations provide various definitions of trade secrets. For example, according to Section 4 of the first chapter titled "Definitions" of the Uniform Trade Secrets Act, which is intended to be applied interstate, a trade secret is a formula, pattern, compilation, program, device, method, technique, or process that: is not generally known to others and cannot be readily obtained by lawful means; has actual or potential independent economic value; and is subject to reasonable efforts to maintain its secrecy, where disclosure or use could result in economic benefit to those who obtain it *(Uniform trade secrets act, 1986).*

Other legal regulations have defined the concept in roughly the same way, showing only minor differences in scope. For example, in the 1995 *Restatement (Third) of Unfair Competition*, a commercial secret is defined as any information that can be used in the operations of a business entity and that has value to the extent that it provides a factual or potential economic advantage over others *(Restatement (Third) of Unfair Competition, 1995).*

As can be seen from the definitions of commercial secret in the cited legal acts, in U.S. law a commercial secret is characterized by information arising from the operations of a business enterprise, the primary purpose of legal protection being the economic value that such information confers. That is, information containing elements of a commercial secret within a business enterprise and whose confidentiality provides an economic advantage is considered within the scope of a commercial secret.

In Turkish law, as noted above, the concept of a commercial secret is mainly defined in the context of acts that cause unfair competition. Currently, Turkish legislation does not contain a legal regulation that defines the concept of a commercial secret. However, for the first time, the *Draft Law on Commercial Secrets, Banking Secrets, and Client Secrets* (which has not yet entered into force) provides a definition of a commercial secret. According to this draft law, a commercial secret is information related to a company's field of activity, known only to a limited number of members and other employees, which could cause harm if obtained by competitors, must not be disclosed to third parties or the public, and is of great importance for the company's success and efficiency in economic activity. This includes internal structure and organization, financial, economic, credit and monetary conditions, research and development activities, operational strategy, sources of raw materials, technical characteristics of production, pricing policies, marketing tactics and costs, market shares, wholesale and retail customer potential and networks, contractual relations subject to authorization or otherwise, and similar information and documents.

Although the cited legal acts do not provide a separate definition of "secret," in the scientific literature (doctrine) the term is generally defined as: "information not known to everyone, the disclosure of which could harm the personal rights and interests of the concerned party," or "information not publicly available, known only to certain persons, whose secrecy must be maintained" *(İçel, 2010).*

As can be seen, the main point emphasized in definitions of commercial secret is that such information must relate to production or technological activities concerning goods (works or services) offered by a business entity to the market and must have economic value. In other words, the dissemination of such information in any form must result in harm to the interests of the market participant.

As the name of the crime under analysis indicates, the object of this crime is the commercial secret. Although normative and doctrinal explanations exist regarding the concept and essence of a commercial secret, determining the precise scope of information that constitutes a commercial secret is critically important for holding a person criminally liable under this offense.

The question of whether information can be considered the object of a crime has been debated in the academic community for many years. N. F. Kuznetsova noted that the object of a crime "consists of different types of material and non-material values, capable of meeting human needs, and whose criminal influence (or illegal use) can cause harm or create a risk of harm" *(Полный курс уголовного права, 2008).* From this, it can be concluded that information can be considered a non-

material object of a crime.

However, according to Article 202 of the Criminal Code, the object of this crime consists only of documents containing commercial or banking secrets—i.e., material carriers of information. At the same time, criminal legislation does not provide a legal definition of the term "document," which creates certain difficulties in the correct qualification of the crime. We believe that such an explanation defines the object of the crime too narrowly.

Thus, the theft of documents as a method of collecting information constituting a commercial or banking secret should be understood broadly, to include both documents and other information carriers.

The Law of the Republic of Azerbaijan "On Commercial Secrets" sets out the criteria for information to be considered a commercial secret. According to these criteria, for information to be classified as a commercial secret, it must meet the following requirements:

- It has commercial value (its secrecy provides an advantage in the field of activity and allows for profit; it may be sold, donated, transferred by contract, or inherited, in whole or in part);
- The owner takes legal, organizational, technical, and other measures to protect its confidentiality;
- Access to this information is legally restricted *("Kommersiya sirri haqqında" Azərbaycan Respublikasının Qanunu, 2001).*

It should also be noted that Article 4 of the same Law, titled "Information Considered as Commercial Secret," actually defines information that is not considered a commercial secret.

As can be seen, although criteria for determining whether information constitutes a commercial secret are set, the legislation does not specify which information is considered a commercial secret.

In general, when explaining the essence of the category of commercial secret, it can be concluded that it is impossible to determine the exact scope of such information. Each market participant has the exclusive right to classify as a commercial secret the information arising from its activities that has economic value and to establish the regime for such information.

In this regard, when holding a person criminally liable for illegally obtaining or disclosing information constituting a commercial secret, it is first necessary to determine whether the information in question falls within the scope of a commercial secret.

Regarding the direct object of the crime, there are various opinions in criminal law theory. For example, T. D. Ustinova argues that the direct object of this crime is the social relations that ensure the protection of intellectual property and information security of participants in economic relations *(Устинова, 2005).*

Furthermore, the crime in question does not only harm fair competition relations but also interferes with the circulation of information constituting a commercial secret. Therefore, these relations should be considered an additional direct object of the crime.

Information constituting a commercial secret (production secret) refers to any information of a production, technical, economic, organizational nature, as well as results of intellectual activity in scientific and technical fields and methods of professional activity. This information is not known to third parties, is not freely accessible on a legal basis, and is protected under a commercial secrecy regime by its owner.

Thus, the main characteristics of a commercial secret are as follows:

1. It has real or potential commercial value because it is unknown to third parties;
2. It is not freely accessible on a legal basis;
3. The owner takes measures to protect its confidentiality;
4. The specific list of information constituting the commercial secret is determined by the head or owner of the enterprise;
5. This information is not included in the list of state secrets or information whose access cannot be restricted.

Objectively, this act is characterized by two constituent elements. Simply obtaining information that constitutes a commercial secret is not sufficient for criminal liability. The

information must be collected specifically for the purpose of dissemination or unlawful use. As can be seen, the intent is reflected as a necessary element of the subjective side of the crime in the provision of the Article.

Another necessary element of this offense is the methods of committing the crime. The collection of information constituting a commercial secret through theft of documents, purchase, threatening the person possessing the secret, or other illegal methods gives rise to criminal liability.

A similar norm exists in Turkish criminal law, stating that a person who, due to their position, profession, or trade, provides or discloses commercial secrets, banking secrets, or client secrets to unauthorized persons is subject to criminal liability.

As can be seen, Turkish Penal Code defines a specific subject of the crime for the act of disclosing information constituting a commercial secret. According to this provision, criminal liability applies to the person who, by virtue of their position, profession, or trade, possesses information and provides it to persons who are not authorized to obtain it *(Türk Ceza Kanunu, 2004).*

Another distinction of the Turkish law is that the provision imposing liability explicitly mentions not only information constituting a commercial secret but also the "disclosure of documents". In contrast, under the Criminal Code of the Republic of Azerbaijan, liability is provided only for the acquisition and disclosure of information, not documents. However, Article 202 of the Criminal Code considers "theft of documents" as a necessary element of the objective side of the crime.

From the perspective of the objective side, this composition is formal. That is, the crime is considered completed from the moment the acts constituting its objective side are initiated, regardless of their consequences.

Criminal law theory provides various definitions of "collection of information constituting a commercial secret." For example, B.V. Voljenkin notes that: "The concept of collection includes the theft of documents and other carriers of commercial secrets; obtaining the secret (or attempting to do so) from the owner or their relatives through bribery or threats; interception of information via communication channels; unlawful access to documents or making copies of them; use of listening devices and other special technical means; unauthorized access to computer systems; and other illegal methods" *(Волженкин, 2007).*

As can be seen, B.V. Voljenkin attempted to specify as concretely as possible the methods of collecting information.

Other authors, however, avoid specifying these collection methods and provide broader definitions. For example, A. F. Zhigalov interprets the concept of "collection" as "any method of illegally obtaining such information" *(Жигалов, 2000).*

The theft of documents constituting a commercial secret should be understood as the illegal and uncompensated taking of information carriers (materials containing commercial secrets) against the will of the owner or a person legally entitled to access them. Theft can be carried out secretly or openly, through the use of force or deception against persons possessing the commercial secret, or by other methods.

In legislation, the term "threat" is neither legally defined nor is the scope of persons against whom the threat is directed specified. This leads to various interpretations of the term. The term "threat" encompasses not only intimidation through psychological coercion but also threats of physical harm, murder, destruction, damage, or theft of property.

Thus, in relation to Article 202(1) of the Criminal Code, "threat" should be understood as any unlawful influence directed at persons possessing commercial or banking secrets (or those legally entitled to access them), as well as their relatives, indicating that negative consequences will occur if they refuse to provide the information. When the crime is committed in this form, the act is considered complete from the moment the threat is communicated to the targeted individuals.

It should also be noted that the execution of the threat is not included within the scope of the analyzed criminal law norm. That is, the use of real physical force or other physical impacts, such as damaging property, to carry out the threat must be additionally qualified under the relevant articles of the Criminal Code.

As a method of committing the crime, the term "other illegal method" should be understood as the collection of confidential information by any means that does not comply with legal forms of access provided by law.

One term used in the scientific literature to describe the illegal acquisition of commercial secrets is commercial espionage. Classic examples of commercial espionage can be found in historical records dating back to the earliest periods of human civilization. One of the most famous examples is found in Chinese chronicles. According to the sources, when a Chinese prince traveled abroad, he wore a magical hat decorated with natural flowers, in which he hid silkworms. He later gave the worms to an Indian, thereby breaking China's monopoly on silk production. This is a classic example of commercial espionage dating back to approximately the 15th century BCE *(Бержье,1972)*.

Throughout history, commercial espionage has been considered one of the most dangerous forms of unfair competition, and civilized countries' legislation has imposed criminal liability for espionage.

For many enterprises, it is common practice to conduct competitive intelligence, which can be carried out by legal and illegal means, aiming to obtain information of commercial value. Legal competitive intelligence involves lawful methods, such as marketing research, analysis of market dynamics and competitors' development prospects, analysis of competitors' financial and productivity data, modeling, and forecasting.

The goal of illegal competitive intelligence, often referred to as commercial espionage, is to obtain confidential information of commercial value that provides certain advantages in the market relative to competitors. A characteristic feature of this activity is the use of unlawful methods to achieve the objective, which infringes upon the rights and lawful interests of other business entities.

In modern economic practice, the role of commercial espionage has increased significantly. Currently, in most large companies, there are specialists or entire departments engaged in the collection, systematization, and analysis of information about competitors, as well as the theft of industrial and commercial secrets and documents. The social danger of this act lies in the fact that the illegal disclosure of commercial secrets can cause serious economic damage to an organization and weaken its commercial potential. Therefore, combating commercial espionage — one of the most socially dangerous forms of unfair competition — should primarily be carried out through criminal-law measures.

One of the most important characteristics of information constituting a commercial secret is that the owner takes measures to protect its confidentiality. It should also be noted that, in terms of commercial value, there are many protective measures that can be applied, but the owner is not obliged to implement all possible measures. What matters is that the owner clearly demonstrates through their actions that the information should remain confidential from third parties. Otherwise, legal protection of the rights of the owner of information constituting a commercial secret becomes impossible.

This situation can be illustrated by a classic example from foreign court practice concerning commercial espionage. In 1987, a Michigan court rejected a commercial espionage claim filed by the "Cadillac Gage" company — specialized in producing armored vehicles for U.S. Army special units and military police — against a competitor, alleging the theft of valuable schematics. The court justified its decision on the grounds that the plaintiff had not taken sufficient measures to protect its commercial secrets. During the trial, it was revealed that the "Cadillac Gage" production facilities were not considered secure and were frequently left open, while the valuable schematics were always left on desks. A competitor's employee exploited this carelessness, entered the factory during working hours, photographed the schematics, and then left the premises.

**Conclusions.** Thus, the above example suggests that the commission of the crime of disclosure of information constituting a commercial secret results in interference with market competition relations, creating unfair competition in the market.

In the criminal legislation of the Republic of Azerbaijan, the terms of the provision describing this act should be adjusted in accordance with doctrinal approaches and the requirements of relevant

normative acts. In addition, the terms of the provision should be amended to reflect the essence of the information constituting a commercial secret as the object of this crime.

Furthermore, considering the increasing pace of development in economic relations, it is necessary to clarify the phrase “without the consent of the entrepreneur” in Article 202.2 of the Criminal Code, so that it corresponds accurately to the circle of persons who legally possess the information.

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# ASEAN TOURISM AGREEMENT: REGIONAL INTEGRATION, SOFT POWER, AND THE TRANSFORMATION OF INTERSTATE RELATIONS

# ТУРИСТИЧНА УГОДА АСЕАН: РЕГІОНАЛЬНА ІНТЕГРАЦІЯ, М'ЯКА СИЛА ТА ТРАНСФОРМАЦІЯ МІЖДЕРЖАВНИХ ВІДНОСИН

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***Abstract.*** *This article analyzes the impact of the ASEAN Tourism Agreement on interstate relations and regional cooperation within the Association of Southeast Asian Nations (ASEAN). Over the past decades, the region has become one of the most dynamically developing tourist destinations in the world, leading to the growing importance of tourism not only economically but also politically. The ASEAN Tourism Agreement has become an important tool for stimulating the liberalization of tourist flows, strengthening the interdependence of ASEAN member countries, and shaping common tourism policies.*

*The article examines how this document facilitates the political and economic integration of ASEAN countries and how tourism is used as a soft power tool to strengthen interstate cooperation. The author analyzes the institutional, political, and economic factors that contributed to the adoption of the Agreement, as well as its impact on population mobility, cultural integration, and economic interdependence in the region.*

*Particular attention is paid to the role of the Agreement in diplomatic cooperation and changing power dynamics within ASEAN. The article concludes that the Tourism Agreement has a significant impact on the development of integration processes in ASEAN, stimulating not only economic ties but also creating new political mechanisms for sustainable regional interaction. The development of tourism within ASEAN is becoming an important factor in the transformation of interstate relations. For many years, the countries of the region have been striving to improve not only their economic performance, but also the level of trust and mutual understanding among themselves. The Tourism Cooperation Agreement plays an important role in this process.*

*Tourism cooperation also helps reduce tensions between states and strengthen diplomatic ties. Amid global competition for the tourism market, ASEAN countries recognize the importance of cooperation and integration in this area to ensure the competitiveness of the region as a whole. Moreover, tourism serves as an important tool for intercultural dialogue. Countries that actively develop their tourism industries achieve greater mutual understanding, which helps reduce the risk of interstate conflict and fosters peaceful coexistence.*

*One of the striking examples is the creation of joint tourism projects such as the ASEAN Heritage Parks, which includes natural and cultural monuments spanning several countries in the region. Such projects contribute not only to the conservation of natural and cultural resources, but also to the formation of a common tourism brand in the region.*

***Keywords:*** *tourism agreement, interstate relations, regional integration, soft power, economic interdependence, cultural integration, population mobility*

***Анотація.*** *У цій статті аналізується вплив Угоди АСЕАН про туризм на міждержавні*

*відносини та регіональну співпрацю в рамках Асоціації держав Південно-Східної Азії (АСЕАН). Протягом останніх десятиліть регіон став одним з найбільш динамічно розвиваючихся туристичних напрямків у світі, що призвело до зростання значення туризму не лише в економічному, а й у політичному плані. Угода АСЕАН про туризм стала важливим інструментом для стимулювання лібералізації туристичних потоків, зміцнення взаємозалежності країн-членів АСЕАН та формування спільної туристичної політики.*

*У статті розглядається, як цей документ сприяє політичній та економічній інтеграції країн АСЕАН та як туризм використовується як інструмент м'якої сили для зміцнення міждержавної співпраці. Автор аналізує інституційні, політичні та економічні фактори, що сприяли прийняттю Угоди, а також її вплив на мобільність населення, культурну інтеграцію та економічну взаємозалежність у регіоні.*

*Особлива увага приділяється ролі Угоди у дипломатичному співробітництві та зміні динаміки сил в АСЕАН. У статті робиться висновок, що Угода про туризм має значний вплив на розвиток інтеграційних процесів в АСЕАН, стимулюючи не лише економічні зв'язки, а й створюючи нові політичні механізми для сталої регіональної взаємодії. Розвиток туризму в рамках АСЕАН стає важливим фактором трансформації міждержавних відносин. Протягом багатьох років країни регіону прагнуть покращити не лише свої економічні показники, але й рівень довіри та взаєморозуміння між собою. Угода про співробітництво в галузі туризму відіграє важливу роль у цьому процесі.*

*Співпраця у сфері туризму також допомагає зменшити напруженість між державами та зміцнити дипломатичні зв'язки. В умовах глобальної конкуренції за туристичний ринок країни АСЕАН визнають важливість співпраці та інтеграції в цій сфері для забезпечення конкурентоспроможності регіону в цілому. Більше того, туризм слугує важливим інструментом міжкультурного діалогу. Країни, які активно розвивають свої туристичні галузі, досягають більшого взаєморозуміння, що допомагає зменшити ризик міждержавних конфліктів та сприяє мирному співіснуванню.*

*Одним із яскравих прикладів є створення спільних туристичних проектів, таких як Парки спадщини АСЕАН, що включають природні та культурні пам'ятки, що охоплюють кілька країн регіону. Такі проекти сприяють не лише збереженню природних та культурних ресурсів, але й формуванню спільного туристичного бренду в регіоні.*

***Ключові слова:*** *угода про туризм, міждержавні відносини, регіональна інтеграція, м'яка сила, економічна взаємозалежність, культурна інтеграція, мобільність населення*

**Introduction.** Over the last few decades, the ASEAN area has emerged as one of the tourist destinations with the fastest rate of growth in the world. It has also emerged as a major hub for the concentration of visitor flows that are crucial to the world's economy and society. However, the region's tourism collaboration extends beyond economic metrics; it is now one of the key instruments for bolstering ASEAN state integration, expanding political cooperation, and forming a sense of regional identity. In this sense, the ASEAN Tourism Agreement *(ATA, 2002)* is recognized as the first basic legal agreement enacted with the intention of liberalizing visitor flows, promoting regional interdependence, and regulating tourism based on a single policy within the organization.

However, the influence of the ATA on interstate relations has not yet been thoroughly examined at the academic level, especially with regard to its role in intra-regional political discourse, the use of soft power, mutual economic dependency, and institutional collaboration. Research questions such what drives the tourism industry’s expanding integration in a diverse region like ASEAN, what the agreement’s actual impact is, and how it affects member nations' political ties continue to be pertinent. This circumstance makes it necessary to look at the subject from both theoretical and practical angles.

The main question posed in this article is how the ASEAN Tourism Agreement influences interstate relations within the organization and to what extent it facilitates regional cooperation. In recent years, tourism has become an important part of the regional integration process within ASEAN, playing a significant role in creating a unified region with an open market and free

movement of people. Regional tourism initiatives help strengthen economic ties between countries, paving the way for further cooperation in other economic sectors, such as trade, technology, and education.

In this context, several research questions arise aimed at better understanding the impact of the ASEAN Tourism Agreement on interstate relations in the region. First, it is important to understand the institutional, political, and economic factors that necessitated the adoption of this agreement. What are the key elements of this agreement that facilitate integration among ASEAN countries? How does tourism cooperation help support soft power mechanisms in interstate relations? And how does the ASEAN Tourism Agreement influence population mobility, cultural integration, and economic interdependence in the region? Finally, it is necessary to understand the impact of this agreement on diplomatic cooperation and power dynamics within ASEAN.

In response to these questions, several hypotheses can be put forward. First, economic cooperation in the region is largely determined by the ASEAN Tourism Agreement, which compels member states to engage in political dialogue due to their growing dependence on the tourism industry. Second, interstate relations become more stable and beneficial by creating conditions for the development of soft power instruments and the formation of a common ASEAN brand. Third, long-term integration mechanisms are strengthened through regional activities carried out under the Tourism Agreement, such as marketing cooperation, visa facilitation, and the "ASEAN as One Destination" campaign. During crises such as the COVID-19 pandemic, tourism cooperation helps strengthen the impulse for collective action and improve coordination among ASEAN countries.

Therefore, the objectives of this article are to thoroughly explore the theoretical and empirical foundations of these hypotheses and to analyze the mechanisms underlying the Tourism Agreement's impact on interstate relations. The study's uniqueness lies in its analysis of the Agreement as a diplomatic and institutional instrument, rather than solely as an economic agreement, which will contribute to a deeper understanding of the role of tourism in shaping regional integration and strengthening ties among ASEAN member states.

The purpose of this article is to explore the impact of the ASEAN Tourism Agreement *(ATA, 2002)* on interstate relations and regional cooperation within the Association of Southeast Asian Nations. The article aims to analyze how tourism as a tool of "soft power" contributes to strengthening the political, economic and cultural integration of ASEAN countries, as well as how it affects the dynamics of diplomatic relations and economic interdependence in the region.

The research methods in this article include several approaches aimed at a comprehensive analysis of the impact of the ASEAN Agreement on Tourism on interstate relations and regional cooperation.:

1. Document Analysis: The study is based on a thorough analysis of the text of the ASEAN Agreement on Tourism *(ATA, 2002)* and other official documents related to ASEAN tourism policy in order to identify the main provisions, objectives and mechanisms for its implementation.

2. Qualitative analysis: The qualitative analysis method is used to study the impact of the Agreement on the political, economic and cultural aspects of ASEAN member countries' interaction. This includes an analysis of interviews, reports, publications, and other materials that illustrate the impact of tourism on interstate relations and integration in the region.

3. Comparative Analysis: A comparison method is used to study how the ASEAN member countries are affected by the Tourism Agreement compared to other international agreements in the field of tourism and regional integration.

4. Soft Power Analysis: A conceptual approach is applied to assess the role of tourism as a tool of soft power in ASEAN interstate relations, including assessing its impact on cultural identity, diplomatic ties, and regional security.

5. Case method: Concrete examples of successful initiatives and projects implemented under the Tourism Agreement are considered in order to demonstrate the real impact of this document on economic and cultural integration, as well as on population mobility.

6. Economic and Political analysis: The method of economic and political analysis is used to study the impact of the Agreement on the economic interdependence of ASEAN member countries,

as well as on changes in political dynamics and diplomatic relations within the organization.

These methods allow for a deeper understanding of the role of the Tourism Agreement in interstate relations, its impact on regional integration and the development of new forms of cooperation in ASEAN.

**Literature Review**. In recent decades, issues of regional integration and political cooperation in Southeast Asia have become increasingly pressing. In particular, ASEAN, as the region's primary organization, plays a central role in these processes, with a particular emphasis on developing the tourism industry as one of the integration mechanisms. Acharya (2014) emphasizes that ASEAN is characterized by "soft institutionalism", which entails maintaining a high level of sovereignty among member states while maintaining platforms for joint cooperation, which forms the basis for the development of numerous common initiatives, including in tourism.

The ASEAN Tourism Agreement, signed in 2002, as noted by the ASEAN Secretariat (2002), was an important step toward liberalizing tourism flows and strengthening economic interdependence among the region's countries. This agreement paved the way for the harmonization of visa procedures, improved infrastructure, and the creation of joint marketing campaigns, significantly contributing to the strengthening of ties and trust between member states. Additionally, the ASEAN Secretariat (2021) notes that tourism has become a critical element of the recovery strategy within the comprehensive COVID-19 recovery program, confirming its importance in the region's economic and social life.

Also of interest is the analysis of the economic and cultural aspects of tourism development in the region presented in Hall (2019). The author emphasizes that tourism development in Asia goes hand in hand with regional economic development, becoming an important tool for not only economic but also cultural integration, as evidenced by statistical data on the growth of tourist flows to ASEAN in recent decades. Meanwhile, a study by Gössling and Peeters (2015) addresses the global environmental impact of tourism and emphasizes the need for a sustainable approach to tourism development, which is also of great importance for ASEAN countries seeking to minimize environmental risks.

Cultural diplomacy, as a tool for enhancing the region's soft power, is also a key theme in the works of Caballero-Anthony (2016) and Kurlantzick (2010). Both authors emphasize that tourism in ASEAN is used not only for economic purposes but also to strengthen political and cultural ties between member states. This is evidenced by the implementation of initiatives such as cultural calendars, regional festivals, and other programs aimed at enhancing mutual understanding and strengthening the region's identity.

Furthermore, Narine (2008) highlights the significance of ASEAN in the context of its 40-year history, demonstrating how the organization has adapted to changes in global politics and economics while taking into account the region's internal dynamics. Within this approach, tourism, as part of a broader integration strategy, has become an important tool for the formation of a unified regional identity, which is now seen as a significant factor in political stability.

Tosun (2000) and Sharpley (2000) focus on the issues of local community participation in tourism and the sustainable development of this industry, which is relevant for ASEAN countries, where tourism is rapidly developing but sometimes faces problems of overexploitation of resources and insufficient involvement of local residents in decision-making processes. Importantly, similar issues are also discussed in the context of tourism sustainability in Asia, as confirmed by research by Rigg (2017), who examines social and environmental changes in rural areas directly related to rural tourism development.

Thus, although the ASEAN Tourism Agreement is primarily an economic document, it plays an important role in the broader context of political integration and cultural diplomacy. Chongkittavorn (2018) notes that the integration of the tourism industry within ASEAN has contributed to improved political relations and the creation of soft power mechanisms, which are key to stabilizing regional ties in the face of global challenges.

**Main Results of the Research.** Examining the organization's integration model and the foundations of regional institutionalism is key to understanding how the ASEAN Tourism

Agreement influences interstate relations. The ASEAN integration model, developed after independence, utilizes the principle of "soft institutionalism", as opposed to the traditional "deep institutionalization" characteristic of the European Union *(Acharya, 2014, p. 69).* Within this approach, the organization supports the idea of "decentralized coordination" in politically sensitive areas and creates adaptable platforms for cooperation, while granting member countries a significant degree of sovereignty (Caballero-Anthony, 2016, p. 88). This concept is also reflected in the ASEAN Tourism Agreement, which serves not only as an economic but also as a political instrument, creating the conditions for more flexible and balanced cooperation among regional states.

Tourism, as a strategic industry with "low political risk and high economic returns", has become a priority for ASEAN. It unites member states and becomes part of key regional documents such as the Economic Cooperation Framework Agreement (1992), ASEAN Vision 2020 (1997), and the Bali Agreement II (2003). Thus, the main factors that influenced the adoption of the ASEAN Tourism Agreement can be divided into three categories: economic motives, political integration, and cultural diplomacy. Economic motives include the significant growth in tourism revenues between the 1990s and 2000s, which significantly increased regional interdependence in this industry *(ASEAN Secretariat, 2002, p. 5).* Political integration became an important element of strategic interaction when ASEAN leaders recognized the need to strengthen regional unity in the face of global system uncertainty *(Narine, 2019, p. 414).* Cultural diplomacy and soft power gained significance in the context of creating a unified regional identity and strengthening the ASEAN brand in the context of a globalizing Asian region *(Kurlantzick, 2010, p. 107).*

Along with the liberalization of tourism flows, the ASEAN Tourism Agreement incorporates elements of political discourse and integration, exerting a multifaceted influence on interstate relations in the region. One notable effect is the stabilizing political impact, which is due to the expansion of economic interdependence between countries. Key provisions of the agreement include the harmonization of border controls, the simplification of visa requirements, the coordination of conditions for tourism investment, and the creation of the "ASEAN as a single destination" brand. These measures have contributed to an increase in domestic tourism, with the number of trips within the region increasing from 42 million to 105 million between 2002 and 2019 *(ASEAN Secretariat, 2020, p. 14).* Even amid political tensions, such as border and maritime clashes between Thailand and Cambodia, Singapore and Indonesia, and Malaysia and the Philippines, cooperation mechanisms have been maintained, which some scholars call the "ASEAN interdependence spillover effect" *(Rigg, 2017, p. 92).*

Developing regional identity and enhancing soft power have become some of the most powerful tools ASEAN uses in its interstate relations. Tourism, which promotes cultural integration, is an important element in the organization's soft power strategy. Regional festival programs, cultural calendars, educational exchanges, and branding initiatives (Feel the Warmth of ASEAN, Visit ASEAN Year) have significantly strengthened the positive political climate and contributed to the creation of a favorable environment for cooperation. This, in turn, strengthens trust between countries in the region, and the cycle of "cultural integration, political trust, and economic cooperation" has become the foundation of ASEAN's soft power strategy *(Chongkittavorn, 2018, p. 63).* This mechanism utilizes social capital to address problems arising from "weak institutionalization" in the region.

The ASEAN Tourism Agreement also serves as a tool for improving regional governance and diplomatic cooperation. It has facilitated more coordinated decision-making among member countries, engaging governments in in-depth discussions on issues related to border crossings, tourism safety standards, crisis management, and the exchange of statistical information. This cooperation was particularly evident in response to the challenges of the COVID-19 pandemic, when ASEAN jointly developed recovery plans through the "ASEAN Tourism Crisis Communications Team" and the "Pandemic Recovery Framework" *(ASEAN Secretariat, 2021, p. 3).* This cooperation has strengthened the institutional foundations of regional diplomacy.

A significant outcome of the ASEAN Tourism Agreement has been a significant increase in

human mobility within the region. Visa facilitation and harmonization of border procedures have facilitated a significant increase in inter-country travel, reducing the number of member countries requiring visas from ten to two since 2002 *(UNESCAP, 2019, p. 27)*. Such mobility not only stimulates interactions between students, researchers, and the business community, but also fosters ties between diasporas, enhances cultural fusion, and creates international business networks. This, in turn, leads to the strengthening of so-called "social diplomacy", where tourism serves as a channel for developing intercultural communication and deepening cooperation.

However, it should be noted that despite these achievements, the ASEAN Tourism Agreement has also led to increased "asymmetric interdependence" within ASEAN. Countries with more developed tourism infrastructure, such as Thailand, Malaysia, Singapore, and Indonesia, have gained greater influence in regional decision-making than less developed countries in the region, which nevertheless also benefit from joint tourism initiatives *(Hall, 2019, p. 112).*

Overall, the ASEAN Tourism Agreement has produced significant diplomatic results in three key areas: integrative, stabilizing, and normative. First, it improves coordination within the region, allowing countries to more easily align their actions across various areas. Second, it creates a stabilizing effect, ensuring open avenues for cooperation even in times of political tension. Third, the Agreement establishes common rules of conduct, shaping ASEAN as a normative space where tourism plays a vital role as an institution, fostering not only economic integration but also political and cultural harmony among the organization's member states.

**Conclusions.** The study shows that the ASEAN Tourism Agreement has a significant impact on interstate relations in the region not only in the economic realm but also in the political, social, institutional, and normative domains. The ATA has emerged as one of the key tools for integration within the ASEAN region, according to a thorough analysis of the research questions and hypotheses put forward at the beginning of the article.

The analysis's findings demonstrate that tourist collaboration is completely consistent with ASEAN's "soft institutionalism" model, and that the industry's "low political risk – high economic return" characteristics offer it more stable and long-term cooperation chances than other sectors.

In addition to increasing economic interconnectedness, the ATA framework's harmonization of border-crossing processes, collaborative marketing, creation of a regional brand, and simplification of visa regimes have also produced new forums for interstate political discourse.

The results of the study show that the ATA has significantly strengthened regional mutual reliance. Between 2002 and 2019, intraregional tourism flows more than doubled, creating long-lasting economic connections between states. In turn, these connections have made it possible for cooperation to continue even in the face of recurring maritime and border conflicts - a phenomenon known as "ASEAN interdependence spillover".

The article's conclusion regarding the ATA's role in the development of soft power is also significant. Initiatives like "ASEAN as One Destination", regional celebrations, cultural diplomacy, and the development of "ASEAN Identity" have heightened the organization's inclinations toward social cohesion and collective identity. In the institutionally deficient ASEAN model, these elements have served as crucial strategies for boosting social capital.

In terms of institutional results, the ATA has improved regional governance procedures and set the stage for standards harmonization and the development of a coordinating culture. Cooperation in recovery planning, information sharing, and tourism safety improved ASEAN countries' ability to take collective action, particularly during the COVID-19 pandemic.

Suggestions and Prospects for Further Research:

- Intraregional travel and human mobility could be further enhanced by the establishment of a regional visa under the ATA framework (a model similar to Schengen).
- ASEAN's ability to act collectively in times of crisis might be improved by fully harmonizing its tourism safety regulations.
- Programs for cultural diplomacy ought to be increased in order to fortify the "ASEAN Identity."
- Deeper empirical models (panel data, difference-in-differences analysis) should be used to

examine how tourism cooperation affects political stability. Separate research should be done on the indirect effects of the ATA on ASEAN's ties with its external partner states, including China, Japan, Australia, and the EU.

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**THE ISIS MEDIA NETWORK AND THE ACTIVITIES OF CYBER JIHADISTS**

**МЕДІАМЕРЕЖА ІДІЛ ТА ДІЯЛЬНІСТЬ КІБЕРДЖИХАДИСТІВ**

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***Abstract.*** *The article examines the directions of the ISIS media strategy. It is shown that, unlike other terrorist groups, ISIS has formed media organizations responsible for the preparation and dissemination of thoughtful propaganda content, including turning social networks from a simple tool into a multifunctional weapon and becoming a skilled, literate Internet user.*

*The military intervention of the US-led coalition forces in Iraq, the overthrow of the Saddam regime, and the subsequent "Arab Spring" revolutions in the Middle East weakened and collapsed state structures in a number of countries in the region, including Iraq and Syria. During the turbulent changes that occurred during these processes, radical Islamist forces, in particular the "Islamic State of Iraq and the Levant" (ISIL), joined the struggle to replace the corrupt former regimes that had lost the support of the population and seize power. ISIS used the resulting social injustice, economic inequality, and political pressures to spread its ideology and achieve its main goals.*

*There was the multilingual ISIS media center Al-Hayat, responsible for propaganda content, the Al-Furqan and Al-Itisam film studios, which produce Islamic songs (Nasheeds) Al-Ajnad, as well as the Al-Bayan radio station, which broadcasts propaganda programs on the territory of the caliphate.*

*ISIS has professionally used Facebook, Twitter, mobile apps, and chat rooms, published reports on its activities on various platforms, and broadcast ideological messages, propaganda videos, and instructions. It has broadcast high-quality propaganda films on various video platforms in order to attract young people from different countries of the world, and has organized forums by creating closed discussion platforms among individuals inclined to radical ideology. A group of hackers under the brand of ISIS also formed on the Internet, which acted as a special unit of the so-called Cyber Caliphate organization.*

*The dissemination of professionally edited videos, high-quality photographs and symbolic messages by ISIS using digital technology allowed it to form the visual power of the "caliphate" and gather thousands of supporters.*

***Keywords:*** *ISIS, Al-Hayat Media Center, Al-Furqan media Agency, Al-Bayan Radio, Cyber Khalifat*

***Анотація.*** *У статті розглядаються напрямки медіастратегії ІДІЛ. Показано, що, на відміну від інших терористичних груп, ІДІЛ сформувала медіаорганізації, відповідальні за підготовку та поширення продуманого пропагандистського контенту, зокрема перетворення соціальних мереж з простого інструменту на багатофункціональну зброю та перетворення на кваліфікованого, грамотного користувача Інтернету.*

*Військове втручання сил коаліції на чолі з США в Ірак, повалення режиму Саддама*

*Саддама та подальші революції «Арабської весни» на Близькому Сході послабили та розвалили державні структури в низці країн регіону, включаючи Ірак та Сирію. Під час бурхливих змін, що відбувалися під час цих процесів, радикальні ісламістські сили, зокрема «Ісламська держава Іраку та Леванту» (ІДІЛ), приєдналися до боротьби за заміну корумпованих колишніх режимів, які втратили підтримку населення, та захоплення влади. ІДІЛ використала отриману соціальну несправедливість, економічну нерівність та політичний тиск для поширення своєї ідеології та досягнення своїх головних цілей.*

*Існував багатомовний медіацентр ІДІЛ «Аль-Хаят», відповідальний за пропагандистський контент, кіностудії «Аль-Фуркан» та «Аль-Ітісам», що випускають ісламські пісні (Нашиди) «Аль-Аджнад», а також радіостанція «Аль-Баян», яка транслює пропагандистські програми на території халіфату.*

*ІДІЛ професійно використовувала Facebook, Twitter, мобільні додатки та чати, публікувала звіти про свою діяльність на різних платформах, транслювала ідеологічні меседжі, пропагандистські відео та інструкції. Вона транслювала високоякісні пропагандистські фільми на різних відеоплатформах, щоб залучити молодь з різних країн світу, та організовувала форуми, створюючи закриті дискусійні майданчики серед осіб, схильних до радикальної ідеології. В Інтернеті також сформувалася група хакерів під брендом ІДІЛ, яка діяла як спеціальний підрозділ так званої організації «Кіберхаліфат».*

*Поширення ІДІЛ професійно змонтованих відео, високоякісних фотографій та символічних повідомлень за допомогою цифрових технологій дозволило їй сформувати візуальну силу «халіфату» та зібрати тисячі прихильників.*

***Ключові слова:*** *ІДІЛ, Медіацентр «Аль-Хаят», Медіаагентство «Аль-Фуркан», Радіо «Аль-Баян», Кіберхаліфат*

**Introduction.** One of the most important components of ISIS' activities has been its skillfully developed media strategy, including a wide presence on social media. The rapid spread of information about ISIS around the world and the group's sudden fame resulted not only from the conquest of vast territories in Iraq and Syria, but also from a well-planned multilingual media campaign, including social media. The campaign included the release of videos, photographs, memorable magazines and Islamic songs (nasheeds), as well as active Twitter activity. ISIS's social media activity has transformed the small, violent jihadist group that emerged after the U.S. invasion of Iraq in 2003 into a symbol of an organization leading a global "jihad" against "infidels". Thanks to their extensive social media activities, ISIS and its leader Abu Bakr al-Baghdadi have become the new face of international terrorism in the 21st century.

ISIS was not the first terrorist organization to use the Internet and other technological tools in its activities. Thus, since the 90s of the last century, Al-Qaeda and other active terrorist groups have been using the Internet. However, the use of the Internet and various mobile applications has never been a key tool in the media strategy of these terrorist organizations. However, unlike other terrorist groups, ISIS used social media, which is an open communication channel accessible to everyone, and its media strategy was fundamentally different from other terrorist organizations in both quality and productivity. Therefore, studying the ISIS media network and propaganda methods through this network is of theoretical and practical importance.

The formation of the religious-ideological foundations of ISIS's activities is examined in a historical context, and the pillar elements of the ideology that turned its inhuman crimes and barbarities into the norm of life are analyzed.

It is shown that the ideology of ISIS was formed mainly on the concepts of Salafi jihadism, takfirism and caliphate. It is emphasized that the ideological foundations of ISIS are based on Salafi jihadism, which is the most radical form of Salafism. In this context, it is shown that one of the main principles of Salafism is considered to be tawhid (monotheism), bid'ah (rejection of innovations) and loyalty to the caliphate.

It is noted that ISIS ideologists interpret the concept of tawhid with a harsh approach towards other sects and trends. They further radicalize the ideas of the ideologists of radical religious

thought, presenting the concept of jihad as not only a defensive, but also an offensive activity. ISIS limits jihad to violence and acts of terrorism, and considers peace and diplomacy to be "weakness". It is emphasized that the ideology of ISIS, which is one of the main elements of its ideology, allows it to declare individuals and any community "infidels" and to legitimize the use of violence against them from a religious point of view. ISIS claims that it is the duty of true Muslims to declare everyone, including Muslim state leaders, various sects, and even moderate Muslims, as infidels and to declare them infidels. ISIS quotes the Quran and hadiths in order to justify its claims and violent actions from a religious point of view, and manipulates religious texts by removing them from their historical and social context. At the same time, they do not accept the views of traditional Islamic scholars and sectarian diversity.

The research mainly uses methods of comparative analysis and source analysis, as well as political analysis. During the analysis, reports of international organizations and scientific articles are used as the main sources of information; in addition, information obtained from reports of various governmental and non-governmental organizations is analyzed in a comparative manner.

**The main purpose** of the study is to study the media strategy of ISIS.

**Main Results of the Research**. First, significant attention has been paid to social media as a tool for mass mobilization and building a global audience. Research shows that ISIS has effectively utilized platforms such as Twitter, Facebook, and YouTube to rapidly disseminate information and engage supporters. In particular, the viral nature of content and the organization's ability to act faster than traditional media are emphasized *(Ajbaili, 2014).* Empirical evidence confirms the scale of digital support and the complex network structure of content distribution, which facilitates the radicalization of users *(Berger and Morgan, 2015; Klausen, 2015).*

Second, a number of authors examine propaganda as an element of ISIS's strategic and institutional activities. These studies emphasize that information activities were integrated into the process of quasi-state building and served as a mechanism for legitimizing power, attracting resources, and attracting foreign fighters *(Barrett, 2014; Farwell, 2014).* Additionally, the synchronization of military action and digital communications has been noted, allowing for the demonstration of successes in real time *(Vitale and Keagle, 2014).*

The third area of research concerns the analysis of ideological content and narrative strategies. Researchers demonstrate that media products such as the magazines Dabiq and Rumiyah form a coherent system of meanings based on religious, apocalyptic, and heroic *narratives (Ingram, 2016; Welch, 2018).* These texts function as strategic communication tools aimed at constructing legitimacy and identity.

A separate body of work is devoted to the technological and cyber aspects of ISIS's activities. This examines cyberattacks, the use of secure communication channels, and the transformation of cyberspace into an arena of asymmetrical confrontation *(Bat Blue, 2015; Sengupta, 2017).* In parallel, the professionalization of media production and the activities of specialized media centers are analyzed *(Kingsley, 2014; Winter, 2015; Zelin, 2015).*

Finally, researchers note the adaptation of marketing and cultural strategies, including the use of pop culture elements and "digital seduction" mechanisms to attract young people *(Hoffman, 2016).* The multi-layered nature of propaganda, including both centralized and decentralized forms of user-generated content, is also emphasized *(Khawaja and Khan, 2016).*

Despite the significant contributions of these studies, several limitations remain in the literature. Most studies either focus on specific aspects (e.g., social media, ideology, or cyberthreats) or are descriptive. As a result, a comprehensive discourse analysis that simultaneously considers the linguistic, pragmatic, and social functions of ISIS digital content remains underdeveloped.

Thus, a research gap exists in the absence of an integrative approach to studying ISIS's digital discourse as a multifunctional system combining elements of propaganda, identity, ideology, and strategic communication. This article aims to fill this gap by analyzing discursive strategies and their functions within a unified theoretical model.

**ISIS's main media outlets.** Several media outlets were responsible for the production and distribution of ISIS propaganda content. Al-Furqan and Al-Itisam produced films in Arabic, the Al-

Hayat media center produced materials in English, German, French and Russian aimed at Western audiences, and Al-Ajnad produced Islamic songs (Nasheeds). The multilingual structure of the Al-Hayat Media Center provided a wide range of media materials to attract potential foreign recruits. One of his products, in particular, was a series of short propaganda videos in HD known as "Mujatwits", which showed various aspects of daily life in the "caliphate", from the battles in Iraq and Syria to Western fighters expressing their joy at joining ISIS. The Al-Hayat Media Center also provided English subtitles for videos released by other ISIS agencies such as Al-Itisam and Al-Furqan. ISIS also had an al-Bayan radio station, which broadcast propaganda programs on the territory of the "caliphate" *(Hoffman, 2016).* Al Bayan radio station broadcast daily news from Mosul and propaganda materials in modern Arabic for those who did not have access to mobile phones or the Internet. These programs were also uploaded to YouTube and streamed via Twitter to expand audience reach. Each program began with Islamic songs (Nasheeds) in Arabic praising ISIS. *(Khawaja and Khan, 2016, p. 115).*

The Al-Hayat Media Center also published an online magazine called The Islamic State Report (ISR). The magazine published articles about the benefits of living in the "caliphate", as well as about ISIS activities and programs. The magazine often contained photographs and interviews with militants and residents describing how they enjoyed the prosperity of the "caliphate". ISIS also published a six-page PDF newspaper called Islamic State News (ISN), which contained images and brief propaganda commentary in English about various events of the day. *(Barrett, 2014; Khawaja and Khan, 2016, p. 115).*

To recruit new ISIS supporters, he also published the electronic magazine Dabiq from 2014 to 2016, which was an expanded version of the online magazine Islamic State: Reports and contained more detailed texts in English. It resembled the popular English-language magazine Inspire, published by Al-Qaeda in the Arabian Peninsula and known for its basic instructions for terrorists. Dabiq included lengthy comments on Islamic texts to give religious legitimacy to the actions of ISIS, and encouraged any attempts to join the "caliphate". In 2016-2017, ISIS replaced Dabiq with the English-language magazine Rumiya, which was published in English and aimed at an English-speaking audience. *(Welch, 2018).*

In addition to the central media structures mentioned above, in each of the provinces (wilayats) ISIS had its own local media departments, which were engaged in the production and distribution of video and photo reports on current events in the province. According to a study published by Aaron Y. In August 2015, the A'mak news agency, Al-Bayan Radio, Al-Hayat Media Center, Al-Furqan Media Center and the Sharia Committee represented only 22% (or 27 out of 123) of the information disseminated. At the same time, the remaining 78% of official publications came from provincial media. This suggests that in 2015, ISIS had a more decentralized media system than two years earlier. The decentralized structure of the main central media agencies, combined with local media offices, ensured a large volume and frequency of ISIS publications. This structure allowed ISIS to create the appearance of continuous activity on a global scale and demonstrate to its supporters that its forces are steadily moving towards creating a "caliphate" and waging war against its enemies *(Zelin, 2015, p. 88).*

**ISIS and social media.** The main innovation in the ISIS media strategy compared to previous terrorist organizations has been the widespread use of social media for propaganda. Indeed, social media platforms such as Facebook, Twitter, mobile apps, chat rooms, social networking sites, etc. have provided ISIS with a wide range of platforms to attract new recruits. ISIS has used social media as an important tool to promote its brand. By publishing videos and photographs depicting the execution of victims, the organization sought, on the one hand, to present itself as brave, and on the other, to impress the audience. On social media, ISIS was presented as the only moral force fighting against the immorality and brutality of the West, and posters depicting Western brutality were posted to this end. The ISIS media strategy positioned itself as a true follower of the faith, a supporter of social justice and an avenger of the suffering of others.

The benefits of social media for ISIS became apparent on July 4, 2014, when photos of Abu Bakr al-Baghdadi, who publicly declared his status as "caliph" for the first time, appeared on Twitter

even before the full video of his speech was uploaded to YouTube. As a result, most major international news agencies continued to report on the creation of the so-called "caliphate". In his speech, Abu Bakr al-Baghdadi called on Muslims around the world to join ISIS. In particular, he called on highly qualified Muslims - doctors, judges, engineers, computer specialists and hackers - to go to Iraq and Syria or join jihad from their countries. Facebook Instyle spread this message online through a free, unregulated group of people with popular accounts on Twitter, Tumblr, Instagram, Facebook, and other social media platforms. ISIS controlled an army of bloggers, analysts, and other writers who monitored global social media. Most of them operated anonymously and were based far beyond Iraq and Syria, in the Persian Gulf and North Africa. These bloggers posted tweets with links to videos, which are usually very effective, and then shared them on social media *(Barrett, 2014; Terror Goes Cyber:.., 2015)*

ISIS used social media to spread its materials as quickly and widely as possible. For example, in April 2014, ISIS launched a special Android application in Arabic called Dawn of Good News, also known as Fajr al-Bashar or Shubh, to create and send out mass tweets (Kingsley, 2014). Between April and June 2014, an estimated 5,000 to 10,000 people downloaded the app to track the progress of ISIS and receive the latest news about its activities. On the day of the capture of Mosul by ISIS, about 40,000 messages were sent through the app *(Khawaja and Khan, 2016, p. 115).*

In addition, ISIS militants conducted hashtag campaigns on Twitter. Hundreds, if not thousands, of ISIS fighters tweeted certain hashtags at certain times of the day, making them appear on the @ActiveHashtags account, which posts the most popular hashtags on Twitter in Arabic on a daily basis. These campaigns allowed ISIS militants to distort the results of a popular account and attract an additional audience *(Ajbaili, 2014).*

In addition to Twitter and Facebook, ISIS militants have also taken over *Ask.FM* and *Instagram*. *Ask.FM* was aimed at teenagers and served as an online recruitment platform. Anyone who wanted to join ISIS could ask their questions anonymously through this platform. The group posted photos on the social network Instagram. On this platform, foreign fighters shared personal stories or details of their daily lives. Among the many photos of weapons or the aftermath of the fighting were photos of jihadists enjoying food and adapting to life on the front lines *(Vitale and Keagle, 2014).*

ISIS has also used various online communication apps such as Skype, Signal, WhatsApp, and SnapChat. These applications were typically used for more confidential forms of communication. Another opportunity for ISIS was the FireChat messenger, which allowed them to communicate without an internet connection.

**ISIS hacker group.** There was also a group of hackers operating on the Internet under the brand of ISIS, which was a special unit of the so-called "Cyber Caliphate". The Cyber Caliphate organization included the hacker division of the Islamic State, the AnonGhost electronic jihad terrorist group, and others. The aim of these groups was to hijack, damage, or hack major media, government, commercial, and educational websites, as well as steal and temporarily control social media accounts and spread their messages. Damaged or hacked websites were usually accompanied by images of ISIS fighters with black flags and the phrase "hacked by the Islamic State". In particular, after the terrorist attacks in Paris in January 2015, 19,000 French websites were subjected to cyber attacks.

Overall, ISIS has demonstrated a significant increase in its cyber capabilities, as evidenced by its increasingly diverse and successful online strategy. In particular, on April 9, 2015, a cyber-Caliphate carried out a cyberattack on the popular French news channel TV5Monde, as a result of which 11 TV5Monde channels were unavailable for several hours. The company's social media accounts were hacked, the website did not work, and employees could not access their emails. Hackers gained control of social media accounts and posted messages in support of ISIS and documents purporting to reveal the identities of French soldiers fighting against ISIS. A message on the hacked TV5Monde Facebook page read: "French soldiers, stay away from the Islamic State! You have a chance to save your families, take this chance. The cyber Caliphate continues its cyber jihad against the enemies of the Islamic State" *(Terror Goes Cyber, 2015).* The ISIS cyberattack on

TV5Monde has become unprecedented in the history of television.

In April 2016, several ISIS hacker groups joined together under the name United Cyber Caliphate (OKH). The United Cyber Caliphate includes the Cyber Caliphate Army, the Ghost Caliphate Section, the Sons of the Caliphate Weapons, and Kalashnikov E-Security.

Within six months of its formation, the United Cyber Caliphate conducted cyber operations, recruited new followers, and provided them with security advice on how to avoid detection and carry out terrorist operations.

In early February 2017, ISIS-linked hackers attacked several websites of the UK National Health Service. Hackers known as the "Tunisian Fallagi Team" attacked six websites three weeks earlier, replacing them with graphic images of the war in Syria. They claimed that the attacks were a response to Western interference in the affairs of the Middle East. The hacked websites displayed the message "Stop killing people in Syria", followed by hashtags such as #Op_Russia and #save_aleppo. It was reported that the Tunisian terrorist group, along with the Global Islamic Caliphate and the DZ Command System, conducted coordinated operations in support of ISIS. It was also reported that in January 2017, these groups carried out a cyberattack on the Barts Health Trust, a large hospital trust that manages four hospitals in East London. The trust was forced to disconnect from the system after a cyberattack compromised the confidential files of thousands of patients *(Sengupta, 2017).*

**Conclusions.** Thus, unlike other terrorist groups, ISIS has proven its ability to skillfully use the Internet, turning social networks from a simple tool into a multifunctional weapon. The ISIS media strategy is, first of all, more consistent and modern. The range of ISIS media strategy ranges from news production to writing educational materials, resulting in high-quality propaganda. The main leitmotif of this propaganda was to create a "gap between the past and the present situation of Muslims", emphasizing that this gap underlies "the anger and insults that have fueled political violence in the Middle East". ISIS has made full use of the concept of "electronic jihad" to achieve its goal and has been able to develop well-structured and comprehensive information operations that have become a key feature of its militancy.

The comprehensive and large-scale use of ISIS's cyberspace capabilities came as a surprise to the international community. Thus, the international community was not prepared for the fact that a terrorist organization would spread its militancy using the capabilities of the global network and thus wage war on social networks. This meant that the fight against ISIS, in addition to military responses, also required a special social media strategy, and international counterterrorism measures had to adapt to new threats from social media.

ISIS has made excellent use of modern information technology to carry out its propaganda on a global scale and has been able to reach millions of people through social media and digital propaganda. To achieve its goals, ISIS published reports on its activities on Twitter and Telegram platforms, broadcast ideological messages, propaganda videos, and instructions. ISIS has released high-quality propaganda films on YouTube and other video platforms to attract young people from around the world, and has created closed discussion platforms and organized forums among those inclined to radical ideology.

ISIS's use of digital technology to broadcast professionally edited videos, high-quality photographs, and symbolic messages has allowed it to project the visual might of the "caliphate" and attract thousands of followers. ISIS makes extensive use of emotional manipulation to spread its ideology and recruit supporters through social media and digital propaganda, using images of suffering victims to incite feelings of hatred and revenge among potential recruits.

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# TATTOOS OF POLITICIANS AND PUBLIC FIGURES IN IMAGE CREATION: A VISUAL-ANALYTICAL ASPECT OF PSYCHOLOGICAL PORTRAIT. PART 1.

# ТАТУЮВАННЯ ПОЛІТИКІВ І ПУБЛІЧНИХ ОСІБ У ФОРМУВАННІ ІМІДЖУ: ВІЗУАЛЬНО-АНАЛІТИЧНИЙ АСПЕКТ ПСИХОЛОГІЧНОГО ПОРТРЕТУВАННЯ. ЧАСТИНА 1.

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***Abstract**. The purpose of this article is to construct a conceptual framework for applying key theories on the origins of tattoos as a component of nonverbal communication to politicians. This section serves as the first and introductory part of the article. It will present key theories on the origin and application of tattoos, along with selected demonstrative cases of public figures. The second part of this article will be devoted to the study of tattoos on specific Ukrainian and American politicians.*

*A number of research areas relevant to tattoos as a subject of independent study have emerged in the scientific literature. Among these, the author considers it necessary to highlight the (bio)evolutionary (cultural-anthropological), psychoanalytic (clinical-psychological and psychiatric), and cultural-sociological (art history) approaches. Each of these approaches offers its own explanatory framework for the origins of tattoos, the motivations for their use/application, and the psychological and sociocultural functions of tattooing both in the lives of individuals and in different social groups. Public figures, including politicians, more often than members of other social groups use tattoos to consciously manage impressions. This does not exclude the possibility of a politician having various tattoos applied at an earlier stage. However, inclusion in the public sphere and the acquisition of recognizable status predisposes one to edit one's personal image and alter the symbolic components of the body.*

*Politicians' constant contact with the media prioritizes the performative function of tattoos, as working with political advertising, propaganda, and PR technologies involves constructing not so much realistic images as simulacra that influence the perceptions of a particular target audience. This is because politics for the media is an art form primarily concerned with constructing appearances.*

***Key words:** tattoos, visual analytics, image, image formation, (bio)evolutionary (cultural-anthropological) understanding of tattoos, psychoanalytic understanding of tattoos, cultural-sociological (art history) understanding of tattoos.*

***Анотація.** Метою статті є побудова концептуальної схеми застосування ключових груп теорій походження татуювань як компонента невербальної комунікації щодо політиків. Ця частина статті виступає першою та вступною. У ній будуть представлені ключові теорії походження та нанесення татуювань з окремими умовно-демонстраційними*

*кейсами громадських особистостей. Друга частина цієї статті буде присвячена дослідженню татувань конкретних українських та американських політиків.*

*У науковій літературі сформувалася низка напрямів, релевантних татуюванням як предмету самостійного дослідження. Серед таких напрямів автор статті вважає за потрібне виділити (біо)еволюціоністське (культурно-антропологічне), психоаналітичне (клініко-психологічне та психіатричне) та культурально-соціологічне (мистецтвознавче). Кожен із напрямків пропонує свою пояснювальну схему походження татувань, мотивації їх застосування/нанесення, психічні та соціокультурні функції татуювання як у житті особистості, так і різних соціальних груп.*

*Громадські особистості, включаючи політиків, частіше за представників інших соціальних спільностей інших використовують татуювання для усвідомленого управління враженнями. Останнє не виключає обставини присутності на тілі політика різного татуювання, завданого в ранній період. Тим не менш, включеність в публічний простір і набуття статусу впізнаваного схиляє до редактури особистісного образу та зміни символічних складових тіла.*

*Постійний контакт політиків зі ЗМІ ставить як пріоритетну перформативну функцію татуювання, оскільки робота з технологіями політичної реклами, пропаганди, PR передбачає конструювання не так реалістичних образів, як симулякрів, які працюють на сприйняття тієї чи іншої цільової аудиторії. Це з тим, що політика ЗМІ є сферу мистецтва, що займається, переважно, конструюванням видимостей.*

***Ключові слова**: татуювання, візуальна аналітика, імідж, формування іміджу, (біо)еволюціоністське (культурно-антропологічне) розуміння татувань, психоаналітичне розуміння татувань, культурально-соціологічне (мистецтвознавче) розуміння татувань.*

**Introduction.** The study of tattooing as a subject of scientific research requires an initial exploration of cultural history. The primary meanings of tattoos are linked to social hierarchies and the construction of inequality within tribal communities. Tattoos can signal the wearer's status niche, express their identity, warn of possible behavioral patterns, manage impressions, and express personal history.

In all of these aspects, tattoos perform an important signifying function, providing preemptive information at a subconscious level. At the same time, the use of tattoos for aesthetic purposes (when a tattoo becomes a kind of decorative canvas) does not preclude all of the aforementioned influences of tattoo symbolic compositions, both consciously and subconsciously. For any public figure, tattoos are a crucial component of nonverbal communication, complementing all other elements of visual existence: body and facial features, gestures, facial expressions and pantomime, clothing styles, accessories and jewelry, visual symbols of personal space, and so on.

**The purpose of this article** is to construct a conceptual framework for applying key groups of theories on the origins of tattoos as a component of nonverbal communication to politicians. This section is the first and introductory part of the article. It will present key theories on the origin and application of tattoos, along with selected case studies of public figures. The second section will examine the tattoos of specific Ukrainian and American politicians.

**Literature review.** A number of areas relevant to tattoos as a subject of independent research have emerged in the scientific literature. Among these approaches, the author of the article considers it necessary to highlight the (bio)evolutionary (cultural-anthropological), psychoanalytic (clinical-psychological and psychiatric), and cultural-sociological (art-historical) approaches. Each approach offers its own explanatory framework for the origins of tattoos, the motivations for their use/application, and the psychological and sociocultural functions of tattooing both in the lives of individuals and different social groups.

Among the authors representing the first approach are Yu. Amurova, R. Artyukhina, R. Carmen, and S. Wohlrab *(Амурова, 2019, pp. 10-16; Carmen at all, 2012, pp. 134-143; Wohlrab, Fink, Kappeler, Brewer, 2009, pp. 202-206)*. The authors' primary explanations for tattoos center on utilitarian and pragmatic rationales, explaining the biological and economic benefits of tattooing.

The researchers' consensus is that tattooing allowed for, firstly, intimidation and other psychological effects, and thus, more effective resistance to members of other tribal groups in the face of a brutal struggle for survival.

Secondly, it provided a comprehensive phenotype for viewing, thereby advantageously emphasizing the symbolic differences between one group and another, which created and continues to create the necessary cultural advantages in the exploration of space.

Thirdly, tattoos, according to evolutionary logic, provided tattooed males with evolutionary demographic advantages due to their intuitively ascribed higher masculinity.

Among the authors representing this second approach are M. Atkinson, A. Armstrong de Almeida, G. Grumet, W. Karacaoglan, and D. Maxwell *(Atkinson, 2003; Armstrong de Almeida, 2005; Grumet, 1983, pp. 482–492; Karacaoglan, 2012, pp. 5–28; Maxwell, 2017).*

The main explanations for the essence of tattoos among the authors presented are their use as a tool for processing unverbalized traumatic experiences and archetypal projections. In both cases, tattoos allow for the expression of personal and group affects that are intolerable or difficult to bear due to the painful component, high torturality, and/or abusiveness.

Among the authors representing the third direction are S. Alter-Muri, G. Forbes, L. Kirstein and K. Kjelskau, K. Doss and A. Ebesu Hubbard (*Alter-Muri, 2020, pp. 139–146; Forbes, 2001, pp. 774–786; Kierstein, Kjelskau, 2015, pp. 37–40; Doss, Ebesu Hubbard, 2009, pp. 62–74).*

The main explanations for the essence of tattoos among the authors presented are their presentational and aesthetic functions and background visual fascination. This is both about constructing a positive image and various forms of impression management.

**Main results of the study.** ***(Bio)evolutionary (cultural-anthropological) approach.*** In the first approach, researchers focus on the question of what pragmatic components of tattooing provided its wearers with biological, and later, socio-hierarchical advantages. Thus, Ya. Amourova, summarizing a number of research studies, within the evolutionary paradigm, notes a connection between tattooing and primitive (imitative) magic, a kind of self-programming hard recording associated primarily with hunting and self-defense *(Амурова, 2019, pp. 10-12).*

By incorporating the image of a particular animal into their bodies, primitive hunters hoped to acquire the characteristics of that animal (plant, bird) and/or use it as a means of defense. According to this magical "logic," a hunter who tattooed the image of a tiger on his body "acquired" tiger-like qualities, namely ferocity, unbridled courage, terrifying strength, and so on.

***Illustrative case 1.*** *A politician has the following tattoo on his right arm: a tiger grasping a doe by the throat, writhing in agony. The tattoo may serve an imitative-magical function due to its display to others. This is because the tattoo itself, on a latent, unconscious level, informs recipients of their likeness to a predator (rather than a prey), which may correspond to liberal-evolutionist identities and philosophies such as "woe to the weak and vanquished" and "the vanquished are the cause of their own misfortune." The individual who has inflicted such a tattoo has created a permanent inscription, which, through the work of the imagination (i.e., magically), is intended to maintain the zoomorphic identity of the tiger in the tattooed subject's psyche. At the same time, the politician communicates his ideological identity in a way that makes his message clear.*

A similar utilitarian logic in understanding the essence of tattooing is also shared by English-language authors representing the evolutionary school. Thus, R. Carmen, A. Guittar, and H. Dillon, within the framework of their evolutionary view of tattoos, put forward two hypotheses regarding their origins (*Carmen at all, 2012, pp. 134-143).* The first hypothesis, which the authors call the "human canvas hypothesis," describes tattoos in their marking role in relation to the individual or community. In this understanding, a tattoo is a complementary phenotypic representation of identity. At the same time, the symbols presented in tattoos emphasize, first of all, the differences of an individual or community from other individuals and communities, but not their similarities.

The second hypothesis, which the authors dubbed the "raising the stakes hypothesis," suggests a connection between tattoos and perceived levels of resilience, endurance, and resistance to foreign substances, including viruses and infections. This hypothesis relies heavily on common sense notions that individuals who can afford tattoos enjoy significant health, i.e., biological and genetic

advantages for reproduction.

In primitive conditions, tattooing itself was a risky act, as it was performed without any precautions for the body. At the same time, in primitive societies, genetic and biological superiority coincide with social dominance, since a tattooed individual is inherently capable (given good health) of coping with threatening environmental factors (both animal and human). Wohlrab et al. *(2009, pp. 202-206)* were able to empirically confirm the evolutionary hypotheses described above in their study of intuitive health assessments of exhibited subjects. Respondents of both sexes were asked to rate the health of tattooed men and tattooed women. Women generally rated tattooed men as healthier than non-tattooed men. Conversely, male respondents rated tattooed women as less healthy than female respondents rated men as less healthy.

N. Artyukhina, in her study of youth tattoos, partially adheres to evolutionary logic, viewing tattoos as a symbolic tool for emancipation and the ability of young people to challenge society. Such defiant behavior, a marker of psychopathicity (sociopathicity), is explained, in no small part, by the young person's general excitability and aggression, their ability to assert themselves at the expense of others, not so much by adapting to the environment as by breaking habitual adaptations and creating new ones. These characteristics relate not so much to the psyche as to the body and organism, and are more biological and organismic than sociocultural *(Артюхіна, 2016, pp. 17-22)*.

***Illustrative case 2.*** *An Instagram blogger has several complex tattoos on the front of his torso. On the neck are fragments of barbed wire or wire-like thorns. In the center of the chest are two Dobermans, one breaking free from its chain, while the other remains frozen in a motionless pose. On the lower torso, on the right, is a writhing snake, while on the left, an angelic creature with wings and a spear. On the front of the shoulder muscles, a mirror is visible on the right (diagonally from the Doberman breaking free from its chain), and on the left (diagonally from the Doberman frozen in a motionless pose), a scale.*

*The tattoo simultaneously demonstrates both convention and rebellion against it. The upper part of the tattoo composition reflects the experience of pain and suffering as a censorship structure. Considering the cross symbol located on the left temple, there is reason to assume that this is a painful and suffering (even tortural) experience of Christianization. The central psychopathic conflict is presented as a confrontation between two Dobermans: the psychopathic torturality itself is determined by the high intensity of the affect of anger/hatred/rage/pain and the need to maintain external equanimity and coldness.*

*Hypothetically, the Christianizer(s) employed bullying tactics (moral and/or physical), which corresponds to narcissistically demonstrated aggression and unhinged emotionality (the Doberman on the right, under the mirror), combined with rational-volitional inhibitions and a show of equanimity. At the level of empirical consciousness, close to the unconscious (in the composition, this corresponds to tattoos located closer to the two internal oblique muscles), this corresponds to the basic psychopathic conflict between angelic "holiness" and demonic infernality, i.e., the dual manifestations of the angel within and the demon without.*

In closed pre-industrial societies, the connection between the individual and the community is rigid, as community discourages social mobility (both horizontal and vertical). This circumstance is reflected in the creation of mechanisms for attaching the individual to the group and the creation of conditions where the loss of group membership and affiliation becomes tantamount to the biological death of the individual. It is in this context that social ties can be equated with biological ones, and the origin of tattoos can be supplemented by yet another evolutionary explanation.

The purpose of tattoos, as follows from this explanation, is linked to the ascriptive status of closed societies. The latter, as is well known, are intended to socially immobilize the individual and anchor them to a social group during their lifetime. Ascriptive statuses typically derive from biological characteristics, such as race, gender, age, region of origin, family kinship, and so on. Evolutionary essentialism helps explain certain subcultural tattooing practices, such as criminal tattoos. In penitentiary settings, regardless of the type of society, ascriptive status is reproduced due to the very harshness of these institutions.

Criminal society is built, at its lowest ebb, on biological hierarchies, and subcultural (criminal)

tattoos record evolutionary advantages or involutionary defects, marked by certain signs (symbols). As T. Uplisashvili notes, in prisons in Ukraine, Russia, Georgia, and Moldova, real power lies with informal groups that create a semblance of a caste order. Moreover, the prison administration itself is swayed by the latter, profiting from the shadow penitentiary economy that exists within such informal caste hierarchies *(The Shadow Code, 2025).*

Tattoos document evolutionary and biological differences between the top caste of thieves-in-law, the overseers, and the "posledentsi," who represent the former, the muzhiks, the goats, and the downtrodden (lowered), reflected in both individual symbols and symbolic compositions. Thus, thieves-in-law may tattoo themselves with eight-pointed stars or military epaulets, as well as various symbols of monarchical power. Tattoos in the criminal world ascribe not only an individual's place in the informal biological hierarchy but also their "suit," that is, the characteristics of the criminal group, which are fixed, like innate (biological) traits, on certain sectors of the body (thieves, rapists, murderers, robbers, etc.).

***Illustrative Case 3.*** *A thief-in-law has a complex tattoo on the front of his torso. On his shoulders are distinctive epaulettes with ligature, and beneath them, in the upper pectoral area (right and left), are eight-pointed stars. Under the right epaulette are two St. George's crosses, and in the center of his torso is an image of the Madonna and Child. The tattoo signifies the evolutionary and biological advantages of its bearer as a traditionalist monarchist in opposition to the Soviet system. A thief-in-law and anti-Soviet figure must represent a more powerful biological and organic formation than the average thief-in-law who does not oppose the system.*

***Psychoanalytic (clinical-psychological, psychodiagnostic) approaches*** link tattoos to unconscious contents and/or various types of character organization, both within the conditionally normal (neurotic) and pathological (borderline or psychotic) continuums. A common thread running through all these explanations of tattoos is the connection between tattoo symbols and ways of processing intolerable emotions.

In their studies of psychodynamic psychiatry, Grumet and Karakoglan document the correlation between tattoos and masochistic affective complexes (anger/hatred under control). In this conceptual framework, the masochistic type of character organization visualizes the acting out of anger and hatred that are repressed. Thus, with the help of a tattoo, a person illustrates not only their ability to survive the pain of sadistic abuse (primarily from parents, but also from other significant parental figures), but also to cope with it *(Grumet, 1983, pp. 482–492; Karacaoglan, 2012, pp. 5–28).*

Atkinson, Anderson, Almeida, and Maxwell also come to similar conclusions. All of the authors listed examined the connection between tattoos and masochism, abusive dissociation (primarily in victims of sexual violence), as well as grief, separation, and depression. The authors believe that a common factor in explaining the reasons for tattooing is the achievement of a state of control over a particular affect through experiencing laboratory pain during tattooing *(Atkinson, 2003; Armstrong de Almeida, 2005; Maxwell, 2017).*

This achieves a partial catharsis, which, while not a substitute for verbal insights, is nonetheless a better alternative to total alexithymia. The tattoo thus serves as a tool for visually symbolic verbalization of affect, thereby providing a semblance of therapeutic (self-)help. Maxwell points to the potential for tattoos to be used as symbols of transformation and healing in his article. This applies, in particular, to tattoos in the form of Buddhist mandalas, which, according to the author, induce an altered (meditative) state of consciousness in which post-traumatic transformations become possible.

Further conceptualization of tattoos within the framework of Carl Jung's analytical psychology allows them to be interpreted as visually symbolic projections of archetypes. Understanding archetypes as structures of group (societal) apperception that structure individual perception, the author of this article has reason to believe that archetypes can be visualized as symbols or symbolic compositions, with tattoos themselves becoming their unconscious symbolic projections.

***Illustrative Case 4****. Case 4 features a complex tattoo of a thief in law and an anti-Soviet*

*activist. The centerpiece of the tattoo composition is the image of the Blessed Virgin Mary holding a baby. In a Jungian sense, this symbol represents the archetypal projection of the Great Mother, under whose protection (both in one's own imagination and through induced fantasies) the tattoo wearer "is." The archetypal motif of "mother and child" itself is simultaneously hypnotic and somnambulistic, i.e., describes both the altered state of consciousness of the owner and his unconscious intention to introduce others into such a state, i.e. to induce the work of their imagination in the direction of his infantile identity and dependence on women.*

***Illustrative Case 5.*** *Justin Trudeau's left shoulder features a composite tattoo depicting a combination of Hyde the Raven and the planet Earth within his torso. The image itself is a projection of the Trickster archetype, which represents the identity of the Creator of the world and the cunning rogue. The archetypal motif is that cunning/flexibility rules the world, and those who identify with the Trickster image exhibit similar qualities. The manifestation of wisdom as cunning can border on creative qualities, but the semantics of this image extend beyond creativity. The Trickster image itself is also a shapeshifter, since when Hyde is turned 180 degrees, he transforms into a shaman disguised as a raven. The politician apparently ascribes similar qualities of a shaman (influencing a group of people to induce them into altered states of consciousness) to himself.*

***Sociocultural (cultural and sociological) and art studies.***

In cultural and sociological understandings, tattoos become tools for presenting identity and self-decoration. To capture group affiliation, tattoos must fulfill certain functions within group memory, as indicated by numerous researchers *(Alter-Muri, 2020, pp. 139–146; Forbes, 2001, pp. 774–786; Kierstein, Kjelskau, 2015, pp. 37–40; Doss, Ebesu Hubbard, 2009, pp. 62–74)*. If a tattoo is part of group memory, then it naturally becomes a kind of "memory knot"—a symbol and/or symbolic composition that reminds the individual of their membership in a particular subculture (counterculture) or social community.

However, it's worth noting that individuals are more likely to inflict such commemorative knots on their own bodies when they experience incomplete internalization of their identity. Incomplete internalization of identity reflects a state of life in which certain meanings remain incompletely understood or accepted, and therefore more conditional and dubious than real. The very act of symbolically emphasizing group affiliation through tattoos reflects the transitory nature of identity and/or the search for value-based references that could become personal meanings.

The memorial function of tattoos in relation to significant others (for example, idols or deceased relatives), as well as memorable events and/or memorable places, is also linked to the presentation of identity. This connection stems from the identitarian nature of memory, the very purpose of which, in the individual or societal psyche, is to imprint factuality. What has become factual usually acquires a fatal cultural or social heaviness. Facts are usually pressing events or actions whose consequences are characterized by irreversibility. Tattoos capture this irreversibility and become its visual-symbolic narrative and performative.

***Illustrative case 6.*** *The tattoo's owner (an American politician) has a portrait of J.F. Kennedy framed by laurel branches inked on his right shoulder. Above Kennedy's head is a rising sun and a dove with an olive branch in its beak. In this case, the tattoo's owner not only presents his left-liberal ideological identity but also a narrative of personal peace and commitment to Judeo-Christian values regarding the permanence of the post-flood world.*

*The combination of the image of Kennedy the peacemaker (known for his resolution of the Cuban Missile Crisis) with the Old Testament symbol of a dove with an olive branch in its beak is no coincidence. According to the Old Testament, the first world was destroyed by God in a global flood. This was an image of God's first judgment. According to the Book of Revelation, the Second World is destined for God's judgment in the form of burning by fire. The "analogue" of such a "judgment" (no longer in the sacred, but in the secular sense) could have been a nuclear catastrophe, which was averted thanks to the common sense of politicians. Therefore, the Old Testament allusion in the tattoo is no coincidence.*

K. Doss and E. Hubbard *(Doss, Ebesu Hubbard, 2009, p. 70)* conducted their own empirical study and a secondary analysis of empirical research by other authors, which revealed a number of

interesting patterns in tattooing within the framework of I. Goffman's impression management theory.

The first pattern concerns the public display of tattoos as an important impression management tool. Politicians, for example, may get tattoos based on how others perceive them, that is, by reading their mirror self and the reactions of others to it. Thus, tattoos can become part of a useful image necessary for attunement to a group environment. For example, a politician from a left-wing party might tattoo a gear (cogwheel) on the back of his hand in an attempt to build a favorable image among members of the industrial elite. The second pattern is that the use of tattoos as impression management tools will depend on the value (or devaluation) of the social identity. The higher the value of the corresponding social identity, the higher the likelihood that tattoos will be used as impression management tools, i.e., consciously.

This also follows the converse: the lower the value of the corresponding social identity, the lower the likelihood that tattoos will be used as impression management tools. If the value of the social identity is insignificant, then tattooing usually occurs as an impulsive, unconscious expression. The individual is little concerned with the meanings conveyed by their tattoo or the unconscious mental reactions it evokes in their cultural and social environment.

Doss and Hubbard support this conclusion by stating that "tattoos are widely considered to be communicative to some extent and that many people actually use their tattoos to convey messages to others" *(Doss, Ebesu Hubbard, 2009, p. 70).* There can be little doubt about this, as communication between people is inevitable (indeed, it occurs in any case), regardless of whether it is verbal or nonverbal. In both cases, tattoos are communicative (regardless of respondents' opinions on this matter).

Even if tattoos are not intended for public display and visible exposure to the external environment (for example, they are hidden under clothing), these messages are nevertheless conveyed to another part of the social environment – the internal microenvironment (parents, spouses, friends and acquaintances, etc.), not to mention the fact that the individual conveys the tattoo's symbolic narratives to themselves, thereby engaging in a kind of NLP.

This suggests some modification of the authors' conclusion that "from an impression management perspective, for people who do not consider their visible tattoos to have communicative value, this may simply be an example of poor impression management." Here, it's probably worth discussing not so much that such people may be examples of poor impression management, but rather that they are unconsciously predisposed to different reference groups whose impressions they hope to manage. Overall, the authors correctly conclude that "tattoos can be communicative regardless of whether the person with the tattoo perceives them as such. Individuals less aware of the communicative value of tattoos may unintentionally send messages about themselves to others" *(Doss, Ebesu Hubbard, 2009, p. 70).*

**Conclusions.** In a society of caste and class inequality, tattooing serves important stratification functions, distinguishing between the dominant and the dominated. Moreover, tattooing is often carried out under coercive circumstances. Caste- or class-based societies entrench property rights over people and treat some people as objects. This dehumanization corresponds to the right of dominants to brand members of subordinate groups, marking them with signs of their personal ownership, use, and control.

Tattooing in this context expresses a certain fatally coercive identity, with the inability of the wearer to shed their material status. In caste and class-based societies, tattoos are applied to the bodies of slaves, as well as to livestock, utensils, and other objects. In such cases, they represent a kind of personal brand for the owner.

An analog of this tattooing practice in modern society is the practice of forced tattooing of members of the lower criminal castes in prisons. The semantic context of their application reflects the group contempt of the strong for the weak and the stigmatization of the latter as the humiliated and defeated, with the forced inscription of the history of their humiliation/enslavement on their bodies.

With the emergence of a society of social mobility and class structure, the functions of

tattooing increasingly shift toward self-expression, the presentation of identity, and aesthetic individualization. All of these functions, however, are based on a predisposition to the continuous reproduction of traumatic experiences in the present. This experience, from the often unconscious perspective of the tattooing subject, is not simply not to be forgotten. It must be continually retained in the field of perception due to the supreme value of the elusiveness of a particular image or symbolic composition.

That which is continuously focused on usually has the highest value. Such objects are associated with both cultic reverence and an unbearable fear of loss. But both are determined not so much by the tattoo itself as by its content and the area of the body where it is applied. Nevertheless, whatever the symbolic meaning of the tattoo or the area of the body where it is applied, the tattoo itself reflects the central status of a "weak spot" in a particular mental function or group of functions.

This becomes all the more logical and justified because the weakest mental functions (as well as the associated bodily, social, and cultural functions) are usually the object of the greatest care and "guardianship" on the part of the registers of consciousness and/or censorship. Common sense dictates that existing strength does not require constant efforts to confirm it. Nor does this strength require any additional efforts or arrangements to confirm its significance.

Silent calm usually accompanies the image of real strength. Weaknesses, on the other hand, exhibit a peculiar garishness and behave defiantly. The attempt of any provocative weakness to focus and/or capture attention, to become a situational attractor, is usually beyond question. Anything dubious and weak behaves provocatively; anything stable and certain, durable and long-lasting, behaves rather routinely and monotonously, even, to a significant degree, monotonously and boringly. This logical chain can, with a significant degree of correspondence, be extrapolated to tattoos.

The more vivid, rich, varied, and multi-compositional the tattoos, the greater the glaring discrepancy between the image and reality, the higher the level of expression of the probable need to complement the mental apparatus, bodily functions, and, not least (and perhaps even primarily), cultural and social identities.

Both individual tattoo images and their symbolic compositions are blatant signifiers of weak and/or minority mental and/or bodily functions. Such functions require a continuous attentional tone and constant reproduction in the perceptual field of both the one who applies them and those who perceive them.

In terms of self-perception, of the three self-images, tattoos express (as is already becoming clear) not so much the real self as the mirror and/or ideal self. However, for the first (real) self, any tattoo symbolic image becomes a reinforcing, psycho-shaping visual performative, since the latter's reflection in both the conscious and unconscious minds of the recipients (at least sometimes) initiates questions about the meaning of the tattoos. Such questions are usually followed by storytelling, the importance of which for the psyche is difficult to overestimate.

Storytelling about the meanings of tattoo symbols and symbolic compositions becomes therapeutic narratives for the storytellers themselves, allowing them to build upon existing identities, fulfill a claim or demand for a particular social status or role, both imagine themselves and manage the impressions and/or fantasies of others, and, in an unconscious symbolic-dramatic format, express the personal stories behind particular tattoos.

Public figures, including politicians, more often than representatives of other social groups use tattoos to consciously manage impressions. This does not exclude the presence of various tattoos on a politician's body, applied at an earlier time. Nevertheless, inclusion in public space and the acquisition of recognizable status predisposes one to edit one's personal image and alter the symbolic components of the body.

Politicians' constant contact with the media prioritizes the performative function of tattoos, as working with political advertising, propaganda, and PR technologies involves constructing not so much realistic images as simulacra that influence the perceptions of a particular target audience. This is because politics for the media is an art form primarily concerned with constructing appearances.

The goal of any public figure is to "subvert shadow in favor of light," to imbue their image with features that best manage the positive impressions they create. In their self-construction, politicians also allow themselves to delve into the depths and depths of the worst crimes against humanity. However, both the strategy of emphasizing the positive and the negative is usually chosen consciously. And tattoos play a significant role in such presentations. Political will to power allows and presupposes a wide variety of tattooed representations of identity. Their presentation to newsmakers creates another piece of news about the politician, alongside the public speeches of himself and/or his speechwriter.

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# THE ANTI-COERCION INSTRUMENT (ACI) AS A TOOL OF PREVENTIVE DIPLOMACY

# ІНСТРУМЕНТ БОРОТЬБИ З ПРИМУСОМ (ACI) ЯК ЗАСІБ ПРЕВЕНТИВНОЇ ДИПЛОМАТІЇ

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***Abstract.*** *The European Union's Anti-Coercion Instrument (ACI) is an effective trade weapon that the bloc approved in 2023 but has not yet used. Some have likened this instrument to a "bazooka" and it is designed as a deterrent to any country that uses trade measures to pressure one of the 27 member states of the EU. This instrument specifically allows for restricting imports from a country, limiting their access to certain tenders and public markets, or prohibiting certain investments. The possibility of using this new economic weapon was raised in the dispute between Lithuania and China, as the Baltic country accused Beijing of banning its exports in protest against the establishment of Taiwanese diplomatic representation in Vilnius. This was before Donald Trump returned to power in the United States, making tariffs his preferred tool during his second term. The possibility of resorting to this tool was also raised during 2025 in response to customs duties announced by the US President, but the 27 countries did not activate it, while some European representatives and analysts warned that the deterrence capacity remains weak if this tool is never used. Trump's threats to raise tariffs on eight European countries if they do not facilitate a "full" sale of Greenland to the United States sparked strong reactions within the EU and revived debate about activating the tool. This research reveals the use of the ACI as a preventive diplomatic tool with hard power and not soft power with the aim of limiting the expansionist role of the USA under the administration of President Trump since his return to the White House at the beginning of 2025, and his use of economic pressure by increasing customs duties as well as threatening to acquire Greenland from Denmark along with pressuring Nato member countries (European countries and Canada) to increase their defense spending to no less than 5% of their gross domestic product.*

***Keywords:*** *anti-coercion instrument, common commercial policy, common foreign and security policy, sanctions, restrictive measures, economic coercion.*

***Анотація.*** *Інструмент боротьби з примусом Європейського Союзу (ACI) – це ефективна торговельна зброя, яку блок схвалив у 2023 році, але ще не використав. Цей інструмент, який дехто порівнює із "базукою", розроблений як фактор стримування будь-якої країни, що використовує торговельні заходи для тиску на одну з 27 держав-членів ЄС. Цей інструмент спеціально дозволяє обмежувати імпорт з країни, обмежувати його доступ до певних тендерів та публічних ринків або забороняти певну інвестиційну діяльність. Можливість використання цієї нової економічної зброї була, зокрема, порушена в суперечці*

*між Литвою та Китаєм, оскільки балтійська країна звинуватила Пекін у забороні свого експорту на знак протесту проти створення дипломатичного представництва Тайваню у Вільнюсі. Це було до того, як Дональд Трамп повернувся до влади в США, зробивши тарифи своїм пріоритетним інструментом під час свого другого терміну. Можливість залучення цього інструменту також була порушена протягом 2025 року у відповідь на мита, оголошені президентом США, але 27 країн не активували його, тоді як деякі європейські представники та аналітики попереджали, що стримувальна здатність залишається слабкою, якщо цей інструмент ніколи не буде використано. Погрози Трампа підвищити тарифи для восьми європейських країн, якщо вони не сприятимуть "повному" продажу Гренландії Сполученим Штатам, викликали бурхливу реакцію в ЄС та відродили дебати щодо активації цього інструменту. Це дослідження розкриває використання ACI як превентивного дипломатичного інструменту з жорсткою, а не м'якою силою, спрямованого на обмеження експансіоністської ролі США за адміністрації президента Трампа з моменту його повернення до Білого дому на початку 2025 року, а також використання ним економічного тиску шляхом підвищення митних зборів поряд із погрозами щодо придбання Гренландії у Данії та тиском на країни-члени НАТО (європейські країни і Канаду) з метою збільшення своїх витрат на оборону до не менше 5% ВВП.*

***Ключові слова:*** *інструмент боротьби з примусом, спільна торговельна політика, спільна зовнішня та безпекова політика, санкції, обмежувальні заходи, економічний примус.*

**Introduction.** The Anti-Coercion Instrument (Regulation 2023/2675) is the main EU legal instrument aiming at tackling economic coercion undertaken against the European Union and/or its Member States. Under Regulation 2023/2675, "economic coercion exists where a third country applies or threatens to apply a third-country measure affecting trade or investment in order to prevent or obtain the cessation, modification or adoption of a particular act by the Union or a Member State, thereby interfering in the legitimate sovereign choices of the Union or a Member State" *(Regulation (EU) 2023/2675, 2023)*.

This is not solely a mere theory. Indeed, the EU has been increasingly facing and has been targeted by all kinds of economic coercion due to the hostile environment of the weaponization of international trade, the misuse of (trade) interdependence and the weakened international cooperation. For instance, the EU was challenged by secondary US sanctions in 2018, followed by 2021 when some of its Member States, including Lithuania, were subject to a Chinese trade embargo. All these third-country measures and steps, to some extent, strive to affect the Union and/or its Member States to enforce the EU policy-makers to change the certain actions or policies which were considered legitimate choices for the policy-makers *(Corlin, & Tadeo, 2026)*.

**The purpose of this article.** Referring to the above-mentioned, it is worth exploring the Anti-Coercion Instrument (ACI), in particular, to disclose the legislative history of this new EU legal instrument and its development. Besides, the article touches upon the mechanism of forming the Union's agenda by the so-called geopolitical Commission, being influenced by the recent geo-economic rivalries that had occurred in the preceding few years. It also explains the mutual interaction between the Union's institutions, especially while referring to several Council Presidencies and Member States and their seeking to secure the position of the executive in the determination of economic coercion. The article also draws attention to a number of political and foreign policy statements, made by some EU institutions and Member States. Including such statements lies in the significant political nature of the ACI, as a minimal understanding of the geopolitical context is truly necessary to thoroughly understand the coming of this new Regulation.

**Main results of the study.** There can be singled out two main reasons why an overview and analysis of the legislative history of the ACI are of true significance. The first one is associated with the geopolitical Commission that played a pivotal role in the elaboration of this Union legislative act. The geopolitical Commission, headed by a former defense minister Ursula von der Leyen,

works with the reasonable assumption that nowadays the EU is operating in a more hostile environment. In this context, the geopolitical banner under which the current Commission is functioning should be treated as a response to the profoundly transformed international relations which are facing a growing need to better align economic and foreign policy. In practice, it assumes that the EU, namely the Commission, is presently establishing further links between the EU's Common Commercial Policy (CCP) and the Common Foreign and Security Policy (CFSP). Therefore, the Commission has turned a considerably dominant policy-making authority, even in the areas which are explicitly related to the CFSP. The significance of the creation of such links is determined by the fact that traditionally the Commission's role in CFSP matters has been limited *(Szép, 2024)*.

The second reason, making this legislative history remarkable, lies in the present EU's capability to more confidently develop externally oriented policy instruments evading the CFSP legal framework, by means of using non-CFSP Treaty provisions, including Article 207(2) TFEU. Under the provisions of Article 24(1) TEU, the CFSP remains subject to "specific rules and procedures" as well as the unanimity is required. The fact that the ACI has a different legal basis from the CFSP is highly substantial, as the Union's reactions under the ACI are similar if not identical to restrictive CFSP measures / sanctions. In other words, the EU is presently able to develop sanctions-like tools outside of the CFSP legal framework, as the latter's rules and procedures are becoming increasingly obsolete for handling the contemporary challenges of international relations *(Szép, 2024)*.

The present article is divided into three main parts. The first part accentuates the sufficient preparations undertaken by the geopolitical Commission for drafting a proposal on the ACI. The second part will characterize the Council and its rotating Presidency, and illustrate some Member States' reactions to the Commission's proposal. The importance of the Council's role in the legislative process is explained by the fact that it has introduced considerable changes associated with its role in the ACI. The amendment intended to ensure and secure that the Member States could assess international economic developments. The third part of the article will highlight certain amendments, adopted in relation to the ACI *(Questions and answers…)*.

***The ACI Establishment.*** The mentioned instrument is not automatic, and its implementation requires time. For many, the power behind the ACI manifests in the form of deterrence. Once the "trade bazooka" is applied, it becomes clear that the EU is determined and willing to enter a fight with the single market as leverage. Once the issue of coercion is brought up, the European Commission has 4 months to evaluate the case and the actions of the non-member state, after which EU Member States must decide by qualified majority whether the instrument should be activated or not. If that happens, a negotiation phase with the third country in question is set up. Should the negotiations fail, the EU can implement a diverse range of countermeasures, in addition to tariffs.

The ACI encompasses services, investments and access to government procurement as well as may allow for exclusion of foreign companies from EU tenders or a partial suspension of the protection of intellectual property rights. This implies that any response in terms of the ACI must be "proportionate and not exceed the level of injury to the European Union" *(Regulation (EU) 2023/2675, 2023)*.

The economic coercion has been undoubtedly triggered by escalating geopolitical tensions, weakened international cooperation as well as increasing weaponization of trade and investment. The coercion, emanating from various countries, threatens to cripple the ability of the EU and its Member States to perform legitimate action in areas of their own sovereignty. Consequently, in 2021 the European Parliament and some Member States aired their concerns on the issue and addressed the Commission to work out the mechanism to deter and combat the economic coercion *(Corlin, & Tadeo, 2026)*.

***The relationship between the ACI and preventive diplomacy.*** The EU's ACI, which came into force on December 27, 2023 and uses the threat of countermeasures to thwart economic blackmail, has become a key tool for preventive diplomacy.

The ACI and preventive diplomacy relationship may be illustrated by the below-listed major points:

- Deterrence as Prevention: The ACI's principal purpose is to deter coercion to ensure that no countermeasures need to be applied. The EU seeks to prevent conflicts from escalating via establishing a weighty "trade bazooka" including potential tariffs and investment restrictions.
- Structured De-escalation: Prior to any retaliation measures, the ACI mandates a formal process of dialogue and interaction, enabling the EU to identify coercion and attempt to find an amicable solution by means of diplomatic consultations at first.
- Preserving Sovereignty: Under the ACI, preventive diplomacy aims at mitigating risks to the legitimate sovereign choices of the EU and its Member States, acting as a shield against foreign interference in domestic policy decisions.
- Alignment with Global Peace: The ACI targets preserving peace and preventing conflicts, as stated in the EU's broader external action policies.
- Multilateral Coordination: The ACI sets up a framework for the EU's coordination with international partners (e.g. the G7) to tackle economic coercion globally by boosting and fortifying collective preventive diplomacy efforts.
- Last Resort Principle: Countermeasures are considered the ultimate step to be used only if direct negotiations and diplomatic means have been worn out.

These points specify the EU's ACI functions as a tool for preventive diplomacy and administering international economic relations *(Regulation (EU) 2023/2675, 2023)*.

***An example of economic coercion.*** There are various coercive practices. For example, "an EU trading partner may try to shape future legislative initiatives of the EU or dissuade the EU from putting in place a measure altogether by, for example, introducing (or threatening to introduce) extra, discriminatory import duties, intentional delays or refusing (or threatening to refuse) authorization needed to do business. They might also impose discriminatory selective border or safety checks on goods from a given EU Member State or organize state-sponsored boycotts against goods or investors from that country" *(Questions and answers…)*.

***EU response measures available under the ACI.*** The scope of perspective measures should be diverse in order to allow choosing and working out an effective and efficient response to any specific case of economic coercion, the EU economy bearing minimal or no impact at all. These measures aim at ceasing of the coercion.

The ACI enables to impose import and export restrictions on goods and services, intellectual property rights and direct foreign investments, in addition to various restrictions on access to the EU market, notably to government procurement, as well as to place products on the market meeting chemical and sanitary rules.

The Commission's Communication to the both European Parliament and the Council on the Commission's proposal for an Anti-Coercion Instrument of December 2021 recalls further possibilities within the Commission's existing powers, especially those related to funding, where restrictions might be also imposed, if required.

Vitally, the EU's response measures are available solely as a last resort, being subject to a number of conditions - that they can be deployed promptly, if the need occurs. The measures also must be proportionate to the harm they counter along with being targeted and temporary (i.e. are merely applied as long as the breach prevails).

The regulation's adoption, publication and entry into force complete the ordinary legislative procedure.

The first review of the regulation is due by December 2028, or three years after the first implementing act on determination, if it takes place earlier. Subsequent reviews will take place every five years thereafter *(Schäffer, 2024; Trade: political agreement…)*.

The EU is actively seeking to reduce reliance on US-based communication platforms like Microsoft Teams and Zoom by promoting European-hosted, open-source alternatives. Driven by

Digital Markets Act (DMA) regulations aiming to curb "gatekeeper" power, the EU is pushing for digital sovereignty, fostering tools like OpenTalk, Digital Samba, and Nextcloud Talk.

In this context, France will replace the American platforms Microsoft Teams and Zoom with its own domestically developed video conferencing platform, which will be used in all government departments by 2027.

This move is a pivotal part of France's strategy to seize using foreign software vendors, especially those from the United States, and regain control over critical digital infrastructure. This steps out at a crucial moment as France, like Europe, is reaching a turning point regarding digital sovereignty.

"The aim is to end the use of non-European solutions and guarantee the security and confidentiality of public electronic communications by relying on a powerful and sovereign tool," said David Amiel, minister for the civil service and state reform *(Davies, 2026)*.

It is also worth mentioning that during Munich Conference 2026 discussions took place regarding the possibility of reconsidering major military purchases from the USA due to rising political tensions, trade disputes, and concerns over long-term reliability of U.S. supply chains.

**The consequences for the EU.** There are a number of second-round effects. The first one derives from the fact that the ACI has never been applied and used in practice. Member States have widely discussed it, yet they are not aware of the possible consequences on political and geoeconomic terms.

For this very reason countries from Germany to Italy have repeatedly warned against introducing the ACI too quickly or without a good legal case behind it. Berlin and Rome became two of the member states most in favor of reaching an agreement with the US last year.

Last year, even as the US threatened to impose punitive tariffs on the bloc, the EU feared that implementing such strong measures against the US could backfire and damage the transatlantic ties. The EU still hopes to keep Washington engaged in the continent's security through NATO and discussions around Ukraine's peace settlement.

Besides the US, the EU also considered launching the ACI after China at the end of 2025 started weaponizing the export licensing of rare earth and critical minerals – crucial for Europe's tech and defense industries. Ultimately, the EU opted for dialogue *(EU anti-coercion instrument)*.

**Likely EU Use Against Greenland-Linked Tariffs.** The ACI has been described as a "trade bazooka" by the European policymakers and media in the context of tariff threats related to Greenland. Current EU deliberations show a preference for diplomacy initially. At the same time, EU institutions have openly signalized that ACI deployment remains an option if tariffs proceed.

A plausible sequence would follow, if tariffs were imposed in the range of 10% to 25% and explicitly conditioned on Greenland.

The Commission would first determine the coercion through documenting the tariff measures as economic pressure intended to force Denmark, and subsequently the EU, to agree to a territorial transaction. After that The Council would affirm the existence of coercion.

Second, a negotiation window. The EU would issue a formal request to withdraw the tariffs. This step could be linked to broader transatlantic trade discussions, while the Commission quietly prepares a retaliation package under the ACI.

Third, response package design. While maintaining EU unity, measures would likely be selected to maximize political and economic salience in the United States. Elevated tariffs on emblematic exports such as automobiles, agricultural products, aerospace goods, and spirit could be included. This could also include procurement and services restrictions affecting US technology, defense, and infrastructure suppliers competing for EU projects. Also, Selective financial and capital markets constraints could be applied to firms operating in strategic sectors such as defense technology, data, and critical infrastructure.

Fourth, escalation and linkage. The EU could expand measures against digital platforms and services or apply stricter FDI and IP restrictions on strategic technologies, If the United States escalated further. The EU could revive or combine other instruments, including traditional

retaliatory tariffs, previously prepared retaliation packages, and enforcement under the Foreign Subsidies and International Procurement regimes, In parallel. The outcome would be a layered response designed to amplify pressure on US businesses *(Keen, 2026; The EU's preventive diplomacy…)*.

**The EU's "trade bazooka".** The so-called "trade bazooka", officially known as the ACI, is a law that permits the EU to respond to economic extorsion from non-EU countries. It threatens very serious implications if they attempt to impose their will on the EU or its members. Particularly, it targets trade and investment measures by countries who are seen to interfere in the "legitimate, sovereign choices" of the EU or its member states.

This response can include a vast range of trade measures such as tariffs, import and export restrictions, curbs on trade in services as well as reduced access to banking and capital markets. Finally, it allows the EU to prevent access to most of the single market while neglecting existing international treaties. However, this is the nuclear option.

The real purpose of the "bazooka" is to bring other countries to the negotiating table. In fact, deploying it could cause serious economic damage within the EU itself, so it is seen very much as a last resort.

It is also not a rapid response measure, as under the current rules, the European Commission can spend up to four months investigating any possible coercion. Another six months can be spent negotiating with the country concerned and deciding whether there is a case for retaliation. Then, the EU's member states have up to 10 weeks to enable any action. So even if the commission were to pull the trigger now, it could be a year before the "bazooka" is actually fired *(EU–US trade tensions…; Freudlsperger, & Meunier, 2024)*.

**Suspending legislative work on the ratification process of EU–US trade agreement.** The EU is preparing to freeze the ratification process of its trade agreement with the United States as it seeks further clarification from President Donald Trump's administration regarding its new tariff program. The main political groups in the European Parliament announced they would suspend legislative work related to approving the agreement on Monday, February 23 2026, days after the US Supreme Court ruled against Trump's use of emergency powers to impose what he called reciprocal tariffs worldwide.

Bernd Lange, chair of Parliament's International Trade Committee and standing rapporteur for the US, issued the following statement: "The ruling by the Supreme Court of the United States of 20 February 2026 on the use of the International Emergency Economic Powers Act (IEEPA) is clear and unequivocal. Its implications cannot be ignored, and business as usual is not an option. A key instrument used on the US side to negotiate and implement the Turnberry Deal is no longer available. The situation is now more uncertain than ever. This runs counter to the stability and predictability we sought to achieve with the Turnberry Deal. The proposed replacement for IEEPA, Section 122, applies indiscriminately to all countries exporting to the United States and is imposed on top of the Most Favored Nation (MFN) rate. As a result, imports from the EU into the US would be subject to an applied rate exceeding the 15% threshold. This, in itself, constitutes a clear departure from the terms of the Turnberry Deal. Shadow rapporteurs, representing a majority of Members, have agreed that under the current circumstances work on the two Turnberry files should be put on hold until clarity, stability and legal certainty in EU–US trade relations are re-established. Consequently, the scheduled votes in committee on Tuesday, February 24, 2026 will not take place as planned and the shadow rapporteurs will reassess the situation next week" *(EU–US trade legislation…)*.

In this context, the European decision is not merely political; it is also linked to managing economic risks. Parliament seeks to avoid committing to a long-term agreement in an unstable trading environment, which could limit the EU's ability to renegotiate or amend its terms if US tariff policy changes again. In other words, the tariff freeze reflects an attempt to reassess the economic

cost of the agreement compared to the risks of exposure to unilateral decisions that could reignite broader trade tensions between the two largest Western economies.

***Key Findings on the recent researches launching the ACI's Solution:***

- Structure and Goal: The ACI provides a legal framework to address economic pressure – such as restrictions on trade or investment – that does not breach traditional international rules. Its primary aim is to act as a deterrent rather than just a retaliation mechanism.
- Targeted Actions: It allows the EU to impose a wide range of countermeasures, including tariffs, service restrictions, and limitations on access to EU foreign direct investment or public procurement.
- Geopolitical Impact: Research positions the ACI as a key example of the "geopoliticization" of EU trade policy, bringing issues previously considered under foreign and security policy under the umbrella of trade rules.
- Controversies: Discussions revolve around the determination of what constitutes coercion and the potential for a "double-edged sword" effect on businesses.
- Context: The tool was accelerated by incidents like China's trade actions against Lithuania.

The ACI represents a "big stick" aimed at protecting the EU's internal market from foreign pressure by focusing on instances of grave economic coercion *(Jackson, & Paddeu, 2025; Jerome, & O'Sullivan, 2026)*.

**Conclusions.** The EU's discussions about activating the "anti-coercion tool" reflect a qualitative shift in the way Europe deals with American pressure, as Brussels is no longer satisfied with a policy of diplomatic containment, but has begun to move towards building more solid economic and political deterrence tools. This shift indicates a growing European realization that the phase of dependence on American goodwill is over, and that transatlantic relations have entered a new phase governed by explicit interests rather than traditional ties.

The EU is expected to use the threat of activating the "trade bazooka" as a negotiating pressure card to force Washington to back down or ease its customs measures. However, simply introducing this tool into the confrontation arena will set a precedent that may later be used in other crises, meaning that Europe is putting itself on an upward path of economic and sovereign independence.

The European response is likely to push the Trump administration to expand the circle of escalation, whether by imposing additional tariffs or by using American influence within NATO as a counter-pressure card. Here, the trade war intersects with the security dimension, threatening to erode trust within NATO and prompting some European countries to accelerate plans to build independent defense capabilities in anticipation of any decline in American commitment.

This confrontation is likely to lead to a redrawing of the rules of transatlantic trade, so that relations become governed by a mutual balance of power rather than by fixed strategic understandings. Europe will also seek to diversify its trade and security partnerships with Asian and Oceania powers, to reduce its exposure to sudden American decisions.

In conclusion, the current crisis does not appear to be just a passing customs dispute, but rather the beginning of a phase in which Europe is moving to consolidate its position as an independent actor, while relations with Washington are entering an era of constant negotiation over influence, trust and interests.

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# ОСОБЛИВОСТІ РОЗВИТКУ СВІТОВОГО ГОСПОДАРСТВА ТА МЕВ
# TRENDS IN THE GLOBAL ECONOMY AND INTERNATIONAL ECONOMIC RELATIONS

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## SECTORAL PROSPECTS FOR THE IMPLEMENTATION OF QUANTUM TECHNOLOGIES IN INDUSTRY 4.0

## ГАЛУЗЕВІ ПЕРСПЕКТИВИ ВПРОВАДЖЕННЯ КВАНТОВИХ ТЕХНОЛОГІЙ В ІНДУСТРІЇ 4.0

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***Abstract.*** *This article examines the sectoral prospects for the implementation of quantum technologies within the paradigm of Industry 4.0 and the digital transformation of industrial systems. The study addresses the growing problem of technological asymmetry and the limitations of classical computational methods in managing complex industrial processes characterized by high uncertainty, large data volumes, and nonlinear dynamics. The research aims to identify the key sectors of Industry 4.0 where quantum technologies—particularly quantum computing, quantum communication, and quantum sensing—can provide significant competitive advantages. The article analyzes the potential application of quantum algorithms for optimization, risk modeling, predictive analytics, logistics, cybersecurity, and advanced materials engineering. It also evaluates institutional and infrastructural constraints affecting quantum technology adoption, including the lack of skilled human capital, high implementation costs, and regulatory uncertainty. The findings demonstrate that the integration of quantum technologies into industrial ecosystems will be uneven across sectors, with the highest potential in finance, energy, logistics, pharmaceuticals, and advanced manufacturing. The study concludes that the successful deployment of quantum solutions requires a hybrid technological architecture combining classical and quantum systems, as well as coordinated policies in innovation governance, investment, and education.*

***Key words:*** *quantum technologies, Industry 4.0, quantum computing, digital transformation, industrial ecosystems, quantum optimization, cyber-physical systems.*

***Анотація.*** *У статті досліджуються секторальні перспективи впровадження квантових технологій у парадигмі Індустрії 4.0 та цифрової трансформації промислових систем. Розглядається проблема технологічної асиметрії та обмеженості класичних обчислювальних методів у керуванні складними виробничими процесами, які характеризуються високим рівнем невизначеності, великими обсягами даних і нелінійністю динаміки. Метою дослідження є визначення ключових секторів Індустрії 4.0, у яких квантові технології — зокрема квантові обчислення, квантові комунікації та квантові сенсори — можуть забезпечити суттєві конкурентні переваги. У статті проаналізовано можливості використання квантових алгоритмів для оптимізації виробничих процесів, моделювання ризиків, прогнозної аналітики, логістики, кібербезпеки та розробки нових матеріалів. Оцінено інституційні та інфраструктурні бар'єри впровадження, зокрема дефіцит людського капіталу, високу вартість технологій і регуляторну невизначеність. Доведено, що впровадження квантових технологій матиме диференційований характер за секторами, з найбільшим потенціалом у фінансах, енергетиці, логістиці, фармацевтиці та високотехнологічному виробництві. Обґрунтовано необхідність формування гібридної технологічної архітектури та інноваційної політики для ефективної інтеграції квантових рішень.*

***Ключові слова:*** *квантові технології, Індустрія 4.0, квантові обчислення, цифрова трансформація, промислові екосистеми, квантова оптимізація, кіберфізичні системи.*

**Introduction.** Modern Industry 4.0 is characterized by the integration of cyber-physical systems, big data, artificial intelligence, and the Internet of Things. However, the growing complexity of industrial systems and the increasing volume of data create limitations for traditional computational approaches, thereby reducing the efficiency of management, forecasting, and optimization processes. The core problem lies in the need to transition to new computational paradigms capable of processing complex multidimensional systems in real time. Quantum technologies represent a potential response to these challenges; however, their implementation remains uneven, insufficiently explored, and requires a systematic sectoral analysis. This issue is directly related to key practical objectives: improving the efficiency of industrial production, ensuring technological sovereignty, developing innovation ecosystems and strengthening cybersecurity and infrastructure resilience.

**The purpose of this article** is to identify the sectoral prospects for the implementation of quantum technologies within the Industry 4.0 framework and to substantiate the economic feasibility of their application for enhancing the efficiency, security, and innovativeness of industrial ecosystems.

**Literature review.** The issue of quantum technologies in industry has been actively explored in contemporary research. A significant contribution to the development of quantum financial and industrial applications has been made by R. Orús, S. Mugel, and E. Lizaso, who substantiated the potential of quantum algorithms for optimization and modeling tasks. The development of digital financial and innovation ecosystems has been studied by D. Arner, R. Buckley, and D. Zetzsche, who emphasize the role of regulatory innovation and fintech infrastructure**.** Issues related to quantum machine learning and new computational models are addressed in the works of V. Havlíček and other scholars. At the same time, contemporary literature still lacks sufficient research on the sectoral dimension of quantum technology implementation within Industry 4.0, particularly from the perspective of economic efficiency, implementation risks, and institutional barriers. These aspects constitute the scientific novelty and research focus of the present study.

**Main results of the study.** The quantum economy (Q-economy) as a new phenomenon of the 21st century generates not only multifaceted impacts on the industrial systems of developed countries, but also creates new opportunities for their further development through the introduction of effective innovative business processes based on quantum computers (QC), quantum computing, quantum technologies, artificial intelligence (AI), and corresponding business models. Owing to

quantum technologies, more accurate tools for trading, analytics, and forecasting are emerging in various spheres and sectors of the economy. At present, the most "quantum-oriented" industries that are rapidly shaping the international quantum market and the Q-economy include information technology, the financial sector, medicine, transport and logistics, energy, and geological exploration. The management segment is also highly receptive in the context of using quantum computing for planning and optimization of production and business processes, as well as risk analysis and forecasting.

The peculiarities of the development of the ***information technology*** sector in the context of quantum computing are determined by the capabilities of quantum computers and their systems to counter modern cyber threats (methods of breaking classical ciphers bypassing conventional information protection methods), the level of sophistication of digital infrastructures, and the power of quantum AI models. Today, cyber threats are associated with *(PostQuantum, 2024)*:

*1)* intrusion of malicious actors into corporate computer systems and theft of personal customer data, which causes not only a loss of consumer trust but also significant regulatory fines (for example, in the EU, violations of data protection can result in fines amounting to a percentage of a company's annual turnover);

*2)* digital fraud schemes capable of halting the operation of entire enterprises or offices, where a cyberattack can completely paralyze company activities;

*3)* personnel/employees who, sometimes lacking basic cybersecurity knowledge, may inadvertently "open the door" to attackers by clicking on suspicious links or downloading infected files. At the same time, modern IT systems have become so complex that even specialists cannot always quickly identify all vulnerabilities and "holes" in security systems;

*4)* the activities of international criminal groups operating across different countries and regions, exploiting gaps in international law and complicating the work of law-enforcement agencies, thereby making the fight against cybercrime more difficult.

Modern approaches to post-quantum cryptography (*PQC*) and information protection are also linked to the fact that quantum computers are capable of breaking traditional encryption, posing a threat to the protection of personal, corporate, and state data. Quantum key distribution (*QKD*) uses the property of entanglement to guarantee channel security (any attempt at eavesdropping disturbs the quantum state and is quickly detected). This creates the need to develop legislative regulations governing the use of quantum technologies, ensuring security and addressing ethical aspects of healthcare and personal privacy. Moreover, the development of software for quantum computers separately requires a system for protecting intellectual property rights, clear legal frameworks for license distribution, etc. *(Kosobutsky, 2022)*. In addition, since security is ensured through the creation of cryptographic methods resistant to quantum attacks in order to protect information systems from potential threats, cybersecurity issues are moving into the domain of national security and require coordination at all levels of protection of critical infrastructure.

In the segment of AI and machine learning (*QML*), quantum models accelerate clustering and search in large optimization parameter spaces and cost/loss functions, as well as the processing of large and weakly structured data using algorithms such as *Quantum SVM*, *Quantum PCA*, and *Variational Quantum Classifiers*. Practical applications are still limited by the size of existing quantum computers, but this direction is actively developing. As for the modeling of complex systems, quantum computers have the greatest potential because quantum systems naturally model other quantum systems: chemical reactions, materials (superconductors, catalysts), molecular structures for pharmaceuticals, and physical processes in nanotechnology. This implies the creation of new materials for chips, modeling electronic components, and optimizing their architectural solutions *(Opryshchenko, 2025)*.

The current stage of quantum computer development is referred to as *NISQ* – "noisy intermediate-scale quantum" devices. Quantum networks and telecommunications as structural elements of IT infrastructure include quantum internet networks and hybrid classical-quantum cloud services at the first threshold level. At this level, leading companies such as *IBM Quantum, Google Quantum AI, Microsoft Azure Quantum*, and *Amazon Braket* are testing "quantum *VPNs*" based on

*QKD* and providing *Quantum-as-a-Service* solutions that allow the use of quantum algorithms without additional investment in new and expensive equipment. In the medium term, quantum computing in cybersecurity, telecommunications, AI, modeling of new materials for IT, and optimization of logistics and resources will become a significant part of hybrid infrastructure alongside classical supercomputers.

Competition in the field of AI accelerates the development of quantum computing, as the capabilities of hybrid systems that combine "classical AI" algorithms and quantum computing are increasing. In turn, quantum computing technology accelerates the improvement of AI through cloud services, which in the future will be applied in various directions and will influence the development of this segment. For example, this concerns the use of AI in the creation of autonomous vehicles (experts estimate the total value of this direction over the next five years at USD 110–210 billion *(McKinsey & Company, 2024)*), as well as the combination of high-precision quantum sensors and AI in cytology and the creation of new medical equipment for diagnostics and treatment. Materials science is also developing by modeling molecules and chemical reactions with a precision unavailable to classical computers (solving complex mathematical problems based on differential equations).

At present, the development of the IT sector, as well as the emerging industry of quantum AI technologies in general, is associated with an acute shortage of personnel and highly qualified specialists. Therefore, for the practical application of quantum technologies it is critically important to overcome the "talent gap" – to build an effective system for training specialists for the new industry (future quantum innovators whose qualifications combine physics, computer science, mathematics, and engineering). With the development of quantum technologies, various architectures and platforms have emerged, each with its own features (technological, commercial, and software-related) and used for solving different tasks. The main quantum platforms are created by key players in the quantum computing market – *IBM Quantum, Google Quantum, Rigetti Computing, IonQ, D-Wave Systems, and Quantinuum* – and include modular systems and superconducting quantum integrated circuits, cloud services through which quantum algorithms can be executed, and developed ecosystems with clear roadmaps toward fault-tolerant quantum systems. This means that the "quantum future" for the IT sector may be hybrid: classical computers + quantum computers + various types of quantum equipment together with quantum platforms *(Spinquanta, 2025)*.

In the modern ***financial sector*** of developed economies, quantum technologies (quantum computing and quantum algorithms), on the one hand, significantly accelerate the calculation of the value of derivative financial instruments and services, revolutionize algorithmic trading management, and improve traditional methods of risk control and management. On the other hand, they rapidly process and analyze large volumes of data from complex financial operations and optimize investment portfolios in accordance with current market pricing. Leading banks in developed countries are intensively introducing experimental testing systems aimed at minimizing financial risks (this is especially important for two types of portfolios: mortgage loans and treasury bills). It has been proven that quantum-AI-based computing technologies allow only a few dozen required simulations instead of thousands or millions in the case of classical computing *(Orson, 2025)*. This makes it possible to more effectively prevent fraud in any form and detect anomalies such as unexpected changes in stock prices.

Leading financial institutions that are currently actively investing in the development of quantum solutions (portfolio optimization, risk modeling, the integration of quantum computing and AI) as of 2025 include *JPMorgan Chase, Goldman Sachs, HSBC*, and *Barclays*. For example, *JPMorgan Chase* has its own department and team of specialists in quantum research and cooperates with QC Ware in the segment of developing "deep hedging" – a quantum-classical approach for hedging derivatives, structuring into a single system quantum methods for risk modeling, option valuation, and machine learning. *Goldman Sachs*, cooperating with quantum startups and providers, invests in research into quantum algorithms for building pricing models of complex financial instruments – options and derivatives *(Entangled Future, n.d.)*.

*HSBC*, as one of the recognized leaders in the financial sphere in terms of implementing quantum technologies, is actively investing in quantum-secure communications (*QKD*) and asset tokenization. In 2025, together with *IBM*, it implemented a pilot project, the results of which showed that a hybrid quantum-classical algorithm improved the accuracy of forecasting bond order-fill conditions by approximately 34% *(Elizadeh et al., 2024)*. As for *Barclays*, the bank, also in partnership with *IBM*, created a "brain trust" consisting of physicists, mathematicians, and programmers to study quantum algorithms for optimizing settlement calculations.

Currently, for banks, the key areas in which quantum approaches are actively researched, adapted to business processes, and implemented as pilot projects are the following:

1. ***Portfolio optimization and trading strategies.*** Quantum optimization algorithms (for example, QAOA), which significantly accelerate the solution of problems with a large number of variables, are used for: optimizing portfolio structure taking into account risk; selecting the most effective assets; forming rebalancing strategies; routing and optimizing trade execution.
2. ***Risk management.*** Quantum methods enable accelerated calculation of VaR, CVaR, and stress-testing scenarios, while quantum computing accelerates the modeling of complex dependencies between assets.
3. ***Modeling and valuation of derivatives.*** Quantum algorithms accelerate Monte-Carlo simulations used for option pricing, evaluation of complex structured products, and quantitative analytics.
4. ***Cryptography and cybersecurity.*** Quantum-secure communications (QKD) for banking transactions and internal communications, and preparation for the PQC era to ensure protection against future quantum attacks.
5. ***Fraud detection and anomaly detection.*** Quantum machine learning models (QML) improve anomaly classification, recognize patterns in transaction data, and contribute to combating money laundering (AML).
6. ***Algorithmic trading and market forecasting.*** Quantum ML models improve time-series forecasting, increase signal accuracy, and accelerate models with high-dimensional data.
7. ***Portfolio insurance and actuarial calculations.*** Quantum models optimize not only forecasting of insurance risks, but also insurance reserves and actuarial scenarios.

From these seven key areas, four main directions of the use of quantum technologies by banks in modern conditions should be highlighted *(Byrum, 2025)*. First, quantum cryptography (*QKD*) for protecting channels for transmitting financial information from unauthorized interception based on quantum mechanics principles. A number of well-known banks – *Bank of China, BBVA, HSBC, JPMorgan Chase* – have already carried out pilot projects related to quantum cryptography in cooperation with *ID Quantique, Toshiba Quantum*, and *ZTE Quantum Lab*.

Second, quantum machine learning (*Quantum ML*) for processing large volumes of financial data to detect fraud, calculate risks, credit scoring, dynamic pricing, and algorithmic trading. *Goldman Sachs* together with *IBM Quantum* studied the use of quantum computing for pricing complex derivatives, while *Barclays* already applies quantum algorithms to portfolio optimization tasks.

Third, quantum optimization for finding the best financial strategies, investment decisions, logistics, and resource allocation. Classical optimization methods require large computational power, whereas quantum algorithms (such as *QAOA* or *Grover's search*) significantly accelerate such calculations. *JPMorgan Chase* together with *D-Wave* is actively researching portfolio optimization, while *BBVA* tests quantum optimization in corporate banking.

Fourth, *PQC* algorithms resistant to quantum attacks, used to upgrade the entire digital security infrastructure of banks before quantum computers become a threat. *HSBC* and *Deutsche Bank* are already testing post-quantum algorithms as replacements for *RSA* and *ECC* (together with *NIST, Microsoft*, and *IBM*).

Currently, leading banks create simulations of unstable markets that account for nonlinear probabilistic factors (quantum market modeling), use quantum classifiers (*QNN, QSVM*) to detect atypical transactions (fraud), hybrid quantum-classical ML models to analyze customer behavior

(AI consulting), and partnerships with leading quantum companies. For example, *JPMorgan Chase* partners with *IBM* and *D-Wave* in quantum optimization and derivatives pricing; *Multiverse Computing* works with *BBVA* on "portfolio optimization on quantum processors"; *HSBC* together with *BT* and *Toshiba* develops QKD projects for secure communications; *IBM Quantum* and *Goldman Sachs* cooperate on QML for financial models; next-generation cryptography is developed jointly by *Standard Chartered* and *ID Quantique (Zhou, 2025).*

Such active cooperation is due to the fact that the banking sector is highly concerned that quantum computers may break *RSA, ECC*, and *TLS* encryption, making critical information vulnerable. The full migration to new ciphers (including quantum-secure protocols) is estimated to take 5–10 years. In general, banks use quantum technologies both for innovation and for self-protection, investing in *QKD, QML*, optimization, and the development of quantum-resistant infrastructures, since the second quantum revolution will transform everything – from encryption to financial decision-making.

The potential advantage of quantum approaches over classical ones in efficiently solving financial problems—such as portfolio optimization and derivatives hedging—lies in the following *(Ko & Lee, 2025)*.

In the classical approach to ***portfolio optimization***, classical quadratic programming is used (for example, minimizing risk at a given return within the mean–variance framework) together with classical algorithms whose computational complexity increases sharply in the presence of nonlinear constraints such as transaction costs, rebalancing, and risk considerations when scaling to many assets. In addition, Monte Carlo simulations (used for risk assessment) typically require a large number of iterations, especially for high-precision estimates, which becomes computationally slow in high-dimensional settings.

Under a quantum approach, the *QAOA* algorithm formulates portfolio optimization as a quadratic unconstrained binary optimization (*QUBO*) problem and searches for the optimum potentially faster and more effectively under complex (including hybrid) constraints. Compared to classical approaches, some hybrid quantum solutions have already demonstrated competitive results even on limited quantum hardware. Thus, the potential advantage of the quantum approach lies in its ability to process more complex constraints with fewer trade-offs in speed, even when combined with classical computing platforms. At the same time, real quantum advantage is not guaranteed in all cases, especially for small or well-structured problems where classical solutions are already highly efficient.

With regard to ***derivatives hedging***, the classical approach relies on stochastic models (e.g., the Black–Scholes model, delta-hedging models, or more complex multifactor models) combined with classical machine learning methods such as reinforcement learning (*RL*). However, classical *RL* faces limitations: training an agent that accounts for transaction costs, nonlinear markets, and liquidity risk is a complex and computationally expensive task. Within a quantum-classical (actor–critic) framework, the search and evaluation of hedging strategies are performed with a quantum component, whose solutions demonstrate significantly higher quality (for example, more accurate hedging with lower error) compared to classical approaches. Even at the current stage of quantum technology development, hybrid quantum-classical models can better capture complex market factors—such as liquidity, nonlinearity, and transaction structures—than simplified classical models. In the medium term, with the development of quantum computing, quantum infrastructure, and cloud-based access via *APIs*, such an approach is expected to provide a real competitive advantage in derivatives hedging.

The use of quantum computing in the context of modern mortgage lending markets is of particular interest to banks and other financial institutions, as it enables the solution of a wide range of tasks: (a) real estate pricing and valuation of mortgage collateral; (b) forecasting changes in real estate markets; and (c) more accurate risk calculations in mortgage lending, including the selection of optimal scoring models and default probability forecasting *(Myronchuk et al., 2024)*. Another potential application of quantum technologies is the development of more efficient project management systems for residential construction.

In addition, several important advantages arise from the use of quantum computing. First, there is a significant increase in the security of mortgage lending operations through the use of advanced encryption methods that ensure the protection of clients' personal data against unauthorized access. Second, quantum approaches enable the creation of individualized lending programs for each borrower, determining the maximum loan amount that can be granted with minimal risk to the bank, thereby reducing errors in risk calculations and improving overall operational efficiency. Third, the optimization of banking systems through nonlinear optimization based on *Grover's algorithm* can accelerate mortgage approval processes, while the use of blockchain technologies enables secure recording of all stages of loan issuance and repayment. This creates a transparent accounting system for transactions between banks and clients and reduces opportunities for borrower fraud.

Quantum technologies are no longer viewed merely as a distant prospect, but rather as an integral component of banking cybersecurity strategies. Although quantum computing has not yet been widely implemented across all banking processes, concrete research initiatives and pilot projects are already underway. This indicates that European banks are preparing for the future active deployment of quantum hardware, quantum computing, and quantum algorithms. Today, the European Union and European financial institutions are taking quantum readiness very seriously, particularly in the field of cybersecurity – through forums, conferences, and cooperation among central banks. Banks are exploring quantum technologies, testing transaction models, and researching quantum key distribution (*QKD*) and post-quantum cryptographic algorithms with strategic investment support from supranational institutions (for example, the *European Investment Bank* promotes the development of quantum companies to build an ecosystem that can positively impact the financial sector). While significant challenges remain, there is a clear understanding that the "quantum era" in finance is not a question of "if," but of "when."

According to an optimistic forecast scenario for the development of the banking sector for 2035–2040, the 2Q revolution will achieve the following *(PostQuantum, 2024)*:

- ***Absolute communication security*** – through quantum cryptography: all major banks will transition to *QKD* connections between headquarters, data centers, and exchanges. Client transactions will be encrypted using post-quantum algorithms approved by the *NIST standard* (e.g., *CRYSTALS-Kyber, Dilithium*). Information breaches will become physically impossible—any eavesdropping attempt alters the quantum state of the key, and the system signals an attack.
- ***Quantum asset management optimization***: banks will utilize quantum optimization algorithms (*QAOA, VQE*) for portfolio and risk management, dynamic hedging, and real-time liquidity analysis. Calculations that previously took hours or days on supercomputers will be performed in seconds on a quantum chip. For example, banks will be able to calculate an optimal portfolio of 1,000 assets in real time, taking into account macroeconomic shocks and client constraints.
- ***Quantum machine learning (QML) → personalized banking AI***: client analytics will operate on hybrid quantum-classical neural networks capable of understanding behavioral patterns, emotions, and client preferences. AI assistants in banks will recommend investment products that align not only with income but also with the client's values, forecast future solvency using quantum probabilistic models, and detect fraudulent actions before they become visible.
- ***Quantum-resilient banking infrastructure***: all internal bank protocols will be built on post-quantum cryptographic algorithms; smart contracts, blockchain, and tokens will account for quantum threats, and networks will self-assess for quantum influence (e.g., via random fluctuations linked to quantum noise).
- ***Quantum-accelerated trading***: algorithmic trading will run on specialized quantum processors. Arbitrage strategies will be implemented faster than classical algorithms, leveraging the parallel superposition of possible market scenarios. Banks without a quantum processor will lose revenue due to slower algorithmic execution.
- ***Financial forecasting = quantum simulation***: economic scenarios will no longer be constructed manually; quantum simulations will model market collapses, the impact of climate

change on global finance, cryptocurrency instability, and the effects of wars, migration, and pandemics within a complex nonlinear environment.

New banking professions will emerge, such as quantum financial analysts (designing quantum risk and return models), quantum crypto-architects (ensuring quantum-resilient bank security), *QML*-engineers (developing hybrid quantum-classical AI for banking services), quantum simulator operators (creating future financial simulations), and quantum asset trust managers (managing assets built on quantum cryptography). Overall, the banks of the future will be a hybrid of quantum physics, AI, and financial ethics, with the most successful financial institutions being those that begin preparing for the quantum transition today.

Quantum technologies also have the potential to radically transform the ***medical sector*** – from drug development at the atomic level with specified properties to diagnostics and data protection. Quantum computing creates new opportunities, first, for discovering novel treatments, including personalized therapies aligned with a patient's genetic profile; second, for rapid diagnostics and chemical reaction modeling in the near future with initial practical applications; third, for developing measures against viruses, oncological and autoimmune diseases, protein folding simulations, and advancing therapies for neurodegenerative disorders such as Parkinson's and Alzheimer's, currently considered incurable. The prospects for quantum technologies in medicine are substantial, although most remain in active research and prototype stages. Key breakthrough directions in applying quantum approaches to medicine include *(Alrashed, 2025)*:

a) ***Quantum computing for drug discovery*** – QC is already capable of modeling molecules and chemical reactions at levels unreachable by classical supercomputers. Potential benefits include accelerated discovery of new drugs (precise modeling of proteins, enzymes, and drug interactions), optimization of drug structures, and prediction of side effects and interactions. This could reduce drug development time and cost from 10–15 years to 2–3 years.

b) ***Quantum sensors for diagnostics*** – highly sensitive to magnetic and electric fields, temperature, or gravitational changes, enabling next-generation ultra-precise *MRI* (quantum magnetometers based on *NV* centers in diamonds) and early detection of oncology or neurodegenerative diseases through nanoscale biomarkers. In the future, quantum sensors may detect neuronal electrical activity at the single-cell level without invasive implants. Although still experimental, mass adoption is expected within 5–7 years.

c) ***Quantum biology*** – a young field studying quantum effects in biological systems, enabling the use of quantum technologies to understand photosynthesis mechanisms, bird migration, new therapeutic methods (e.g., through effects on quantum processes in proteins), and ultra-precise models of cellular processes, including *DNA* mutations. Significant progress in quantum molecular modeling is expected over the next 8–10 years.

d) ***Quantum cryptography for medical data*** – ensuring fully secure communication channels (*QKD*) between hospitals, safe telemedicine, secure medical cloud systems, and protection of large medical AI systems from cyber threats.

e) ***Quantum modeling of the human body using QC*** – enabling more accurate protein folding simulations than AlphaFold, real-time cellular reaction modeling, and personalized predictions of patient responses for diagnosis and treatment (next-level personalized medicine).

Today, medical information (electronic patient records, examination results, telemedicine data, and personalized therapy data) is among the most valuable assets for hackers—on the "black" market, it sells for higher prices than banking data. According to research, within 5–10 years, powerful quantum computers will be capable of breaking classical ciphers (*RSA, ECC*), making it essential to update medical systems with quantum-resistant measures today. Commercial *QKD* systems are beginning to be integrated into medical data centers. *QKD* makes communication channels between hospitals virtually unbreakable, enabling secure transmission of diagnostic images, protecting AI models from theft, and preventing falsification of medical data *(Chow, 2024).* Currently, large hospitals and research centers in the *PRC* are transitioning to cloud platforms with AI modules, while video consultations, test result transfers, and remote surgery rely on quantum-protected channels to prevent information leaks.

At present, QC can model complex molecular processes involved in cancer diagnostics, such as drug interactions with oncogenic proteins (e.g., *p53, KRAS*), enabling the discovery of new compounds that block mutational pathways and accurately predict toxicity. This is achieved through accelerated testing of thousands of molecular variants (with higher precision than classical simulations) and personalized drug selection for specific tumor genotypes. Companies such as *Roche, Amgen*, and *Pfizer* are already using quantum simulators to study oncological drugs, and quantum magnetometers (e.g., sensors based on *NV* centers in diamond) capable of detecting: a) single protein markers; b) minimal changes in tissue magnetic properties; c) nanoparticles binding to oncomarkers. This allows preventive detection of tumors at an early stage—when they consist of only a few hundred cells, rather than millions *(Liu, 2025)*.

Quantum sensors already play a leading role in magnetoencephalography, measuring magnetic fields generated by the human brain to determine the precise location of magnetic signals in the body. Potentially, this allows early diagnosis of brain tumors and oncology, Alzheimer's syndrome, or epilepsy without tissue sampling, and more accurate disease monitoring at cellular and molecular levels than existing methods. In real time, quantum dots are experimentally used to deliver drugs directly into cancer cells, while controlled nanostructures facilitate photodynamic therapy. Additionally, quantum effects in DNA are being studied for their impact on mutation and repair processes *(Magesh et al., 2024)*.

In fact, quantum computers, thanks to their ability to operate on quantum states, have significant potential for modeling proteins (including oncogenic proteins) and the electronic structure of molecules. Quantum algorithms (e.g., *Variational Quantum Eigensolver, VQE*) allow identification of fundamental energy states of molecules (electronic configurations) and more accurately reproduce generative design of new molecules (ligands), assessing their stability, binding energy with proteins, and potential efficacy. In other words, AI and quantum computing are combined: AI generates new molecules (ligands), which are then evaluated by a quantum algorithm for their viability *(Yingngam & Khang, 2024)*. Using hybrid quantum computing, startups in medical R&D are developing advanced protein design methods that surpass classical approaches.

Thus, quantum approaches in medicine and microbiology can model protein dynamics – altering shapes and electron motion—particularly important for "hard-to-target" proteins, such as those with conformational changes or complex microenvironments. Quantum models can also be used for pre-screening large molecular libraries to identify the most promising candidates for further laboratory testing, reducing experimental load and accelerating drug discovery. For example, in 2025, researchers at the University of Toronto and Insilico Medicine generated molecules targeting the *KRAS* oncoprotein, previously considered "undruggable," using a hybrid AI + quantum computing approach *(University of Toronto, 2025)*.

Although the current stage of quantum technology in medicine is relatively early, its potential is significant. Experts in quantum medicine estimate approximate implementation timelines as follows: a) quantum diagnostic sensors – 3–7 years; b) quantum drug discovery – 5–10 years; c) quantum treatment methods – 10+ years; d) full-scale quantum cellular modeling – approximately 10–20 years *(Market Research Future, 2025)*.

As the healthcare sector rapidly moves toward cloud storage and data transmission, the risk to patient privacy increases. Modern cryptography, from passwords to financial systems, can be broken with sufficiently powerful quantum computers. Consequently, quantum technologies now offer a secure, unauthorized-access-resistant approach (quantum-safe cryptography) to support safe data transmission on electronic healthcare platforms. This method, in the context of a potential shift to quantum computing paradigms, demonstrates a genuine strategy for effective steganography of medical files, providing high resistance to data loss attacks *(Bera et al., 2025)*. The advantages in improved forecasting and speed offered by quantum computing create opportunities for breakthrough discoveries. While quantum computing cannot yet fully secure medical data, the technology already presents clear use cases requiring innovative thinking and enabling competitiveness in a rapidly changing business environment alongside classical medical methods.

In summary, quantum technology and quantum models in medicine: a) revolutionize the

development of novel drugs and therapeutic methods; b) accelerate research processes for creating effective drugs; c) reduce diagnostic costs and improve accuracy; d) shorten development time and expenses by modeling molecular interactions at the quantum level; e) enable the design of personalized treatment plans using quantum analysis methods, considering patient-specific biological features based on genetic and biomarker information. Essentially, this represents a technological breakthrough in understanding biological processes at the molecular level, accelerating the development of new drugs.

Quantum technologies are beginning to be actively applied in ***logistics*** and supply chain management, fundamentally transforming this segment of the economy by making it more efficient (reducing costs and improving customer service), more flexible (managing inventory through forecasting), and less expensive (reducing delivery times and costs, optimizing logistics routes in real time). In the context of quantum research, time savings become almost decisive – not only in production but also directly in the execution of logistics business operations. Overall, for modern business, time is the most valuable resource, and when it comes to time management, quantum computing is applied simultaneously across multiple areas, significantly increasing efficiency while ensuring consistent results.

The application of quantum technologies in logistics and supply chain management is still at an early stage, but several promising directions for implementation have already been identified *(Dutta et al., 2025, pp. 110–143).*

Today, one of the most important areas is solving complex optimization problems, such as optimal allocation of transport vehicles, finding the shortest or most cost-effective routes, and dynamically rerouting in cases of traffic congestion, delays, or accidents. Quantum algorithms (e.g., *QAOA*) can potentially find optimal solutions much faster than classical methods, especially for very large datasets. Additionally, in the optimization of operations at ports and hubs, modeling includes ship and cargo queues, efficient allocation of cranes and personnel, and rational planning of loading and unloading operations, potentially reducing delays and increasing port throughput.

Secondly, inventory management benefits from quantum modeling of vast multidimensional scenarios and optimization of stock levels across complex networks, objectively reducing storage costs and helping to prevent shortages. This is particularly effective for global companies with large SKU counts and unpredictable demand. Quantum simulations can process large models more quickly, including: a) demand forecasting considering economic and social factors; b) real-time modeling of transport flows; c) fleet management for autonomous vehicles and equipment.

Thirdly, planning global supply chains—which are extremely complex systems with numerous variables (delivery times, risks, customs clearance, weather conditions) – can be enhanced by quantum models that forecast supply disruptions, simulate alternative routes, and optimize supplier selection and interactions. Moreover, quantum technologies encompass not only computation but also quantum cryptography, providing: 1) secure information exchange between logistics centers; 2) prevention of data interception (*QKD*); 3) enhanced security for drones, autonomous trucks, and "smart" warehouses.

Leading companies in the global quantum logistics market actively experimenting with quantum and quantum-inspired solutions include three avant-garde players: *DHL, Toyota & Fujitsu*, and *Einride & IonQ*. For example, *DHL* collaborates with Terra Quantum on hybrid optimization solutions for routing and reducing terminal idle time, and with Honeywell on quantum algorithms for load optimization, multimodal route planning, and supply chain disruption management. *Toyota & Fujitsu* use the "*Digital Annealer*" (quantum-inspired optimizer) and the *QAmplifyNet* model (hybrid quantum-classical neural network) for optimizing transport routes, forecasting delays and backorders in the supply chain, and production planning *(Quantum Horizon, 2025)*.

Regarding the current state of quantum technologies in logistics, companies such as *FedEx, Volkswagen, BMW, Maersk*, and others are testing logistics solutions within pilot projects—applying quantum algorithms to specific supply chain resilience optimization tasks (route optimization, demand forecasting, and quantum data security). However, the current stage is limited by the development of necessary hardware (quantum processors) for widespread adoption. Today,

companies are collaborating on using quantum computing to optimize autonomous vehicle routing and enhance logistics business process efficiency. For instance, within the EU, a quantum-optimized traffic management system is being developed to provide "ultra-fast and environmentally safe routes" for public transport by *Volkswagen* and *D-Wave*. Its features include: first, reducing passenger wait times by minimizing long-distance trips without passengers; second, since transport is currently the largest source of greenhouse gas emissions, the system benefits both passengers and drivers while reducing environmental impact by selecting the most efficient routes.

Currently, most real-world projects in the *PRC* logistics market are pilot projects or research initiatives, with full-scale commercial deployment remaining limited. Significant technological barriers (hardware, integration) and investment in quantum initiatives are treated as conditions for the long-term strategies of major logistics companies. Additionally, not all logistics optimization problems are suitable for quantum algorithms, requiring careful assessment of where to implement quantum solutions. At the same time, due to existing limitations of current quantum computers, many companies employ "quantum-inspired" or hybrid models, which can already provide benefits today – the primary economic effect is realized through reduced costs (fuel, time, idle periods) and increased flexibility (responding to changes).

Meanwhile, implementing and integrating quantum solutions into existing logistics IT systems (*ERP, WMS*) is a complex task. This is not only because current quantum computers are still insufficiently powerful with limited coherence times, but also because quantum computing remains costly (especially for demonstration projects), there is a shortage of specialists knowledgeable in both logistics and quantum algorithms, not all logistics problems are suitable for quantum algorithms, and classical algorithms are already proven and sufficiently effective for "traditional" logistics companies *(Phillipson, 2025)*.

The implementation of quantum technologies in logistics is expected to lead to significant shifts in the labor market, as traditional professions gradually become obsolete, giving way to roles requiring specialized knowledge in physics, programming, and engineering. These include positions such as quantum logistics programmers and engineers specializing in quantum cryptography for logistics, which implies investments in education and professional training. Today, several major international logistics companies are already investing in the development of "quantum qualifications."

Thus, quantum technologies hold significant potential for the logistics sector, particularly in combinatorial optimization, routing, scenario simulation, and security. Currently, they complement rather than replace classical systems, meaning that through hybrid approaches, many companies are already realizing benefits. The most successful cases demonstrate not just improvements but real economic value, including cost reduction, increased efficiency, and enhanced supply chain resilience. Therefore, for modern logistics companies, investing in research and pilot projects now is crucial to be prepared for the moment when quantum technologies mature.

QC provides fundamentally new opportunities for the ***energy sector***, spanning production, storage, system optimization, and security enhancement. A key feature of using quantum technologies in modern energy systems – which are complex networks with numerous variables (demand, generation, prices, losses, balancing) – is the application of quantum computing for system optimization. This involves not only optimizing energy distribution (reducing network losses, identifying the most efficient transmission schemes, dynamic balancing amid demand fluctuations) and the operation of power plants and energy blocks (sequencing unit activation/deactivation, reducing costs, and increasing efficiency) but also managing smart grids: scheduling autonomous sources, forecasting and responding to renewable energy generation fluctuations, and rapidly modeling emergency scenarios.

Monitoring and quantum cryptography for energy networks have become a critical area where quantum computing is gaining priority. This includes quantum sensors, which are far more sensitive than classical sensors and have applications ranging from real-time detection of defects and overloads to precise monitoring of voltage and current. Quantum magnetometers are used to monitor energy infrastructure, detect microcracks in turbines, oversee pipelines, and enhance nuclear power

plant safety. Quantum key distribution (*QKD*) protects network management from external attacks, prevents interception of communications between facilities, and ensures secure communication among dispatch centers, substations, and sensor nodes. This is particularly important for smart grids, which involve millions of interconnected devices *(Fazilat & Zioui, 2025)*.

Promising optimization of renewable energy generation (*RES*) is being carried out using quantum algorithms, which in the near term will help: a) model wind flows and solar insolation; b) optimize the placement of solar and wind power stations; c) forecast *RES* output with high accuracy; d) improve stability in networks with a high share of renewable energy. A "top ten" group of companies has already emerged in the global energy market, investing heavily in quantum R&D for the energy sector and conducting pilot projects:

- *Chevron and ExxonMobil* (quantum chemistry research for fuel and hydrogen).
- *BMW* and *BASF* (new materials for batteries and accumulators).
- *Siemens Energy* (quantum simulations and sensors for energy networks).
- *EDF* and *EON* (Smart Grid optimization using quantum algorithms).
- *Honeywell* (quantum cryptography for energy infrastructure).
- *IBM* and *Google Quantum AI* (modeling catalysts and materials for energy applications).

The advantages of quantum technologies for the energy sector include rapid solution of complex multifactor optimization problems that are difficult for classical systems, increasing efficiency in energy transmission and distribution, reducing network losses and operational costs, and enhancing overall infrastructure security. Since not all energy problems have yet achieved "quantum advantage," the high cost of early-stage quantum technology implementation necessitates a combination of quantum and classical solutions.

Indeed, the near future of the energy sector lies in hybrid quantum-classical systems, which combine the precision of classical systems with the speed of quantum algorithms. While classical methods remain the backbone of energy today, quantum technologies are expected to fundamentally transform optimization models for energy network structures, electricity generation forecasting methods, the development of new materials for the sector, and cybersecurity for critical energy infrastructure.

The most promising area where quantum technologies and quantum computing offer a real advantage is the chemical industry, particularly in ***quantum chemistry for creating advanced materials with unique, pre-defined properties*** (such as weight characteristics, high strength, and durability). This dramatically optimizes manufacturing processes, enhancing efficiency and reducing overall production costs. Quantum simulations help model the behavior of atoms and molecules to develop solid-state batteries, more efficient lithium-sulfur and sodium batteries, as well as supercapacitors with high energy density. Experimental projects are underway for new catalysts required for "green" hydrogen production, improving fuel cell efficiency, and reducing the energy consumption of chemical processes. The ability to model the electronic structures of complex materials offers a tangible prospect for creating cheaper high-temperature superconductors and new low-loss materials for transmission lines *(Korzh, 2023)*.

In ***geophysical exploration***, the demand for high-precision measurements in critical applications is rapidly growing, and this demand is met by quantum sensing—future quantum technologies that provide sensitivity unattainable by classical sensing. Modern geophysical research requires quantum gravimeters and magnetometers to assess underground resources (gas, water, geothermal zones) and enable more accurate modeling of subsurface structures. Today, in geology, quantum gravimeters assist in locating oil and other minerals, identifying water sources, and efficiently detecting crustal faults using a "quantum film"—a next-generation matrix that identifies magnetic and gravitational fields and delivers more reliable and precise measurements, particularly under harsh environmental conditions. With the development of quantum sensing technology, interest in cloud platforms, which provide the necessary computational power for real-time data analysis, is increasing.

Modern quantum atomic clocks enable measurements of gravity and other parameters, elevating the performance of *GPS* systems, autonomous vehicles, and any other devices requiring

precise timekeeping. By leveraging quantum sensors, the need for *GPS* satellite signals in shielded environments, underwater, or underground could effectively disappear. Their advantages also include minimal calibration requirements and sensitivity and precision 10–20 times higher than conventional systems. Furthermore, quantum sensors (including magnetometers based on neutral atoms or diamonds) will open new possibilities in navigation systems across a wide range of transportation modes. According to *McKinsey* estimates, the commercial quantum sensing market could reach $1 billion by 2030, growing annually by 10–15%, and by 2040, this technology will not only radically transform industries that rely on sensor technologies but will also revolutionize those that depend directly on measurement precision *(Colobridge, 2024)*.

**Conclusions.** Currently, the new era of technological quantum development—the Q-economy of the 21st century – offers prospects that are transforming nearly all sectors based on collaboration and partnerships among governments, businesses, and the scientific community. This cooperation is becoming crucial for creating a secure quantum future and a sustainable economy. The evolution of information technologies and breakthroughs in understanding and utilizing the fundamental laws of nature to develop new products, services, and business models define a new direction in science and technology. This involves joint financing of research in the Q-economy, the formation of safety and operational standards, and the establishment of international protocols for data protection and privacy.

Thus, the solid-state quantum mechanics of the 1Q revolution made it possible to create the transistor, which today underpins all electronics (classical computers, smartphones, smart homes, etc.), yet this represents only 1% of the potential of quantum physics. The 2Q revolution accelerates the development of technological potential for scientific breakthroughs, competent management, and risk assessment as criteria of global security. The capabilities of future quantum computers in the Q-economy of the 21st century will be millions of times greater than today's computing machines, with high-speed data processing and transmission capabilities and strong protection against unauthorized access. Quantum technologies and the creation of smart materials with exclusive properties are enabling ultra-fast information processing systems with built-in data security. They are transforming standards in medicine and energy, rules governing financial systems, and the development of industrial sectors of the economy. The growing digital divide between different market segments creates a unique economic dilemma: the drive for careful market information analysis and strategic planning, accompanied by the need for constant adjustment of national macroeconomic priorities.

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**SHADOWIZATION OF INTERNATIONAL TRADE IN A NEO-INSTITUTIONAL PERSPECTIVE: REGULATORY ARBITRAGE AND STRUCTURAL DUALITY**

**ТІНІЗАЦІЯ МІЖНАРОДНОЇ ТОРГІВЛІ У НЕОІНСТИТУЦІЙНІЙ ПЕРСПЕКТИВІ: РЕГУЛЯТОРНИЙ АРБІТРАЖ І СТРУКТУРНА ДУАЛЬНІСТЬ**

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***Abstract.*** *The article proposes a neo-institutional interpretation of the shadowization of international trade, in which the phenomenon of the shadow economy is analysed through the categories of transaction costs, institutional dysfunctions and regulatory arbitrage. The purpose of the article is to demonstrate that the structural duality of economic systems - the sustained coexistence of formal and informal sectors - is not a self-explanatory characteristic of the economic order but an analytically derivable consequence of specific institutional configurations. It is substantiated that in international trade, institutional gaps between jurisdictions generate systemic incentives for regulatory arbitrage, which transforms the shadow economy from a marginal anomaly into a structurally embedded component of cross-border economic relations. A typology of institutional mechanisms of shadowization of international trade is proposed, including trade misinvoicing, jurisdictional tax engineering, and digital channels for circumventing fiscal control. It is demonstrated that the digitalization of international trade creates a qualitatively new dimension of shadowization, where traditional control mechanisms prove ineffective and the boundary between optimization and shadow activity becomes increasingly blurred. The concept of structural duality is reinterpreted as a product of institutional misalignment: the informal sector is sustained not by cultural inertia or underdevelopment, but by the rational response of agents to high transaction costs of legal activity and weak enforcement. The article concludes that effective de-shadowization policy requires not so much the strengthening of repressive mechanisms as the reduction of institutional barriers, the harmonization of regulatory regimes between jurisdictions and the creation of conditions under which legal activity becomes economically more attractive than shadow activity.*

***Key words:*** *shadow economy, shadowization, international trade, neo-institutional approach, regulatory arbitrage, structural duality, transaction costs, institutional dysfunction, trade misinvoicing, tax engineering, digital trade, de-shadowization*

***Анотація.*** *У статті запропоновано неоінституційну інтерпретацію тінізації міжнародної торгівлі, у межах якої феномен тіньової економіки аналізується через категорії трансакційних витрат, інституційних дисфункцій та регуляторного арбітражу. Мета статті - показати, що структурна дуальність економічних систем - стійке співіснування формального і неформального секторів - є не самоочевидною характеристикою господарського устрою, а аналітично виводиться з конкретних інституційних конфігурацій. Обґрунтовано, що у міжнародній торгівлі інституційні розриви між юрисдикціями генерують системні стимули до регуляторного арбітражу, який перетворює тіньову економіку з маргінальної аномалії на структурно вбудований компонент транскордонних економічних відносин. Запропоновано типологію інституційних механізмів тінізації міжнародної торгівлі, включаючи маніпулювання торговельною вартістю, юрисдикційну податкову інженерію та цифрові канали обходу фіскального контролю. Показано, що цифровізація міжнародної торгівлі формує якісно новий вимір тінізації, де традиційні механізми контролю виявляються неефективними, а межа між оптимізацією і тіньовою діяльністю стає дедалі менш чіткою. Концепцію структурної дуальності переосмислено як продукт інституційної неузгодженості: неформальний сектор підтримується не культурною інерцією чи відсталістю, а раціональною реакцією агентів на високі трансакційні витрати легальної діяльності та слабке правозастосування. Зроблено висновок, що ефективна політика детінізації потребує не стільки посилення репресивних механізмів, скільки зниження інституційних бар'єрів, гармонізації регуляторних режимів між юрисдикціями та створення умов, за яких легальна діяльність стає економічно привабливішою за тіньову.*

***Ключові слова:*** *тіньова економіка, тінізація, міжнародна торгівля, неоінституційний підхід, регуляторний арбітраж, структурна дуальність, трансакційні витрати, інституційна дисфункція, маніпулювання торговельною вартістю, податкова інженерія, цифрова торгівля, детінізація*

**Introduction.** The shadowing of economic activity appears as a multidimensional phenomenon that combines legal and illegal business activities and operates at the interface of the formal and informal sectors. It reflects a complex system of relationships between economic entities that interact within different regulatory regimes, use a wide range of organizational and economic mechanisms, and form alternative channels for the movement of financial and material resources. Shadow practices are not limited to tax evasion or violation of the law. They include a wider range of economic actions aimed at optimizing costs, minimizing transactional restrictions, and adapting to institutional dysfunctions. That is why the study of shadowing requires an analytical framework that can combine the economic, institutional, and managerial dimensions of the problem. The evolution of the theoretical discourse of the shadow economy has deep historical roots. Already within classical political economy, there is awareness of informal practices and the duality of economic processes. However, the shadow economy was conceptualized as an independent object of research only in the second half of the twentieth century. The development of modern approaches to its analysis occurred on a transdisciplinary basis, leading to various conceptual interpretations. Economic approaches focused on the influence of the tax burden, regulatory restrictions, and the level of economic development. Sociological approaches are considered shadowing because of social norms, cultural attitudes, and behavioural models. Political science concepts linked it to the quality of public administration, the level of corruption, and the effectiveness of institutions. Management, accounting, and statistical approaches focused on mechanisms for controlling, monitoring, and measuring the scale of informal activity. Among these approaches, the neo-institutional perspective has particular methodological potential for analyzing shadowing in

international trade. In contrast to approaches that treat the shadow economy as a deviation, a cultural atavism, or a consequence of insufficient control, neo-institutionalism offers an explanatory framework in which shadowing is a rational response of economic agents to specific institutional configurations *(North, 1990)*. In international trade, this logic becomes particularly pronounced, since cross-border transactions by definition cross the boundaries of different institutional environments, creating systemic opportunities to exploit differences across jurisdictions. An important characteristic of the shadow economy is its dualistic nature - the stable coexistence of the formal and informal sectors within a single economic system. On the one hand, shadowing creates risks for fiscal stability, undermines the tax base, reduces the effectiveness of state regulation, and increases inequality. On the other hand, the informal sector is capable of performing adaptation and stabilization functions, providing employment, supporting entrepreneurial activity and contributing to the preservation of economic dynamics in periods of crisis. Traditionally, this duality has been described as an independent structural property of economic systems *(Lewis, 1954)*. However, the neo-institutional perspective allows us to pose the question differently: duality is not an initial condition, but arises as a result of specific institutional gaps - discrepancies between formal rules and real practices, between the costs of legal activity and the availability of informal alternatives.

Functional analysis of the shadow sector enables us to identify several of its economic roles. It can act as a buffer that mitigates the impact of macroeconomic shocks and provides alternative sources of income for the population; act as a channel for redistributing resources between the formal and informal sectors, when part of the informal income returns to the formal economy through consumption and investment; and promote the development of small businesses, providing flexibility and lowering barriers to entry to the market *(De Soto, 2000)*. At the same time, shadowing creates significant challenges: it complicates the forecasting of macroeconomic indicators, reduces the effectiveness of fiscal and monetary policy, increases institutional dysfunctions, and undermines trust in state institutions (Schneider & Enste, 2000). The growth of informal activity distorts the competitive environment, as shadow-sector enterprises benefit from avoiding regulatory and tax costs, creating unequal conditions of competition.

In the international dimension, the shadow economy goes beyond national jurisdictions and takes on forms that directly deform the structure of trade flows. Regulatory arbitrage as a tool for shadowing the global economy allows economic agents to exploit differences between jurisdictions to minimize tax and regulatory obligations *(Reznikova, Ivashchenko & Dvornyk, 2022a).* Tax engineering in offshore financial centers forms a channel through which significant volumes of capital and trade flows are removed from the control of national fiscal authorities *(Reznikova, Ivashchenko & Dvornyk, 2022b)*. These processes create systemic distortions in international trade, distorting the real geography and volumes of commodity and financial flows. Assessing their scale and mechanisms requires an analytical framework that explains not only individual manifestations of shadowing but also its institutional nature and structural stability.

The purpose of the article is to develop a neo-institutional interpretation of the shadowing of international trade, within which the structural duality of economic systems - the stable coexistence of the formal and informal sectors - is interpreted not as an initial characteristic of the economic system, but as analytically deduced from specific institutional configurations. Achieving this goal involves solving the following tasks: systematization of theoretical approaches to the analysis of the shadow economy with the definition of the heuristic potential of the neo-institutional perspective; substantiation of institutional mechanisms of the shadowing of international trade, in particular regulatory arbitrage, trade value manipulation and jurisdictional tax engineering; analysis of the impact of digitalization on the transformation of the channels of the shadowing of cross-border transactions; rethinking structural duality as an institutionally determined phenomenon. The methodological basis of the study is a neo-institutional analysis grounded in the categories of transaction costs, formal and informal institutions, mechanisms for enforcing rules, and incentive structures, supplemented by structural-functional and comparative approaches.

**Literature review**. The theoretical understanding of the shadow economy has gone from the initial identification of the informal sector to the formation of an extensive system of conceptual

approaches. An important starting point is the work that recorded the existence of informal employment as a mass phenomenon in developing countries, identifying informal income as a structural component of the urban economy *(Hart, 1973).* This idea marked the beginning of the systematic study of the shadow sector as an object of economic analysis. Descriptive models of the dual structure of developing economies recorded the coexistence of traditional and modern sectors as a stable characteristic of economic systems *(Lewis, 1954; Boeke, 1953).* Although these models originally concerned the agro-industrial structure, their logic was later applied to the analysis of the shadow economy, where the formal and informal sectors operate in parallel. However, dualistic models posited structural duality without offering a systematic explanation of its institutional causes, thereby limiting their predictive potential.

Quantitative measurement of the shadow economy became the subject of a separate research tradition. Systematization of the conceptual apparatus and classification of forms of shadow activity through the analysis of underground and unregulated economies allowed for the structuring of the subject field of research (Feige, 1990). The methodology of assessing the scale of shadow activity through monetary indicators and the analysis of cash demand offered indirect ways to measure unobserved economic activity *(Tanzi, 1999).* Generalizing studies expanded the empirical base and revealed systemic patterns related to the level of tax burden, the quality of institutions, and the degree of regulatory complexity *(Schneider & Enste, 2000; Medina & Schneider, 2018).*

The turning point in the theoretical understanding of the shadow economy is associated with the formation of the neo-institutional direction. The concept of the institutional environment as a set of formal rules, informal restrictions, and mechanisms for their enforcement created the basis for explaining shadowing as a consequence of institutional dysfunctions, rather than cultural backwardness or moral deviation *(North, 1990)*. The theory of transaction costs holds that the choice between formal and informal activities is determined by comparing the costs of legal and shadow forms of governance, including contracting, information search, control, and enforcement of agreements (Williamson, 1985). Linking the scale of informal activity with excessive bureaucracy and high barriers to entry into the formal economy transferred the problem of de-shadowing from the plane of law enforcement to the plane of institutional design *(De Soto, 2000)*.

Studies of the relationship between regulatory quality, discretionary powers of officials, and the extent of shadow activity have found that increasing regulatory complexity systematically increases the share of the informal sector *(Johnson, Kaufmann & Zoido-Lobatón, 1998).* Analysis of the impact of tax morality and trust in institutions on the behaviour of economic agents has added a cultural-behavioural dimension to the institutional approach, demonstrating that shadowing is determined not only by rational cost accounting, but also by subjective perceptions of the legitimacy of the institutional order *(Torgler & Schneider, 2009).*

In the context of international trade, the neo-institutional logic of shadowing has been explored across several analytical strands. Analysis of regulatory arbitrage demonstrates how divergences across jurisdictions create systemic incentives to shift operations to less-regulated environments *(Reznikova, Ivashchenko & Dvornyk, 2022a).* Research on tax engineering in offshore financial centers reveals mechanisms for removing trade and financial flows from fiscal control *(Reznikova, Ivashchenko & Dvornyk, 2022b).* Analysis of fiscal instruments of regulatory competition has demonstrated that periods of crisis increase incentives for shadowing through increased uncertainty and weakened control *(Reznikova, Bulatova, Yatsenko & Ivashchenko, 2022).*

A separate analytical strand is research on the impact of digitalization on the transformation of shadow practices. Strategic determinants of competitiveness in the digital age include the ability of states to counter shadowing of cross-border digital *transactions (Reznikova, Vovk & Ptashchenko, 2025).* Analysis of digital trade in global markets reveals new channels of shadowing related to the platform economy and cross-border digital services *(Pryiatelchuk, 2023).* Conceptualization of the digital media market highlights the growth of the shadow segment in the digital economy *(Pryiatelchuk & Bekh, 2020).* Financial technologies in the development of e-commerce create new opportunities for both deshadowing through payment transparency and shadowing through control-circumvention tools *(Zablotska, 2025).* These processes are considered

in the broader context of international business, where shadow practices acquire a cross-border nature *(Vergun, 2020).* Despite a significant body of research, several gaps remain in the literature. First, the duality of the formal and informal sectors is mostly described as an empirical fact, rather than inferred from institutional reasons, which limits the explanatory potential of the analysis. Second, the relationship between the macroeconomic dimensions of shadowing and the specific institutional mechanisms of shadowing trade flows needs to be systematized. Third, the impact of digitalization on shadow practices in international trade has been analysed mostly descriptively, without integration into a neo-institutional analytical framework. This article aims to fill these gaps by constructing a neo-institutional interpretation of shadowing international trade, in which the structural duality of economic systems is understood as the result of specific institutional configurations rather than an initial condition.

**Main results of the research.** The legal approach to the shadow economy primarily characterizes it as a set of economic activities that violate the formal rules and norms of economic legislation, including both administrative and criminally punishable forms of activity. In this logic, shadow operations are defined not so much by their economic results as by the legal deviation from established procedures for registration, licensing, income declaration, and transaction recording. Shadowization is interpreted as a violation of the legal regime governing economic activity. The legal perspective distinguishes between illegal activities directly related to the production and circulation of prohibited goods and services, and hidden activities within the framework of permitted types of business *(Feige, 1990).* Such a distinction shows that the shadow economy is not reducible to crime but encompasses numerous practices in the gray area between legality and illegality.

The economic approach defines the shadow economy as a phenomenon that deforms the effectiveness of state policy, distorts the allocation of resources, and distorts the objectivity of macroeconomic indicators *(Schneider & Enste, 2000).* The central point here is not the violation of the norm, but the consequences of concealment: fiscal losses, reduced controllability of the economy, weakening of monetary and budgetary regulatory instruments, and distortion of statistics. Official macro indicators that ignore hidden activity do not describe the entire economy but only its formal part (Tanzi, 1999), creating a statistical incompleteness that distorts not only analysis but also policy instruments calibrated to a distorted picture of reality. At the global level, shadowing manifests itself through cross-border transactions in trade, investment, and finance, including illegal capital outflows, violations of tax regimes, the use of complex corporate structures, and jurisdictional arbitrations *(Reznikova, Ivashchenko & Dvornyk, 2022a; Reznikova, Ivashchenko & Dvornyk, 2022b)*.

The sociological approach reveals the shadow economy as a shadowing of social and labor relations, with the central objects being working conditions, social risks, and inequality in access to legal protection. Shadow employment is considered as a result of structural imbalances in the labor market and social exclusion *(ILO, 2018; Hart, 1973)*. Informal employment is formed as a network of small enterprises and trading practices that provide the population with basic goods and services outside the formal registration regime. Such networks can be technologically primitive but socially sustainable, as they are embedded in everyday practices and compensate for the weaknesses of the formal economy.

The cultural approach shifts attention to the value-normative nature of shadowing. Shadow practices are considered as derivatives of historically formed values, norms of trust, attitudes towards the state, and moral guidelines for economic behaviour *(Torgler & Schneider, 2009)*. This approach helps explain why similar economic incentives across countries yield different levels of informality: cultural codes can either enhance or inhibit the propensity toward informal practices. The accounting and statistical approach links the shadow economy to its invisibility in official accounting systems and national accounts, emphasizing measurement issues and international comparisons *(Medina & Schneider, 2018).*

A comparison of the approaches shows that they describe different but interconnected aspects of the shadow economy. The legal approach emphasizes illegality, the economic approach

emphasizes systemic consequences, the sociological approach emphasizes the shadowing of labor, the cultural approach emphasizes the value-normative foundations of informality, and the accounting and statistical approach emphasizes the problem of invisibility for official measurements. These perspectives partially overlap, since one and the same practice can be simultaneously a legal deviation, an economic distortion, a social adaptation, and a statistical invisibility. However, each of these approaches primarily describes individual manifestations of shadowing, without offering a single explanatory framework that integrates causes, mechanisms, and structural consequences. It is this integrative function that the neo-institutional approach can perform.

The neo-institutional approach proposes an explanatory model in which shadowing is derived from specific characteristics of the institutional environment rather than from agents' moral deficiencies or societies' cultural features. Central to the notion of institutional compatibility is the idea that when formal rules are not perceived as legitimate or are not economically acceptable, incentives arise to circumvent them and form alternative practices *(North, 1990).* The choice between formal and informal activities is determined by a comparison of transaction costs: the costs of contracting, information search, negotiations, control, and enforcement of agreements (Williamson, 1985). When the institutional environment imposes high costs on legal activity, businesses seek alternative forms of organization, including informal agreements and the transfer of operations to less-regulated jurisdictions. Shadowing in this context is a microeconomic optimization strategy that reduces private costs but creates social losses *(Johnson, Kaufmann & Zoido-Lobatón, 1998).*

The theoretical discourse on shadowing encompasses a number of paradigms, each offering its own explanation of the causes and corresponding policy prescriptions. Classical political economy viewed shadowing through the prism of the rational behaviour of subjects and the lack of control but proceeded on the assumption of the stability of production and the low role of institutions. The Keynesian tradition linked shadowing to macroeconomic imbalances and market failures, treating it as a source of instability. The monetary concept assumes that shadow transactions are settled in cash, and that the growth of shadow activity is reflected in the dynamics of demand for monetary aggregates *(Tanzi, 1999)*. The neoliberal concept linked shadowing to excessive fiscal burdens, treating shadow practices as a forced response by businesses to high taxes and complex procedures *(Loayza, 1996)*.

The neo-institutional approach integrates the productive elements of these paradigms into a single analytical framework. It acknowledges the role of fiscal burden (the neoliberal argument) and macroeconomic instability (the Keynesian argument), but explains them through the category of institutional dysfunction. High taxes in themselves are not the cause of shadowing - they become so under conditions of weak law enforcement, low trust in the state, and the absence of a tangible connection between tax payment and the quality of public goods. Similarly, macroeconomic instability becomes an incentive for shadowing not automatically, but through the weakening of the institutional framework and increased uncertainty.

It is in international trade that the neo-institutional logic of shadowing manifests itself most clearly. Cross-border transactions, by definition, cross the boundaries of different institutional environments, and the differences between tax regimes, regulatory standards, and enforcement practices of different jurisdictions create systemic opportunities for regulatory arbitrage - the relocation of transactions to environments with lower compliance costs *(Reznikova, Ivashchenko & Dvornyk, 2022a).* This mechanism is fundamentally different from shadowing within a single jurisdiction: it exploits not so much the deficiencies of a single institutional system as the gaps between systems.

Based on neo-institutional analysis, it is appropriate to propose a typology of institutional mechanisms that shadow international trade. The first mechanism is trade misinvoicing: the artificial overpricing or underpricing of goods and services in foreign trade contracts, which is becoming one of the most common channels for illicit capital outflows from developing countries *(GFI, 2021).* The institutional prerequisite for this mechanism is the asymmetry of customs controls between

partner countries: weak enforcement in one jurisdiction creates an opportunity for value manipulation in bilateral trade. The second mechanism is jurisdictional tax engineering: the use of offshore financial centers and complex corporate structures to shift profits to jurisdictions with minimal tax obligations *(Reznikova, Ivashchenko & Dvornyk, 2022b)*. The institutional basis of this mechanism is competition between jurisdictions for capital, which creates a "race to the bottom" in tax regulation and, in turn, expands the space for shadow operations. Fiscal competition between states becomes particularly intense in times of crisis, when governments, seeking to support economic activity, weaken regulatory control *(Reznikova, Bulatova, Yatsenko & Ivashchenko, 2022)*.

The third mechanism is digital channels for circumventing fiscal control: the platform economy, cross-border digital services, and cryptocurrency payments, which create transactions that are difficult to control with traditional fiscal instruments *(Pryiatelchuk, 2023; Zablotska, 2025)*. The institutional specificity of this mechanism is that the regulatory regimes of most jurisdictions were designed to control physical commodity flows and banking transactions, whereas digital transactions fall outside these regimes. Competitiveness in the digital age is determined, among other things, by states' ability to create effective regimes for regulating cross-border digital transactions *(Reznikova, Vovk & Ptashchenko, 2025).* The digital media market, where traditional control mechanisms are ineffective, is becoming a growth zone for shadow practices *(Pryiatelchuk & Bekh, 2020).* International business in these conditions operates in an environment of growing institutional uncertainty, where the line between optimization and shadowing is becoming increasingly blurred *(Vergun, 2020).* The development of digital financial technologies significantly complicates the institutional picture of shadowing. On the one hand, cashless payments increase transparency and narrow the space for cash shadow transactions. On the other hand, cryptocurrencies and decentralized financial platforms create fundamentally new channels of shadow cross-border transactions that do not fit into existing regulatory regimes *(Zablotska, 2025).* The monetary concept of the shadow economy, which linked shadowing to the demand for cash, proves methodologically limited in the digital context: shadow transactions increasingly occur in a cashless, uncontrolled format.

The proposed neo-institutional framework allows us to rethink the very nature of the structural duality of economic systems. Traditionally, dualism - the coexistence of the formal and informal sectors - was described as an initial structural characteristic that only needs to be stated. Models of the dual economy identified two sectors with different levels of productivity and institutional organization *(Lewis, 1954; Boeke, 1953)*, but did not systematically examine the institutional conditions that generate and reproduce this duality. The neo-institutional perspective allows us to answer this question. Structural duality arises and is reproduced when transaction costs of legal activity systematically exceed those of informal activity for a significant share of economic agents. This gap can be caused by various institutional factors: excessive bureaucratization and high barriers to entry into the formal economy *(De Soto, 2000)*; weak enforcement, which reduces the risks of rule violations *(Johnson, Kaufmann & Zoido-Lobatón, 1998)*; low tax morale and lack of trust in institutions *(Torgler & Schneider, 2009);* inconsistency of formal rules with real business conditions *(North, 1990).*

In international trade, structural duality takes on an additional dimension. Formal trade is carried out within the framework of WTO rules, bilateral agreements and national regulatory regimes. Informal or semi-formal trade exploits the gaps between these regimes - differences in customs rates, asymmetry of control, jurisdictional competition. The informal sector of international trade is supported not by cultural inertia or backwardness, but by the rational response of agents to specific institutional configurations. This means that duality is not permanent - it narrows as the transaction costs of legal trade decrease and expands as they increase.

An important consequence of such a rethinking is a change in the perspective of de-shadowing. If duality is an institutional product, then overcoming it requires not so much strengthening repressive mechanisms as a targeted change in the institutional conditions that make legal activity economically more attractive than shadow activity. In international trade, this involves

harmonizing regulatory regimes across jurisdictions, reducing customs and administrative barriers, strengthening mechanisms for information exchange between tax authorities, and establishing adequate regulatory frameworks for digital cross-border transactions.

**Conclusions.** The study allows us to formulate the following conclusions. First, the neo-institutional approach has the greatest heuristic potential among the available theoretical frameworks for analysing shadowing in international trade. Unlike the legal approach, which states illegality, the economic approach, which records macroeconomic consequences, and the sociological approach, which describes social manifestations, the neo-institutional perspective offers an explanatory model in which shadowing is derived from specific characteristics of the institutional environment - the level of transaction costs, the quality of law enforcement, the degree of institutional compatibility and the structure of incentives.

Secondly, the shadowing of international trade is implemented through three main institutional mechanisms, each of which has its own institutional prerequisite. Manipulation of trade value relies on the asymmetry of customs control between partner countries. Jurisdictional tax engineering uses jurisdictional competition for capital and the "race to the bottom" in tax regulation. Digital channels for circumventing fiscal controls exploit the inconsistency between existing regulatory regimes and the conditions of the digital economy. This typology allows us to differentiate tools to combat shadowing depending on the specific institutional mechanism.

Third, the digitalization of international trade creates a qualitatively new dimension of shadowing that does not fit into the existing analytical framework. The platform economy, cryptocurrency payments, and cross-border digital services create channels that are not controlled by traditional fiscal mechanisms designed to monitor physical commodity flows and banking transactions. This necessitates the development of new institutional control instruments that are adequate to the digital nature of cross-border operations.

Fourth, and this is the central theoretical result of the study, the structural duality of economic systems - the stable coexistence of the formal and informal sectors - is not an initial characteristic of the economic system but is analytically derived from specific institutional configurations. Duality arises and is reproduced when the transaction costs of legal activity systematically exceed the costs of informal activity for a significant part of agents. In international trade, this mechanism acquires additional specificity: duality is supported not only by the dysfunctions of individual institutional systems, but also by the gaps between them - jurisdictional differences that generate systemic opportunities for regulatory arbitrage. This rethinking has direct political consequences: effective de-shadowing of international trade requires not strengthening repressive mechanisms, but reducing institutional barriers, harmonizing regulatory regimes and creating conditions under which legal activity becomes economically more attractive than shadow activity.

The scientific novelty of the study lies in: rethinking structural duality as an institutional product, rather than an initial characteristic of economic systems; developing a typology of institutional mechanisms of shadowing international trade on a neo-institutional basis; integrating the digital dimension of shadowing into a neo-institutional analytical framework; substantiation of the neo-institutional approach as a single explanatory framework capable of integrating productive elements of legal, economic, sociological and cultural approaches to the analysis of the shadow economy. Prospects for further research include empirical verification of the proposed typology of institutional mechanisms of shadowing on the material of specific regions and commodity markets; quantitative assessment of the relationship between the level of transaction costs of legal cross-border activity and the scale of the shadow trade segment; analysis of the effectiveness of various institutional instruments for de-shadowing digital cross-border transactions.

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**DIGITAL AGENTS AS FUNCTIONAL EQUIVALENTS OF ECONOMIC ACTORS: THE DECOUPLING OF DEMOGRAPHICS AND ECONOMIC GROWTH**

**ЦИФРОВІ АГЕНТИ ЯК ФУНКЦІОНАЛЬНИЙ ЕКВІВАЛЕНТ ЕКОНОМІЧНОГО СУБ'ЄКТА: РОЗРИВ ЗВ'ЯЗКУ МІЖ ДЕМОГРАФІЄЮ ТА ЕКОНОМІЧНИМ ЗРОСТАННЯМ**

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***Abstract.*** *The purpose of the article is to substantiate the theoretical interpretation of digital agents as functional equivalents of economic actors and to demonstrate that their expanding role in production and market processes creates the preconditions for a gradual decoupling of demographic dynamics from economic growth, thereby transforming the foundations of production, labour markets, institutional arrangements and the international distribution of economic power. The article proposes a theoretical interpretation of AI-based digital agents as functional equivalents of economic actors, creating preconditions for decoupling the centuries-old link between demographic dynamics and economic growth. The concept of shadow demographics is substantiated as an analytical category describing a growing algorithmic population that expands in parallel with the stagnation or decline of the human population, while the prospect of its transformation into algorithmic demographics through the institutionalisation of digital agent*

*registration is outlined. The transformation of the ontological status of technology is analysed - from a productivity-enhancing tool to an autonomous participant in economic processes, forming a hybrid factor of production that combines characteristics of both capital and labour. An approach to the quantitative identification of algorithmic agents through the category of cognitive full-time equivalent (cFTE) is proposed, enabling the comparison of algorithmic and human productivity within a unified analytical framework, alongside the category of agent energy profile (AEP) as a measure of annual energy consumption per unit of cFTE. The fundamental asymmetry between economic and social reproduction is examined, arising from the capacity of digital agents to compensate for the productive functions of the population while being unable to substitute its functions of social reproduction. It is demonstrated that the institutional architecture of modern societies - from pension systems to taxation models - is built upon assumptions systematically undermined by the agentic economy, necessitating a revision of fiscal and social models, particularly through the introduction of discrete taxation of algorithmic employment. The geoeconomic dimension of algorithmic transformation is analysed, whereby the capacity to create, maintain, and control digital agents becomes a new axis of international inequality, potentially devaluing the demographic dividend of developing countries and creating preconditions for revising the logic of comparative advantages. Particular attention is given to algorithmic collusion as a new form of market failure.*

***Keywords:*** *shadow demography, algorithmic demography, algorithmic population, digital agents, cognitive full-time equivalent, agent capital, human capital, agent energy profile, artificial intelligence, labour market, growth, institutional inertia, geoeconomics, inequality, shadow economy, IT market, digital market.*

***Анотація.*** *У статті пропонується теоретична інтерпретація цифрових агентів на основі штучного інтелекту як функціональних еквівалентів економічних суб'єктів, що створюють передумови для розриву багатовікового зв'язку між демографічною динамікою та економічним зростанням. Обґрунтовується концепція тіньової демографії як аналітичної категорії для опису зростаючої алгоритмічної популяції, що розширюється паралельно зі стагнацією або скороченням людського населення, та показано перспективу її трансформації у алгоритмічну демографію (algorithmic demographics) внаслідок інституціоналізації обліку цифрових агентів. Аналізується трансформація онтологічного статусу технології - від інструменту підвищення продуктивності до автономного учасника економічних процесів, що формує гібридний фактор виробництва, який поєднує характеристики капіталу та праці. Запропоновано підхід до кількісної ідентифікації алгоритмічних агентів через категорію когнітивного еквіваленту повної зайнятості (cFTE), що дозволяє співвіднести алгоритмічну та людську продуктивність у межах єдиного аналітичного простору, а також категорію енергетичного профілю агента (AEP) як характеристику питомого річного обсягу споживання енергії на одиницю cFTE. Досліджується фундаментальна асиметрія між економічним та соціальним відтворенням, що виникає внаслідок здатності цифрових агентів компенсувати виробничі функції населення за неможливості заміщення його функцій соціального відтворення. Показано, що інституційна архітектура сучасних суспільств - від пенсійних систем до моделей оподаткування - побудована на припущеннях, які систематично підриваються агентною економікою, що зумовлює необхідність перегляду фіскальних і соціальних моделей, зокрема через запровадження дискретного оподаткування алгоритмічної зайнятості. Аналізується геоекономічний вимір алгоритмічної трансформації, у межах якого здатність створювати, утримувати та контролювати цифрових агентів стає новою віссю міжнародної нерівності, що потенційно знецінює демографічний дивіденд країн, що розвиваються, та формує передумови для перегляду логіки порівняльних переваг. Окрему увагу приділено проблемі алгоритмічної колюзії як нової форми ринкових провалів.*

***Ключові слова:*** *тіньова демографія, алгоритмічна демографія, алгоритмічна популяція, цифрові агенти, когнітивний еквівалент повної зайнятості, агентний капітал,*

*людський капітал, енергетичний профіль агента, штучний інтелект, ринок праці, зростання, інституційна інерція, геоекономіка, нерівність, тіньова економіка, IT ринок, цифровий ринок.*

**Introduction.** For millennia, the relationship between population and economic growth has been regarded as axiomatic. From agrarian societies to industrial economies, demographic dynamics have determined the volume of production, the depth of markets and the stability of fiscal systems. Classical models of economic growth, from Malthusian to neoclassical, have treated labour as a key factor of production, while its quantity has been interpreted as a function of demographic dynamics *(Kremer, 1993; Acemoglu & Restrepo, 2018).* Strategic development forecasts have been based on the following: demographic ageing in China and the European Union has been interpreted as a factor in growth deceleration, whereas the young populations of India and African countries have been viewed as a foundation for global economic leadership in the twenty-first century. According to recent global labour and demographic projections, the reconfiguration of the global workforce and the shifting balance of human capital across regions are expected to transform the geography of economic growth and technological leadership in the coming decades *(World Economic Forum, 2025),* India's population has already exceeded that of China, and the population of the African continent is expected to double by 2050, which within classical logic would imply a shift in the global centre of economic gravity. However, in the second decade of the twenty-first century, this logic has begun to undergo a potentially fundamental revision. Contemporary economies increasingly compensate for demographic slowdown not through higher fertility or migration, but through the creation of artificial participants in economic processes - digital agents. Algorithms generate content, process information, execute transactions, optimize logistics and support managerial decision-making. They are not reflected in demographic statistics, yet directly influence productivity and the structure of labour markets. Artificial intelligence thus transforms markets not merely as a tool but as a full-fledged participant in economic relations capable of concluding transactions, making decisions, and learning in digital environments *(Shahidi et al., 2025).*

If demographic decline necessarily implied economic decline, the logic of projections for China and the European Union would remain consistent. However, if digital agents can functionally compensate for the reduction in human labour in production processes, this relationship ceases to be linear, and the predictive value of purely demographic models declines significantly. Similarly, the demographic dividend of countries with young populations may prove less decisive than previously assumed if cognitive labour becomes algorithmically reproducible.

The study's relevance is determined by several interrelated factors. First, the scale of implementation of algorithmic agents has already crossed the threshold of statistical significance: artificial intelligence-based agents and robotic systems can generate substantial economic value annually in advanced economies *(McKinsey Global Institute, 2025).* Second, empirical studies record the actual substitution of human labour by algorithmic agents in a number of sectors, transforming a theoretical discussion into a practical economic challenge (*Brynjolfsson, Chandar & Chen, 2025; Ozkan & Sullivan, 2025).* Third, the existing categorical apparatus of economic science - particularly the concepts of population, labour market, and factors of production - proves insufficient for an adequate description of the emerging reality, which necessitates further conceptual and theoretical development.

**The purpose of the article** is to conceptualize digital agents as functional equivalents of an economic entity and to analyse the structural consequences of this transformation for the relationship between demography and growth, the institutional architecture of societies, and the international distribution of economic power. Achieving this goal involves solving the following tasks: substantiating the change in the ontological status of technology from a tool to an autonomous participant in the economic process; conceptualizing shadow demography as an analytical category and substantiating the prospect of its transformation into algorithmic demography; developing an approach to the quantitative identification of algorithmic agents through the categories of cFTE and AEP; analysing the fundamental asymmetry between economic and social reproduction; studying

the institutional and fiscal consequences of the agent economy; analysing the geoeconomic dimension of algorithmic transformation. The article's methodological basis is a theoretical and analytical approach aimed at conceptualizing the transformation of production factors under the influence of algorithmic technologies. The study is based on a structural-functional analysis that reveals the functional equivalence of digital agents and human participants in the economic process, without identifying their ontological status. The comparative-historical method is used to compare the current technological transformation with previous technological revolutions. The use of a case-oriented approach is heuristic and serves to demonstrate the practical consequences of theoretical provisions.

**Literature review.** Modern research on the transformation of labour, productivity, and the competence structure of the economy in the context of robotization and digitalization emphasizes the growing role of human capital as a key intangible resource for economic development and competitiveness *(Rubtsova & Reznikova, 2018a; Rubtsova & Reznikova, 2018b).* Within the framework of the analysis of global structural changes, attention is focused on the formation of a "new normal" of the world economy, which is accompanied by increased systemic risks, changes in consumption and ownership patterns, and the transformation of the logic of economic behaviour in the context of the transition to stakeholder capitalism and increased geoeconomic turbulence *(Panchenko, V. H. et al., 2024; Reznikova & Ivashchenko, 2017; Reznikova et al., 2023; Reznikova & Panchenko, 2023).* A separate area of research is shaping the idea of data and information technology markets as a space of strategic competition for digital leadership, where technological competencies and access to intellectual resources become determining factors in the positioning of countries and companies in the global economy *(Reznikova et al., 2025; Reznikova et al., 2023).* Within the framework of international business and the digital economy, attention is increasing to the role of human capital as a fundamental intangible asset, to the processes of socialization of public and corporate governance, as well as to the transformation of global markets under the influence of digital trade and the media economy *(Vergun, 2020; Pryiatelchuk, 2017; Pryiatelchuk & Naida, 2025; Pryiatelchuk, 2023; Pryiatelchuk & Bekh, 2020).* The combination of these approaches provides a theoretical basis for analysing digital transformations of the international economy, in which technological changes, human capital, and new forms of economic interaction are considered interrelated factors in the structural restructuring of the global system.

The impact of artificial intelligence on economic growth and the labour market has become the focus of intensive research, which can be systematised along several analytical directions. The first group of studies examines the macroeconomic consequences of automation within the framework of neoclassical and post-neoclassical growth models. Within this approach, the dynamics of the «race between man and machine» are analysed through the interaction between technological change and labour displacement, demonstrating that technological progress simultaneously replaces workers in routine tasks and generates new, specifically human forms of economic activity *(Acemoglu & Restrepo, 2018).* Further development of this analytical perspective emphasises that the macroeconomic effects of artificial intelligence depend on whether it primarily automates existing tasks or creates new productive opportunities, thereby shaping the trajectory of productivity, employment and income distribution (*Acemoglu, 2024).* In this context, artificial intelligence is understood not merely as an additional technology but as a distinct form of capital capable of partially or fully substituting for human labour across an expanding range of functions.

In traditional growth models, productivity increases through the accumulation of physical and human capital. Within the emerging macroeconomics of artificial intelligence, a third component is introduced: algorithmic or cognitive capital, characterized by high scalability and rapid diffusion across sectors and regions. This shift places the elasticity of substitution between human labour and digital agents at the centre of macroeconomic analysis. When artificial intelligence complements labour, it enhances productivity and income growth. When it operates as a functional substitute, a divergence may arise between productivity dynamics and the trajectories of employment and wages. Under such conditions, the prospect of economic growth without a proportional increase in labour input becomes increasingly plausible. The analytical consequence of this transformation is a gradual

decoupling of economic growth from demographic dynamics, as productive capacity can expand even amid population stagnation or decline, given the scalable nature of algorithmic agents and their ability to perform cognitive, managerial, and innovative functions. Trammell and Korinek demonstrate that full automation of production, in which machines can self-reproduce, can dramatically accelerate economic growth while reducing the share of labour in income, thereby challenging the Kaldor facts that long characterized growth at the technological frontier *(Trammell & Korinek, 2023).*

A second group of studies focuses on the empirical labour market effects of artificial intelligence adoption. Large-scale analyses of wage and employment data reveal significant employment declines among younger workers in occupations with high exposure to artificial intelligence, indicating structural shifts in labour demand (*Brynjolfsson, Chandar & Chen, 2025).* Complementary research identifies a correlation between the diffusion of generative artificial intelligence and rising unemployment within exposed occupational groups, suggesting that technological substitution effects are already observable in contemporary labour markets *(Ozkan & Sullivan, 2025).* Further assessments of large language models highlight their character as general-purpose technologies capable of affecting a wide spectrum of professional activities and task structures across sectors *(Eloundou et al., 2024).*

A third research direction explores the transformative potential of artificial intelligence agents as a new type of economic actor. Analytical work on the emerging «agentic economy» demonstrates that AI agents can reshape demand, supply, and market design by altering traditional market coordination mechanisms and reducing transaction costs associated with human attention and decision-making *(Shahidi et al., 2025).* Conceptual studies of agent-based artificial intelligence further emphasise the transformation of capitalism through the emergence of agentic capital and new forms of value creation rooted in algorithmic autonomy *(Klover.ai, 2025).* The broader implications of transformative artificial intelligence for development strategies, income distribution, and global economic dynamics are examined through the lens of international political economy and technological change *(Korinek, 2024; Korinek & Stiglitz, 2021).* A fourth strand of research focuses on algorithmic behaviour in markets, particularly the phenomenon of algorithmic collusion. Studies of reinforcement learning systems demonstrate that pricing algorithms can «learn» collusive strategies without explicit programming, revealing the potential for autonomous coordination among digital agents *(Calvano et al., 2020).* Empirical analyses based on real market data further confirm these findings, showing that algorithmic pricing can contribute to coordinated market outcomes in competitive environments *(Assad et al., 2024).*

At the same time, several significant gaps remain in existing literature. First, there is no comprehensive conceptualisation of an algorithmic population as a demographic phenomenon, as most studies focus on sector-specific effects of automation rather than on systemic shifts in the relationship between human population and algorithmic agents. Second, an analytical framework for quantitatively comparing algorithmic and human productivity within a unified measurement system has not yet been developed. Third, the institutional implications of algorithmizing, particularly for pension systems, taxation models, and the broader mechanisms of social reproduction, are examined only fragmentarily and without integration into a coherent theoretical framework. Fourth, the geoeconomic dimension of algorithmic transformation remains insufficiently explored, especially the question of how unequal capacities to create and control digital agents may generate new axes of international inequality and reshape the distribution of economic power in the global economy.

**Main results of the research.** Traditional economic theory treats technology as a means of increasing the productivity of human labour. In classical models, including the Cobb-Douglas production function, technological progress is included as a parameter that multiplies the efficiency of production factors but does not create a new factor. Even in the most ambitious models of automation of the twentieth century - from Ford’s assembly line to industrial robots - machines remained tools that supplemented or replaced human physical labour in narrowly defined operations. Their economic effect was to increase each worker's productivity and, accordingly, to

raise per capita productivity indicators. In this paradigm, technology has always been mediated by humans: a CNC machine tool (computer numerical control), an assembly line, or an industrial robot required a human operator, programmer, or adjuster.

The new generation of digital agents is qualitatively changing this picture. As demonstrated in studies on the transformation of capitalism under the influence of agent-based artificial intelligence, modern agents are not simply tools used by humans but systems capable of performing work autonomously *(Klover.ai, 2025).* Their defining characteristics - autonomy, purposefulness, and adaptive learning - provide them with the capacity to make independent economic decisions, from production and exchange to negotiation and investment. This introduces a non-human actor into the core of capitalist processes and challenges the basic assumptions of an economic system historically grounded in human behaviour, incentives, and constraints. The result is a hybrid factor of production that researchers increasingly conceptualise as agentic capital or digital labour. Classical economics traditionally defines factors of production as land, labour, and capital, with labour implicitly referring to human labour in both its physical and cognitive forms. Artificial agents, as privately owned software systems, formally belong to capital. However, this represents a unique form of capital, since it autonomously performs the cognitive component of labour. This reclassification has implications that extend beyond terminology, fundamentally affecting the interpretation of markets, income distribution and the nature of economic activity itself *(Korinek, 2024; Korinek & Stiglitz, 2021).*

The scale of the potential consequences is determined by the fact that the current transformation concerns not merely the automation of individual operations but the possibility of a systemic replacement of cognitive labour. Full automation of production, including the automation of research and development, is expected to significantly accelerate economic growth and alter the distribution of income between capital and labour *(Trammell & Korinek, 2023).* Estimates of the economic value generated by artificial intelligence further underscore the magnitude of this transformation, indicating that AI-based agents and robotic systems can produce substantial annual economic value in advanced economies *(McKinsey Global Institute, 2025).*

In parallel, the rapid development of humanoid robotics is intensifying, with leading technology companies planning to mass-produce humanoid robots by 2030 at projected costs comparable to or lower than the lifetime investment required for the education, healthcare, and social reproduction of a highly skilled worker. The convergence of digital cognitive agents and physical robotic systems suggests that within the next decade, a new type of economic unit may emerge: an autonomous production entity capable of performing both cognitive and physical functions previously dependent on human participation. According to the logic of recursive production, such entities may also acquire the capacity to reproduce technologically similar units, creating the preconditions for the multiplicative expansion of an algorithmic population. This prospective dynamic has no historical precedent in earlier technological transformations and fundamentally distinguishes the contemporary digital revolution from the industrial revolution *(Korinek, 2024; Korinek & Stiglitz, 2021).*

We use the term *«shadow demography»* by analogy with the concept of *«shadow economy»,* introduced into economic science to denote economic activity that is not recorded in official statistics, but has a real impact on macroeconomic processes. Just as the shadow economy has necessitated a review of methods for measuring GDP and employment, shadow demography calls into question the adequacy of existing demographic indicators as indicators of economic potential. *«Shadow demography»* describes the current state of the algorithmic population - a growing number of digital agents that perform economic functions, but are not recorded by any statistical or regulatory accounting system, are not taxed as units of employment and remain invisible to social protection institutions. This is a state analogous to the shadow economy before the introduction of appropriate assessment and regulatory methods. At the same time, the shadow nature of algorithmic demography is not inherent to it - it is a consequence of the lack of institutional mechanisms for accounting and regulation. As identification systems *(similar to the DEAI system proposed below),* mechanisms for taxing algorithmic employment, and standards for measuring the productivity of

digital agents are introduced, shadow demography is naturally transformed into algorithmic demographics - a full-fledged object of statistical accounting, regulatory policy, and international comparison. This two-stage logic reproduces the trajectory that the shadow economy took in the 20th century: from ignoring and ad hoc estimates to systematic accounting and integration into macroeconomic statistics. The difference is that algorithmic demography can be integrated into statistical systems much more quickly because the agents themselves are digital, by definition leaving a computational footprint.

The scale of the process is already being quantified. Forecasts indicate that within the next few years, a growing share of operational and strategic work decisions will be delegated to autonomous agent-based artificial intelligence systems, while an increasing number of companies integrating generative artificial intelligence are expected to implement pilot projects involving autonomous agents and expand their use in core business processes. Market assessments further demonstrate the rapid expansion of the artificial intelligence agent sector, which is projected to grow at exceptionally high compound annual growth rates over the current decade.

These dynamics point to an exponential expansion of the algorithmic population, increasingly comparable in scale to demographic processes. If transformative artificial intelligence renders human-level intelligence technologically reproducible, it may fundamentally alter the historical relationship between population and economic growth and signal the transition to a new stage of economic development in which both traditional capital and intelligent machines become reproducible resources and the boundary between them progressively erodes *(Korinek, 2024).* Any attempt to include algorithmic agents in demographic or economic analysis requires solving the problem of their measurement. This problem has both technical and conceptual components. The technical component is that algorithmic agents do not have a stable «corporeal» form: a single software product can perform functions equivalent to the work of dozens of people, or thousands of microagents can coordinate to perform a single task. The conceptual component is the lack of a generally accepted unit of measurement that would allow comparing algorithmic and human performance. Historical experience suggests a productive analogy. Engine power is still measured in horsepower - a unit introduced by James Watt in the late 18th century to compare the performance of steam engines with the tractive power of horses. Although the automobile replaced the horse more than a century ago, this metric remains in common use precisely because it provides intuitive comparability. *By similar logic, it seems appropriate to use a unit that is tied to human productivity to measure the «power» of digital agents.*

The proposed metrological transfer - measuring algorithmic agents in units of human productivity - has a direct historical precedent in the inverse transfer that occurred during the nineteenth century, when units originally developed for machines were systematically applied to the human body. The calorie, coined by the French engineer Nicolas Clément in the early 1820s for calculating the fuel efficiency of steam engines, was transferred to human physiology by German scientists Carl von Voit and Max Rubner in the 1860s-1890s, who used bomb calorimeters - devices that measured the energy content of food by *burning* it in a pressurised chamber - to quantify human metabolism in the same thermodynamic units as mechanical combustion *(Hargrove, 2006)*. This approach was extended to the USA by W. Atwater, whose caloric values (4 kcal/g for protein and carbohydrates, 9 kcal/g for fat) remain standard to this day. The broader intellectual project of treating the working body as a «human motor» - measuring labour in energy units, fatigue in thermodynamic terms, and nutritional needs as fuel requirements - has been extensively documented *(Rabinbach, 1990)*. The same logic of cross-domain commensurability underpinned the concept of «human capital» (Becker, 1964), rendering investment in education analytically equivalent to investment in machinery. In each case, the transfer of metrics across ontological boundaries served not as a claim of identity between entities but as a pragmatic instrument for quantitative comparability. The cFTE and AEP categories proposed in the present article perform the *symmetrical inverse* of this operation: whereas the nineteenth century *«dressed the human in the clothes of the machine»,* measuring bodies as engines and labour as combustion, the twenty-first century *«dresses the algorithm in the clothes of the human»,* measuring digital agents in full-time

employment equivalents and their resource requirements in energy-per-unit-of-cognitive-productivity profiles. The calorie precedent also provides a useful caution: the mechanistic model of the body as a combustion engine proved analytically productive for approximately a century before encountering systematic challenges from metabolic science, suggesting that cFTE will function as a workable first approximation whose limits will become apparent as the specificity of algorithmic cognition is better understood.

We propose the cognitive full-time equivalent (cFTE) as the basic unit of measurement for an algorithmic agent's productivity. One cFTE corresponds to the cognitive work performed by one skilled worker in a standard work year (approximately 2,000 hours) in a specific professional context. Under this approach:

• a generative AI system that processes client requests with the speed and quality equivalent to the work of 50 operators would be evaluated as 50 cFTE;

• an algorithmic trader that performs the amount of analysis equivalent to the work of 200 analysts would be evaluated as 200 cFTE;

• an automated programming system that generates code with the speed and quality of 30 developers would be evaluated as 30 cFTE.

The cFTE approach is not perfect, since the cognitive work of a person and an algorithm is qualitatively different. However, it allows us to build an analytical bridge between algorithmic and human productivity, similar to how “horsepower” bridged mechanical and animal traction. Fundamentally, cFTE is a measure of productivity, not subjectivity: it does not imply attributing human qualities to an algorithm, but only allows us to quantitatively compare economic results. To contextualize the scale, it is worth citing a historical analogy. The mid-20th century was characterized by tens of thousands of workers occupying vast office spaces, performing calculations that today can be done by a single laptop. The term «computer» originally meant a person’s profession, not a device. In agriculture, the transformation was even more massive: areas that used to employ thousands of people are now served by a few dozen workers and units of equipment. If these transformations have occurred over decades in physical labour, there is reason to expect a similar transformation in cognitive labour - but in a much shorter time frame. To move from shadow to algorithmic demography, it is necessary to address the problem of identifying and recording digital agents. Today, algorithmic agents are not subject to any form of accounting comparable to that required for legal entities or individuals. They are deployed, scaled, and liquidated without any formal procedure, which makes their «population» largely unobservable for regulatory and statistical authorities.

The analogy with corporate law is instructive. Just as the institution of the legal entity emerged to provide legal status to organisations performing economic functions without being individuals, and just as registers of enterprises record the number, activity, and liquidation of firms, a system of digital economic agent identification *(DEAI)* may be required. Such a system would include registering algorithmic agents that exceed a defined productivity threshold, assigning unique identifiers analogous to corporate identification codes, periodic reporting on productivity and energy consumption indicators, and recording the creation and termination of agents to track the dynamics of the algorithmic population. This approach does not imply the granting of legal personality to algorithmic agents. Rather, it involves statistical and regulatory accounting comparable to vehicle or industrial equipment registration, but focused on economic functionality. The introduction of a DEAI framework would therefore mark the transition from shadow demography to algorithmic demography by transforming an unobserved population into an object of systematic measurement and governance. Recent research already explores regulatory approaches to the governance of digital agents, including proposals for licensing mechanisms and institutional oversight prior to their deployment in sensitive sectors such as finance, law or critical infrastructure management, which supports the feasibility of a structured identification and monitoring system for algorithmic agents *(Shahidi et al., 2025; Bengio et al., 2024).*

The process of algorithmic substitution is already producing measurable empirical effects. Evidence indicates a significant decline in employment among young workers in occupations with

high exposure to artificial intelligence, particularly in software development and customer support, where algorithmic systems increasingly perform cognitive and routine tasks *(Brynjolfsson, Chandar & Chen, 2025).* Additional labour market data confirm a reduction in employment shares within occupations most exposed to artificial intelligence following the large-scale deployment of generative AI systems, reflecting early substitution dynamics in knowledge-intensive sectors. Empirical analyses further demonstrate a correlation between the adoption of generative artificial intelligence across occupational groups and rising unemployment within those segments, with computer and mathematical professions experiencing some of the most pronounced effects due to their high level of exposure to algorithmic substitution *(Ozkan & Sullivan, 2025).*

At the same time, aggregate employment continues to expand, indicating that current dynamics reflect substitution rather than absolute displacement of labour. Historical and forward-looking assessments of technological change show that productivity growth driven by advanced technologies may temporarily increase unemployment rates, but this effect tends to dissipate as new forms of employment emerge and labour markets adjust to structural transformation. Long-term employment trends confirm that a substantial share of current occupations did not exist in earlier technological eras, demonstrating the capacity of innovation to generate new forms of work even as existing functions are automated *(Goldman Sachs Research, 2025).*

These findings support two analytically significant conclusions. First, substitution effects are sectorally uneven and possess a distinct cognitive profile, as algorithmic systems primarily replace formalised, repetitive, and codifiable cognitive functions. Second, substitution in the cognitive full-time equivalent dimension occurs at a significantly faster pace than changes in recorded employment, since a single algorithmic agent may perform tasks equivalent to the productivity of multiple human workers, thereby accelerating the expansion of the algorithmic component of the productive system.

The growth of the algorithmic population creates a fundamental asymmetry that has important theoretical and practical implications. Digital agents are capable of performing productive and managerial functions, but they are incapable of performing functions of social reproduction. They do not form political communities, do not create generations, and have no needs for housing, education, or social infrastructure. They compensate for the economic role of the population, but cannot replace it as the basis of society. The analytical depth of this asymmetry is revealed in research demonstrating that artificial intelligence has the potential to disrupt three key functions of work in the modern economy: work as the main scarce factor of production, work as the principal source of income for the majority of the population, and work as the dominant form of time allocation for working-age individuals *(Korinek & Stiglitz, 2021).* Critically, none of these functions can be reduced to pure productivity. They are intertwined with social order, identity, dignity, political participation, and the reproduction of institutions. As a result, the trajectories of economic development and social structure begin to diverge. Economic activity may continue to expand even amid demographic decline, while social institutions remain dependent on human reproduction. Pension systems, educational models, urban infrastructure and mechanisms of political representation were designed for societies characterised by demographic growth or at least stability. They now operate in an environment in which economic activity can be sustained without demographic expansion, creating a structural contradiction between the logic of production and the logic of social reproduction.

This asymmetry acquires an additional dimension in research demonstrating that artificial agents are also transforming the logic of value creation and competition on digital platforms. Contemporary digital platforms traditionally monetise human attention through the optimisation of clicks, engagement and emotional responses; however, the growing presence of autonomous agents capable of interacting with platforms independently of human users alters the structure of demand, supply and market design within digital environments *(Shahidi et al., 2025).* But AI agents don't click or scroll - they act rationally, filtering content and making decisions without distraction. This means that even the commercial infrastructure of the digital economy, built around human psychology, turns out to be ill-adapted to the agentic reality, which may prompt a transition to

fundamentally different business models - subscriptions, utility-based pricing, or machine-to-machine APIs. The question arises whether a specific logic of machine-to-machine interaction will emerge in the future, similar to that studied in behavioural economics for human agents. If algorithmic agents interact with each other to generate economic value, their «behavior» is subject to laws that are not described by either the classical theory of rational choice (since agents are not people) or the theory of automatic control (since they have adaptive properties). The study of this intermediate zone may become a priority area of economic theory in the coming years. Digital agents do not consume in the classical sense - they do not require food, clothing or housing. However, they consume energy, and the scale of this consumption is expanding rapidly. Computing systems, data centres, and algorithmic infrastructures form a specific resource profile that determines the material preconditions for the existence of an algorithmic population.

Estimates of global electricity consumption demonstrate the growing material footprint of digital infrastructures. Global electricity consumption by data centres is assessed at several hundred terawatt-hours annually, accounting for a notable share of total global electricity demand, and is projected to grow substantially over the current decade as digitalisation intensifies (International Energy Agency, 2025). Under baseline scenarios, data centre electricity consumption is expected to increase significantly by 2030, reaching levels comparable to those of major industrialised economies. This expansion is characterised by exceptionally high growth rates that substantially exceed overall growth in global electricity demand *(International Energy Agency, 2025).*

Artificial intelligence is emerging as the primary driver of this growth. The share of energy consumption attributable to AI workloads is projected to increase sharply over the coming years, reflecting the rapid scaling of computationally intensive models and the proliferation of AI-enabled services. At the same time, the energy requirements of individual processing units are rising due to the increasing complexity and performance demands of advanced AI systems, intensifying energy consumption across digital infrastructures *(Deloitte, 2024).*

Within the proposed analytical framework, the resource characteristics of an algorithmic agent may be formalised as an agent energy profile (AEP). AEP is defined as the specific annual volume of electricity consumption required to sustain the functioning of a cognitive full-time equivalent unit. Analogous to historical calculations of the resource requirements necessary to maintain draft animals in early transport systems, the AEP concept enables the quantification of the energy cost of maintaining an algorithmic worker and allows for systematic comparison with the resource costs associated with sustaining human labour, thereby providing a basis for analysing the material constraints of an expanding algorithmic population.

AEP will vary depending on the type of cognitive tasks (model training requires significantly more energy than inference), on the hardware architecture and on the energy efficiency of a particular data center. However, the very principle of linking resource consumption to a unit of productivity allows: (1) to compare the efficiency of different algorithmic agents in single coordinates (productivity in cFTE relative to costs in AEP); (2) to assess the total resource load of the algorithmic population on the energy infrastructure; (3) to form the basis for regulatory decisions regarding the energy intensity of algorithmic agents.

Thus, in parallel with human demography, a resource dimension of the algorithmic population emerges, which determines new material limits to growth. The economy begins to support a parallel population of digital “workers” who are neither born nor age, but constantly convert energy into productivity. This fundamentally changes the structure of investment: instead of investing primarily in the reproduction of human capital *(education, healthcare, social security),* economies begin to invest in the reproduction of computational capital *(data centers, energy infrastructure, semiconductor supply chains).* Accordingly, energy infrastructure becomes a strategic resource of comparable importance to human capital, significantly altering the priorities of public policy.

One of the most acute consequences of the transformation described is the gap between the institutional architecture of societies and the new economic reality. Modern institutions - from pension and taxation systems to models of education and political representation - were formed in the context of demographic growth and mass employment. They are built on the assumption that

each succeeding generation will be larger (or at least comparable) than the previous one, that the majority of adults will work for wages, and that the tax base will be determined by the number of people employed.

The agent economy consistently undermines each of these assumptions. The World Economic Forum's Future of Jobs Report, 2025, notes that up to 92 million jobs could be eliminated by 2030, while about 170 million new ones will be created *(WEF, 2025)*. However, these replacements are not symmetrical: the new jobs do not appear in the same locations, require different skills, and will not go to the same people. The problem of asymmetric substitution is not new. It has accompanied every technological system since the Industrial Revolution and already has a well-established methodological basis. However, classical economic theories that assume the replacement of one unit of labour by another, equivalent one, systematically underestimate the qualitative heterogeneity of new and eliminated jobs. The inability to adequately respond to the asymmetric substitution is, to some extent, a consequence of the use of models in which labour is treated as a homogeneous factor, and one «unit of labour» is assumed to be replaceable by an identical one. The current wave of algorithmization exacerbates this problem: AI-related skills increase wages by 56%, while professions without AI-competences stagnate or lose their positions *(WEF, 2025),* which effectively means a bifurcation of the labour market. At the same time, participation in adult retraining programs remains consistently low, and employers are aware that employees often change jobs after acquiring new skills.

The issue of pension systems becomes particularly acute under conditions of algorithmic substitution, as solidarity-based systems require a stable or expanding base of contributors, while labour-centred taxation regimes risk losing their fiscal foundation as algorithms increasingly replace human workers. When algorithmic agents substitute for employees who would otherwise pay social contributions, corporate productivity may grow alongside a simultaneous erosion of the fiscal base necessary for social reproduction. In this context, the category of cognitive full-time equivalent acquires not only analytical but also regulatory significance. If algorithmic agents are assigned identifiable productivity metrics and registered within a dedicated identification framework, it becomes possible to introduce discrete taxation of algorithmic employment, whereby each cognitive full-time equivalent replacing human labour generates a contribution to pension and social funds comparable to that associated with a human worker. Such an approach would establish a direct link between the scale of algorithmic substitution and the financing of social security systems, thereby reducing firms' capacity to externalise the social costs of automation. The adaptation of economic and regulatory infrastructures to the emergence of algorithmic agents as economic actors thus becomes a necessary condition for maintaining the sustainability of existing social protection and redistribution systems *(Shahidi et al., 2025).*

A separate analytical issue is the ability of digital agents not only to participate in market processes, but also to deform them. Collusion (from the Latin *«collusion» - conspiracy*) in economic theory means the coordinated behaviour of competitors, which leads to maintaining prices above the competitive level. Traditionally, collusion has been viewed as the result of explicit or tacit agreements between human agents with bounded rationality. One of the most significant empirical discoveries of recent years concerns algorithmic collusion - the ability of independent artificial intelligence agents to coordinate supra-competitive prices in repeated pricing games. Evidence shows that reinforcement learning algorithms can “learn” collusive strategies even without explicit programming for such behaviour, demonstrating the potential for autonomous coordination among digital agents *(Calvano et al., 2020).* Subsequent empirical analysis based on real market data confirms that the introduction of algorithmic pricing mechanisms may be associated with observable price increases in competitive markets, highlighting the practical relevance of this phenomenon *(Assad et al., 2024; Panchenko et al., 2024).*

This development has profound theoretical implications. Classical competition theory is grounded in the assumption of human agents characterised by bounded rationality, information asymmetry and coordination constraints. Algorithmic agents may partially overcome these limitations, necessitating a reconsideration of antitrust regulation and traditional interpretations of

market failure. Research suggests that collusive outcomes may emerge from structural properties of reinforcement learning systems themselves, particularly from insufficient exploration within learning processes, and that increased exploration can lead to pricing outcomes closer to competitive benchmarks *(Abada & Lambin, 2023).* This indicates that the core issue lies less in intentional collusion than in the systemic characteristics of learning algorithms, thereby requiring new forms of regulatory and analytical response.

Within the conceptual framework of shadow demography, algorithmic collusion acquires an additional dimension. The expansion of the algorithmic population implies that a growing share of market decisions will be made by agents capable of coordination beyond the scope anticipated by classical competition theory. This dynamic creates a novel type of market failure that calls not only for adjustments in antitrust practice but also for a broader reconsideration of the theoretical foundations of competition in an economy increasingly shaped by autonomous digital agents.

The described transformation has a distinct geopolitical dimension. The ability to create, maintain and control algorithmic agents is unevenly distributed. According to available estimates, North America accounts for a substantial share of the global AI agent market, reflecting the concentration of technological capabilities and digital infrastructure in advanced economies *(Klover.ai, 2025).* The United States and China together are projected to account for the overwhelming majority of the increase in electricity consumption by data centres by 2030, demonstrating the geographical concentration of the material infrastructure required to sustain the algorithmic economy *(IEA, 2025).* At the same time, the exposure of labour markets to generative artificial intelligence differs significantly across income groups: the share of jobs potentially affected by generative AI reaches approximately one-third in high-income economies compared to significantly lower levels in low-income countries *(World Economic Forum, 2025).*

This indicates that the decoupling between demographic dynamics and economic growth is uneven across countries. Advanced economies facing demographic ageing have the opportunity to compensate for labour force decline by deploying algorithmic agents. Developing countries with young and growing populations risk the erosion of their demographic advantage: if cognitive labour can be reproduced algorithmically, the traditional demographic dividend may transform into a demographic burden. Such a scenario has been anticipated in analyses of the global distributional consequences of artificial intelligence and technological change, which emphasise the risk that countries relying on labour cost advantages may lose their development trajectory as production and service functions become increasingly automated *(Korinek & Stiglitz, 2021).* This dynamic can reverse the traditional logic of comparative advantage and contribute to the emergence of new forms of technologically driven international inequality.

Competition for the energy resources required to sustain an algorithmic population introduces an additional dimension of international rivalry. Electricity production becomes an indicator not only of industrial capacity but also of the ability to maintain algorithmic infrastructure. The scale of this challenge is illustrated by the substantial energy requirements of large-scale artificial intelligence computing clusters, which demand electricity levels comparable to those of major industrial or urban consumers. Countries with constrained energy resources risk remaining on the periphery of the emerging algorithmic economy, even when they possess significant human capital in information technology. The parallel development of humanoid robotics reinforces this trend. As the cost of producing humanoid systems with functional capabilities comparable to human labour approaches the total cost of training a skilled worker, countries with advanced industrial bases acquire the capacity to expand their productive «population» through robotic manufacturing. Projections by technology firms indicate the possibility of mass-producing humanoid units at costs comparable to or lower than the lifetime investment in human capital formation, transforming industrial capacity into a functional demographic resource. In this perspective, enterprises built on predominantly robotic production systems may achieve productivity levels significantly exceeding those of firms relying primarily on human labour, further intensifying structural asymmetries within the global economy.

In the middle of this spectrum are countries like Ukraine, for which the issue of algorithmic

demography is particularly acute. On the one hand, Ukraine is experiencing an unprecedented demographic crisis, exacerbated by migration and the consequences of armed conflict. On the other hand, it has significant human capital in the IT sector and the potential for integration into global chains of algorithmic production. The strategic issue for such countries is not so much in counteracting algorithmic substitution as in developing their own capacity to create, control and regulate digital agents, as well as in providing the energy infrastructure to support them.

The academic nature of the article obliges consideration of counterarguments. Is it correct to consider digital agents as functional equivalents of economic entities? Isn't this excessive «anthropomorphization»? Critics may argue that agents have no self-interest, do not make decisions in the full sense of the term, and are not responsible for their actions. They remain objects of ownership and control by human or corporate entities. In the legal sense, they are not subjects of law, do not enter into contracts in their own name, and do not possess legal capacity. These objections are well-founded. However, they do not refute the central thesis; rather, they refine it. Functional equivalence does not imply ontological identity. A corporation is also not a human being, yet it is recognised as a subject of economic and legal relations. The legal fiction of corporate personality emerged precisely because the functional role of corporations in economic processes required appropriate institutional formalisation. Similarly, the growing role of digital agents in production, exchange, and distribution may eventually necessitate new institutional frameworks even if these frameworks do not involve granting agents full legal personality.

Current technological trajectories suggest the potential emergence of a global economy in which autonomous artificial intelligence agents interact with one another to generate economic value independently of human labour (*Shahidi, Rusak, Manning, Fradkin & Horton, 2025).* This differs fundamentally from previous technological transformations. Historically, technological progress was driven by relatively inflexible inventions that sequentially increased productivity in specific sectors *(Mokyr, Vickers & Ziebarth, 2015).* Artificial intelligence agents, by contrast, assume the form of "flexible capital" capable of automating diverse cognitive tasks across industries and professions *(Eloundou, Manning, Mishkin & Rock, 2024).*

The Digital Economic Agent Identification *(DEAI)* system proposed in this article represents an institutional solution that does not grant legal personality to agents but ensures their visibility for regulatory and statistical systems. Just as the registration of companies does not imply that a legal entity is a human being but merely records its existence and activity, the registration of algorithmic agents would document their economic functionality. In the longer term, it may prove appropriate to require the discrete registration of software complexes by functionally separating them into identifiable units for regulatory purposes, in a manner analogous to the possibility of compulsory corporate division within antitrust law.

A historical perspective is useful for understanding the transformation described. Each of the great technological revolutions changed the relationship between population and production. The agricultural revolution loosened the Malthusian trap, allowing population growth without a commensurate increase in hunger. The industrial revolution transformed the very nature of growth: rapid technological progress became its key engine, accompanied by reproducible capital in the form of machines and factories *(Korinek, 2024).* As technology and capital accumulated, labour became the bottleneck. It was this labour scarcity that led to a significant increase in wages, creating the current level of well-being that has increased approximately twentyfold in advanced economies since the Industrial Revolution. The digital revolution may mark another paradigm shift, making human intelligence reproducible *(Korinek & Suh, 2024)*. Artificial intelligence systems and robots have the potential to replace both cognitive and physical human labour. In this new era, both traditional capital and intelligent machines are becoming reproducible resources, and the line between them is increasingly blurred.

However, each of the previous revolutions generated new forms of employment that compensated for those displaced. Predictions that technology would reduce the need for human labour have a long history but uneven empirical confirmation, as technological change has historically created new forms of employment even as it displaces existing ones *(Goldman Sachs*

*Research, 2025).* The question that remains unanswered is whether the digital revolution will follow this pattern, or whether artificial intelligence capabilities will advance so rapidly that even newly created occupations will be performed more efficiently by machines than by humans.

The degree of divergence in expert opinion on this issue is extraordinary. Analytical assessments of the labour market effects of artificial intelligence indicate that a significant proportion of researchers and technology developers consider large-scale substitution of human labour by artificial intelligence within the coming years to be a plausible scenario (*Brynjolfsson, Chandar & Chen, 2025)*. At the same time, leading technology companies are incorporating into their strategic planning scenarios of extensive robotization of production processes within the next decade, including the mass production of humanoid robots and the deployment of digital workers capable of performing a wide range of cognitive tasks traditionally associated with human labour (*McKinsey Global Institute, 2025).* Within the analytical framework of the present study, the direction and speed of these technological trajectories, as perceived by the actors who create and deploy these technologies, constitute empirically significant indicators of structural transformation.

**Conclusions.** The article proposes a conceptual framework for analysing digital agents as functional equivalents of an economic subject, enabling us to identify a fundamentally new situation for economic theory: the disconnect between demographic dynamics and economic growth, which for millennia seemed axiomatic. First, it is substantiated that the change in the ontological status of technology - from a tool for increasing productivity to an autonomous participant in economic processes - forms a hybrid factor of production *(«agent capital»)*, which does not fit into the classical triad of factors of production and requires a rethinking of the fundamental categories of economic theory. Second, a paired categorical construct is proposed: shadow demographics, which describes the current unobserved state of the algorithmic population, and algorithmic demographics as a promising state arising from the institutionalization of accounting for digital agents. An approach to the quantitative identification of algorithmic agents is developed through the categories of cognitive full-time equivalent (cFTE) and agent energy profile (AEP), and the concept of digital economic agent identification (DEAI) as an institutional mechanism for the transition from shadow to algorithmic demography. Thirdly, it is shown that a fundamental asymmetry arises between economic and social reproduction: digital agents can compensate for the population's production functions but cannot replace its social reproduction functions, leading to a divergence between the logic of production and the logic of the social order. Fourthly, it is substantiated that the institutional architecture of modern societies is built on assumptions that are systematically undermined by the agent economy. The concept of discrete taxation of algorithmic employment is proposed as a mechanism to preserve the fiscal base of social protection amid algorithmic substitution. Fifthly, the geoeconomic dimension of algorithmic transformation is analysed, within which the ability to create, maintain and control digital agents becomes a new axis of international inequality. It is shown that developed economies can potentially compensate for demographic aging through algorithmic substitution, whereas in developing countries, the demographic dividend risks being devalued. For countries with an intermediate status, such as Ukraine, the strategic priority is to develop their own capacity to create and control digital agents, as well as to provide the energy infrastructure to support them. Economic power is no longer measured solely by population size. It is increasingly determined by the ability to create, maintain, and control technological agents. This does not mean devaluing human life or human labour as such, but it does mean the need for a radical revision of the categorical apparatus that economists, demographers, and politicians operate. Bridging the gap between economic logic that adapts to algorithmic reality and social institutions that remain built on the assumption of demographic growth is one of the central tasks of economic theory and policy in the 21st century.

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# INVESTMENT DEALS IN THE INTERNATIONAL IT SERVICES MARKET AS A MECHANISM FOR THE REDISTRIBUTION OF TECHNOLOGICAL COMPETENCIES

# ІНВЕСТИЦІЙНІ УГОДИ НА МІЖНАРОДНОМУ РИНКУ ІТ-ПОСЛУГ ЯК МЕХАНІЗМ ПЕРЕРОЗПОДІЛУ ТЕХНОЛОГІЧНИХ КОМПЕТЕНЦІЙ

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***Abstract.*** *The article proposes a conceptual interpretation of investment deals in the international IT services market as a mechanism for the redistribution of technological competencies, rather than merely a form of cross-border capital movement. The IT services market is conceptualized as the intellectual-service core of the global ICT space, distinguished by the dominance of intangible assets, the decisive role of human capital, high mobility of technological competencies and platform-based business models. It is substantiated that classical theories of foreign direct investment and mergers and acquisitions, developed for material-oriented sectors, have limited explanatory capacity when applied to a market where the object of a transaction is not a physical asset but a team, an algorithm, a client base or a position within a digital value chain. A typology of investors in IT services is proposed, distinguishing strategic technological acquirers, private equity funds and venture capital, each characterized by distinct investment logics and effects on market structure. The wave theory of consolidation is applied to demonstrate that M&A activity in IT services follows cyclical patterns linked to technological adoption curves, creating preconditions for strategic forecasting. Particular attention is given to the position of Ukraine as a territorial cluster of the global IT services market, whose investment attractiveness is shaped by the combination of human capital concentration, cost competitiveness and the geopolitical context of armed conflict.*

*The scientific novelty of the research lies in the integration of the resource-based view, the knowledge-based theory and the concept of profiting from innovation into a unified analytical framework for interpreting investment deals in the sector of intangible assets. A cascading model of the investment cycle is developed, describing the sequential interaction of three investor types - venture capital, private equity funds and strategic acquirers - where activity at each level serves as a predictor of activity at the next. Technological shock is identified as a sector-specific generator of*

*consolidation waves, distinguishing IT services from material-oriented industries where merger waves are typically driven by deregulation or macroeconomic shifts. The position of the Ukrainian IT sector is substantiated through the categories of VRIN (valuable, rare, inimitable, non-substitutable resources) resources and complementary assets, demonstrating that knowledge-intensive assets exhibit structural resilience to geopolitical disruption and that the post-conflict context creates preconditions for the accelerated integration of Ukrainian IT companies into European digital value chains.*

***Key words:*** *IT services market, investment deals, mergers and acquisitions, technological competencies, intangible assets, human capital, ICT space, strategic forecasting, consolidation waves, private equity, venture capital, digital value chains, Ukraine*

***Анотація.*** *У статті запропоновано концептуальну інтерпретацію інвестиційних угод на міжнародному ринку IT-послуг як механізму перерозподілу технологічних компетенцій, а не лише форми транскордонного руху капіталу. Ринок IT-послуг концептуалізовано як інтелектуально-сервісне ядро глобального ІКТ-простору, що вирізняється домінуванням нематеріальних активів, вирішальною роллю людського капіталу, високою мобільністю технологічних компетенцій і платформною організацією бізнес-моделей. Обґрунтовано, що класичні теорії прямих іноземних інвестицій та злиттів і поглинань, розроблені для матеріально орієнтованих секторів, мають обмежену пояснювальну здатність щодо ринку, де об'єктом угоди є не фізичний актив, а команда, алгоритм, клієнтська база або позиція у цифровому ланцюгу вартості. Запропоновано типологію інвесторів у сфері IT-послуг, що розрізняє стратегічних технологічних покупців, фонди прямого інвестування та венчурний капітал, кожен з яких характеризується власною інвестиційною логікою та впливом на структуру ринку. Застосовано хвильову теорію консолідації для демонстрації того, що M&A-активність у сфері IT-послуг підпорядковується циклічним закономірностям, пов'язаним з кривими технологічної адаптації, що створює передумови для стратегічного прогнозування. Окрему увагу приділено позиції України як територіального кластера глобального ринку IT-послуг, інвестиційна привабливість якого формується поєднанням концентрації людського капіталу, цінової конкурентоспроможності та геополітичного контексту збройного конфлікту.*

*Наукова новизна дослідження полягає в інтеграції ресурсної теорії фірми, знаннєвої теорії фірми та концепції отримання прибутку від інновацій (англ. «profiting from innovation») у єдину аналітичну рамку інтерпретації міжнародних інвестиційних угод у секторі нематеріальних активів. Розроблено каскадну модель інвестиційного циклу, що описує послідовну взаємодію трьох типів інвесторів - венчурного капіталу, фондів прямого інвестування (англ. «private equity») і стратегічних покупців, де активність на кожному рівні формує передумови активізації наступного. Ідентифіковано технологічний шок як специфічний для сектору IT-послуг генератор хвиль консолідації, що відрізняє його від матеріально орієнтованих галузей, у яких хвилі злиттів і поглинань зумовлюються передусім дерегуляцією або макроекономічними зрушеннями. Позицію українського IT-сектору обґрунтовано через категорії ресурсів, що мають цінність, рідкісність, складність імітації та незамінність, а також через концепцію комплементарних активів, що дозволило продемонструвати структурну стійкість знаннєвих активів до геополітичних потрясінь і визначити повоєнний контекст як передумову прискореної інтеграції українських IT-компаній у європейські цифрові ланцюги вартості.*

***Ключові слова:*** *ринок IT-послуг, інвестиційні угоди, злиття і поглинання, технологічні компетенції, нематеріальні активи, людський капітал, ІКТ-простір, стратегічне прогнозування, хвилі консолідації, прямі інвестиції, венчурний капітал, цифрові ланцюги вартості, Україна*

**Introduction.** Over the past two decades, the international IT services market has evolved from an auxiliary service segment into the structural core of the global ICT space, where the bulk

of digital solutions underpinning the functioning of modern economies are created, integrated, and scaled. The information and communications technology market is structured as a multi-level system comprising four basic segments: hardware, which provides the material foundation of digital infrastructure; telecommunications, which ensure data transmission and connectivity; software, which encompasses the development of operating systems, platform solutions and digital products; and IT services, which integrate the service-oriented component of ICT and ensure the implementation, adaptation and operation of digital technologies in business and the public sector. The intersection between the ICT and IT services markets is functional in nature and centres on commercialization: the IT services market draws on the outputs of software producers and telecommunications infrastructure while ensuring their practical implementation and scaling across various sectors of the economy *(Reznikova, Ptashchenko & Ptashchenko, 2025)*. Within the structure of the IT services market, six key areas of activity can be identified: software development services (custom and platform-based development), IT outsourcing (delegation of development, support and testing functions to external providers), IT consulting services (digital transformation of business processes), system integration (combining software and hardware components into unified information systems), cloud services (access to computing resources and software platforms), and cybersecurity services (protection of data and digital infrastructures) *(Reznikova, Vovk & Ptashchenko, 2025b)*. Each of these areas generates its own logic of investment attractiveness and deal typology, which necessitates a differentiated analytical approach.

Unlike other components of the ICT market, IT services are characterized by several structural features that shape investment behaviour. The dominance of intangible assets means that the bulk of company value resides not in physical infrastructure but in intellectual property, algorithms, technology stacks and client bases *(Haskel & Westlake, 2018)*. The decisive role of human capital manifests in the fact that developers' and engineers' competencies constitute the industry's principal resource, yet, by definition, this resource does not belong to the company in the same sense as a patent or a production line *(Pryiatelchuk & Naida, 2025)*. The high cross-border mobility of competencies precludes a classical national market residency: a company may be legally registered in one jurisdiction, its team may work in another, its clients may be located in a third, and the acquirer in a fourth *(Vergun, 2020)*. The platform-based organization of business models generates network effects whereby the value of a product increases with the number of users, fundamentally altering the logic of company valuation and investor motivation *(Kenney & Zysman, 2016)*.

It is precisely these features that cause investment deals in the IT services sector to acquire the character not merely of capital movement but of a mechanism for the redistribution of technological competencies, teams, and access to digital ecosystems. The acquirer obtains not a factory or a licence but a development team, a technology stack, access to a client base, and a position within a global digital value chain. This shift in the nature of investment activity calls into question the sufficiency of classical analytical frameworks developed for material-oriented sectors and necessitates the formation of supplementary theoretical approaches.

The study's relevance is determined by several factors. First, mergers and acquisitions are becoming the dominant mechanism of structural transformation in the IT services market, and their volumes demonstrate sustained growth with pronounced wave-like characteristics *(UNCTAD, 2024)*. Second, the theoretical understanding of investment deals in the intangible asset sector remains fragmented: classical FDI and M&A theories only partially explain the observed patterns, while newer concepts have yet to be integrated into a coherent analytical framework. Third, for countries with significant human capital in IT, particularly Ukraine, understanding the logic of investment deals becomes strategically important, as it determines the possibilities for integration into global value chains and for attracting capital to scale *(Reznikova & Panchenko, 2023)*. What is at stake is the formation of a new normal in the global economy, where technological competition determines development trajectories and the structure of international investment flows *(Reznikova & Ivashchenko, 2017)*. This study conceptualizes investment deals in the international IT services market as a mechanism for the redistribution of technological competencies and advances an integrated analytical framework that combines the resource-based view, knowledge-based theory

and the concept of profiting from innovation.

**The purpose of the article** is to substantiate a conceptual interpretation of investment deals in the international IT services market as a mechanism for the redistribution of technological competencies. Achieving this objective involves: systematizing classical and contemporary theoretical approaches to the analysis of cross-border investment deals with a determination of the boundaries of their applicability to the intangible asset sector; conceptualizing the IT services market as a specific object of investment analysis within the structure of the global ICT space; developing a typology of investors and substantiating a cascading model of the investment cycle; analysing the wave logic of consolidation as a basis for strategic forecasting; and determining the position of the Ukrainian IT sector within the global architecture of investment flows. The methodological foundation of the study comprises a combination of structural-functional analysis of the ICT market, comparative analysis of investment logics in material-oriented and knowledge-oriented sectors, the resource-based approach, and elements of institutional analysis.

**Literature review.** The theoretical understanding of investment deals in the IT services sector lies at the intersection of several research traditions, each offering a partial but insufficient explanation of this market's specifics. The first tradition is associated with classical theories of foreign direct investment. Dunning's eclectic paradigm (the OLI model) explains cross-border investment through ownership, location and internalization advantages *(Dunning, 2000)*. However, this model was developed for sectors where ownership advantages are embodied in tangible assets, patents, or brands, and location advantages are linked to access to natural resources or domestic markets. In the IT services sector, ownership advantages are concentrated in human capital and technological competencies, which are by definition mobile, while location advantages are determined by the availability of qualified teams rather than the geography of resources. The internalization theory *(Buckley & Casson, 1976)* explains why firms prefer internal organization of cross-border operations over market transactions, but in the IT services sector, where the critical resource is knowledge and competencies rather than transaction-specific assets in the classical sense, its explanatory capacity is limited.

The second tradition concerns the theory of the market for corporate control, which interprets mergers and acquisitions as a mechanism for disciplining management and improving asset utilization efficiency *(Manne, 1965)*. In the IT services sector, this logic applies only partially: many M&A deals are motivated not by the inefficiency of the target company's management but by the acquirer's desire to rapidly gain access to competencies that cannot be created organically within an acceptable timeframe. The phenomenon of «acqui-hire» - *acquiring a company primarily for its team* - is characteristic of the IT sector and does not fit within the classical logic of corporate control.

The third research line concerns the analysis of digital markets and their specific features. Studies of data and information technology markets as a space of strategic competition for digital leadership emphasize that technological competencies and access to intellectual resources are becoming the defining factors in the positioning of countries and companies in the global economy *(Reznikova, Ptashchenko & Ptashchenko, 2025)*. The formation of international competitiveness in the IT sector is determined by strategic factors, among which the ability to attract investment and form partnerships occupies a central place. Competition in the digital era takes on the character of a contest over strategic determinants of competitiveness, where investment deals serve as a mechanism for rapidly acquiring the necessary competencies *(Reznikova, Vovk & Ptashchenko, 2025b)*.

The fourth line is formed by studies of the competitive positions of national IT sectors in the global market, which provide an empirical basis for analysing the investment attractiveness of individual territorial clusters. An analysis of the Ukrainian IT sector's positions in the global market demonstrates that, even under conditions of full-scale armed conflict, the sector retained a significant share of its export revenues and client relationships, attesting to the specific resilience of intangible-oriented markets *(Melnyk & Zavhorodnia, 2022)*. This resilience is explained by a set of competitive advantages, among which high specialist qualifications, cost competitiveness, integration into global value creation chains and the flexibility of business models adapted to remote

work are prominent *(Melnyk & Zavhorodnia, 2023a)*. At the same time, the competitiveness of the IT sector is not a static characteristic; it requires theoretical understanding through the lens of contemporary competition concepts that account for the specifics of intangible assets and network effects *(Zavhorodnia & Melnyk, 2023)*. The methodology for assessing the international competitiveness of the IT sector reveals the limitations of traditional approaches developed for material-oriented industries and the necessity of forming an adapted toolkit that accounts for the role of human capital, technology stacks and positioning within global digital value chains *(Melnyk & Zavhorodnia, 2023b)*. It is precisely these characteristics that determine the investment attractiveness of IT companies and shape demand for deals from strategic acquirers and financial investors.

In the context of broader transformations of the world economy, investment deals in IT services take place under a new normal characterized by intensified systemic risks, changing consumption patterns, and growing geoeconomic turbulence. These conditions create a specific context for investment behaviour, in which uncertainty and the pace of technological change heighten the importance of strategic forecasting. The geoeconomic dimension of investment processes is analysed in the context of civilizational shifts, where technological competition becomes the key arena of international rivalry.

Human capital, as a fundamental intangible asset in international business, acquires particular significance in the IT services sector, as it determines company valuations and their attractiveness as targets for investment deals *(Pryiatelchuk & Naida, 2025)*. Processes of socialization in state and corporate governance affect the institutional environment in which investment decisions are made *(Pryiatelchuk, 2017)*. Digital trade in global markets creates new channels of value creation that directly influence the structure of demand for IT services and, correspondingly, investment dynamics *(Pryiatelchuk, 2023)*. The conceptualization of the digital media market reveals the formation of new types of digital assets that become objects of investment deals *(Pryiatelchuk & Bekh, 2020)*.

Despite the significant body of research, substantial gaps remain in the literature. First, there is no systematic conceptualization of investment deals in the IT services sector as a distinct type of cross-border capital movement, distinct from investment in material-oriented sectors. Second, the wave dynamics of M&A activity in IT services have not been integrated into a theoretical framework for strategic forecasting. Third, the typology of investors and their strategies is insufficiently developed with respect to the specifics of the intangible asset market. Fourth, the position of individual territorial clusters, particularly the Ukrainian one, requires analysis not as isolated national markets but as nodes in a global network of competency redistribution - and although empirical studies of the Ukrainian IT sector's competitiveness provide the necessary foundation for this, they have not yet been integrated into a theoretical framework for the analysis of investment deals.

**Main results of the research.** Classical theories of foreign direct investment and mergers and acquisitions were formed in the context of an industrial economy where the object of an investment deal is a tangible asset - a factory, a deposit, a logistics network, a distribution channel. In the eclectic paradigm, ownership advantages are described through patents, brands and production technologies, location advantages through access to resources and markets, and internalization advantages through the reduction of transaction costs compared with market exchange *(Dunning, 2000)*. Internalization theory holds that a firm expands abroad when its internal organization of cross-border operations is more efficient than market alternatives *(Buckley & Casson, 1976)*. Both concepts successfully explain investment behaviour in extractive, manufacturing, and infrastructure sectors.

In the IT services sector, these explanatory frameworks reveal systemic limitations. Ownership advantages are concentrated primarily in human capital, which does not belong to the company in the same way as a patent or a production line and may be lost after a deal is completed *(Coff, 1999)*. Location advantages are determined by the availability of qualified teams and embeddedness in knowledge networks rather than by the geography of resources or sales markets.

Company value is shaped by the scalability of solutions, network effects, and positioning within the digital value chain - characteristics that are poorly described by the categories of classical models *(Haskel & Westlake, 2018)*. The theory of the market for corporate control *(Manne, 1965)* explains M&A as a mechanism for replacing inefficient management, but in the IT services sector, acquirers frequently acquire successful, well-managed, and rapidly growing companies precisely because their competencies are unique and cannot be created organically.

The resource-based and knowledge-based theories offer a more productive explanatory framework. Within the logic of the resource-based view *(Barney, 1991)*, an investment deal in IT services is directed at acquiring resources and capabilities that are valuable (providing competitive advantage), rare (available to a limited number of firms), difficult to imitate (cannot be copied or created from scratch) and non-substitutable (having no functional equivalents). A technological team that has developed a unique product and possesses experience in scaling it constitutes precisely such a resource. The knowledge-based theory *(Kogut & Zander, 1993)* holds that a multinational corporation is an institution that specializes in the transfer of tacit knowledge across borders, and that acquiring an IT company is the most effective means of internalizing knowledge that cannot be transferred through market mechanisms.

The concept of profiting from innovation *(Teece, 1986)* adds a further dimension: an innovative IT company may create a unique technological solution, but without access to complementary assets - a client base, a brand, distribution channels - it is unable to realize its full market potential. The strategic acquirer possesses precisely these complementary assets, which creates a fundamental motivation for M&A: the deal generates synergies unattainable for either party individually. Technological compatibility and synergy potential are empirically confirmed predictors of specific acquirer-target pairs *(Bena & Li, 2014)*. Thus, for the IT services sector, it is appropriate to supplement classical FDI and M&A theories with an analytical framework built on resource-based and knowledge-based theories, in which an investment deal functions as an instrument of rapid access to competencies that cannot be created organically (the resource motive), effective transfer of tacit knowledge across borders (the knowledge motive) and acquisition of control over complementary assets for the commercialization of innovations (the innovation motive).

The competitive environment in the IT services market is shaped by the interaction of several types of investors, each characterized by its own investment logic, time horizon, and impact on market structure. Strategic technological acquirers are transnational technology corporations that make acquisitions to expand their product line, acquire technological competencies or eliminate competitors. Their logic is determined by the aspiration to integrate acquired competencies into their own ecosystem and is explained in terms of the category of complementary assets *(Teece, 1986)*: the strategic acquirer possesses scale, brand, and distribution, while the target company possesses an innovative solution. Strategic acquirers are characterized by controlling acquisitions with full integration or «acqui-hire» - acquisition for the sake of the team. This type dominates in cloud services, cybersecurity, and platform solutions, where network effects and winner-takes-all dynamics create incentives for rapid consolidation *(Kenney & Zysman, 2016)*. Firms with high R&D intensity are more likely to become targets of such acquisitions, as their innovation potential constitutes the principal value for the acquirer *(Phillips & Zhdanov, 2013)*.

Private equity funds focus on financial scaling. Their strategy consists of acquiring controlling stakes in mid-sized IT companies, operational optimization, and consolidating several companies into a single platform (the buy-and-build strategy), followed by an exit through a sale to a strategic acquirer or an IPO. This type of investor is particularly active in the IT outsourcing segment, where there exists a significant number of mid-sized companies with predictable cash flows and consolidation potential. The choice of M&A as a mode of entry is explained by the fact that intangible asset intensity renders greenfield investment inefficient: the organic creation of comparable teams and client relationships takes disproportionately long *(Nocke & Yeaple, 2007)*.

Venture capital invests in early- and mid-stage IT companies, creating a pool of potential targets for subsequent M&A deals. Venture capital performs the function of a mechanism for the

selection, cultivation and legitimation of technological competencies: companies that have passed through several rounds of venture financing have formalized processes, a validated business model and transparent financial reporting, which makes them attractive targets for strategic acquirers and PE funds.

The interaction of these three investor types forms a cascading model of the investment cycle: venture capital cultivates competencies and forms companies with validated potential; private equity funds consolidate them into larger platforms, achieving economies of scale and operational efficiency; strategic acquirers integrate the acquired platforms into global ecosystems, providing access to complementary assets and completing the cycle of competency redistribution. This cascading logic means that activity at each level is a predictor of activity at the next: growth in venture financing in a particular technological segment signals future growth in PE consolidation, which in turn signals subsequent strategic acquisitions.

M&A activity in the IT services market is not linear. Classical research demonstrated that merger waves emerge as a result of economic disturbances - technological, regulatory, or macroeconomic - that generate divergence in asset valuations across different categories of investors *(Gort, 1969).* Subsequent studies established that aggregate M&A activity is driven primarily by industry-specific shocks under conditions of sufficient capital liquidity *(Harford, 2005),* while the intensity of merger waves is further amplified by information asymmetry regarding the true value of assets *(Rhodes-Kropf & Viswanathan, 2004).* In the IT services sector, wave logic takes on a specific meaning through its association with technological adoption curves.

Each technological wave - from the diffusion of ERP systems to cloud computing and generative artificial intelligence - unfolds through three interrelated phases. During the accumulation phase associated with the emergence of new technologies, numerous firms enter the market to develop solutions within the new technological niche, venture capital actively finances start-ups, and the market remains highly fragmented. The subsequent consolidation phase is marked by intensified acquisition activity by strategic buyers and private equity funds, which seek to secure leading firms, integrate competencies, and strengthen market positions, resulting in a growing number and average size of transactions. The stabilization and integration phase follows: as acquired firms are incorporated into the organizational structures of acquirers, the market reaches a new configuration characterized by fewer, larger players, and overall M&A activity gradually declines until the next technological shift. Such cyclicality confirms the theoretical proposition that M&A waves arise in response to industry disturbances *(Gort, 1969; Harford, 2005),* while also revealing a mechanism specific to the IT sector. In this context, the primary disturbance is not deregulation or a change in the trade regime but a technological shift that transforms the structure of demand for competencies and reconfigures the competitive landscape.

The cyclicality of M&A activity and its factor-driven nature create preconditions for strategic forecasting. Factors determining the probability and parameters of deals can be systematized into several groups: characteristics of target companies (scale, technology stack, growth rate, R&D intensity, position in the value chain), investor strategies (expansion vs. consolidation, investment horizon), industry context (phase of the technological cycle, demand structure) and the macro-environment (geopolitics, regulatory conditions, cost and availability of capital). Empirical confirmation of the link between technological compatibility and the probability of specific acquirer-target pairs *(Bena & Li, 2014)*, as well as between R&D intensity and the probability of acquisition *(Phillips & Zhdanov, 2013)*, indicates that the forecasting of specific deals is methodologically feasible.

Forecasting investment deals in the IT services sector cannot be reduced to econometric models built exclusively on financial indicators, since the value of IT companies is determined by intangible factors that are poorly reflected in financial reporting *(Haskel & Westlake, 2018)*. It requires a strategic-analytical framework that combines quantitative analysis with qualitative assessment of technological trends and investor strategies. The construction of such a framework involves developing several interrelated models: a target prediction model, a buyer prediction model and an acquirer-target matchmaking model. Each of these models requires adaptation for different

market segments and contextual conditions.

The IT services market lacks classical national residency. National segments - American, European, Indian, Israeli, Ukrainian - should be interpreted not as isolated markets but as territorial clusters of the global market, interconnected by flows of capital, competencies and contractual relations. Each cluster is characterized by a specific combination of location advantages: the availability of qualified human capital, cost competitiveness, the institutional environment and the geopolitical context.

Ukraine occupies a specific position within this architecture. Significant human capital in IT makes it one of the largest reservoirs of technological competencies in Eastern Europe. Human capital as a fundamental intangible asset determines the value of Ukrainian IT companies and their attractiveness as targets for investment deals *(Pryiatelchuk & Naida, 2025)*. The Ukrainian IT sector demonstrated resilience even amid full-scale armed conflict, retaining the bulk of its export revenues and client relationships *(Reznikova & Panchenko, 2023)*. This fact constitutes empirical confirmation of the thesis that the IT services market is structurally distinct from material-oriented sectors: knowledge assets are geographically more mobile and less vulnerable to physical destruction than production infrastructure.

At the same time, the geopolitical context significantly affects investment attractiveness. Under conditions of armed conflict, the risk discount increases, the structure of acquirers changes (the role of strategic acquirers diminishes while specialized funds' role grows), and requirements for the legal structuring of deals intensify. These processes unfold within the context of broader geoeconomic transformations. The post-conflict context creates preconditions for the intensification of investment activity: M&A may serve as an instrument for integrating Ukrainian IT companies into European value chains. Processes of socialization in corporate governance and the formation of transparent institutional mechanisms are prerequisites for attracting foreign investors *(Pryiatelchuk, 2017)*.

The strategic dilemma for the Ukrainian IT sector is choosing between positioning as an acquisition target (inbound strategy) and pursuing its own outward expansion (outbound strategy). Within the resource-based view *(Barney, 1991)*, Ukrainian IT companies possess valuable and rare competencies, making them attractive targets. Within the logic of profiting from innovation *(Teece, 1986)*, they require access to the complementary assets of global players to fully commercialize their solutions. The optimal strategy combines both directions based on the company's scale and the market cycle phase. Digital trade and financial technologies create additional channels for integrating Ukrainian IT companies into global value chains *(Pryiatelchuk, 2023)*.

**Conclusions.** In the course of addressing the research task, which consisted of substantiating a conceptual interpretation of investment deals in the international IT services market as a mechanism for the redistribution of technological competencies and involved the use of structural-functional analysis of the ICT market, comparative analysis of investment logics in material-oriented and knowledge-oriented sectors, the resource-based approach and elements of institutional analysis, a number of scientific results were obtained that permit the formulation of the following conclusions.

First, the international IT services market serves as the intellectual-service core of the global ICT space, in which investment deals take on the character of a mechanism for the redistribution of technological competencies. Unlike material-oriented sectors, where investment is directed at acquiring physical assets or access to resources and markets, in the IT services sector, the object of a deal is a specific combination of knowledge assets - a team, an algorithm, a client base, and a position within a digital value chain. This combination meets the criteria of the resource-based view - it is valuable, rare, difficult to imitate and non-substitutable - which creates the fundamental motivation for M&A as a form of access to it.

Second, classical theories of foreign direct investment and mergers and acquisitions retain partial relevance but require supplementation with an analytical framework built on the resource-based and knowledge-based theories of the firm. The eclectic paradigm and internalization theory successfully explain the general logic of cross-border investment, but do not account for the

specifics of intangible assets - their scalability, mobility, and the risk of loss following deal completion. The resource-based view explains why the object of investment is a unique combination of competencies. The knowledge-based theory explains why M&A is a more effective means of knowledge transfer than market alternatives. The concept of profiting from innovation explains the mutual benefit for the acquirer and the target through the category of complementary assets.

Third, the typology of investors in the IT services sector encompasses strategic technological acquirers, private equity funds, and venture capital, which form a cascading model of the investment cycle: venture capital cultivates competencies, private equity funds consolidate them into platforms, and strategic acquirers integrate them into global ecosystems. Cascading logic means that activity at each level predicts activity at the next level, with direct implications for strategic forecasting.

Fourth, M&A activity in the IT services sector is subject to the wave logic of consolidation, generated by technological shocks that redefine the structure of demand for competencies. The recurrence of structural deal configurations, the stable factor-driven nature of their parameters, and the empirically confirmed link between company characteristics and the probability of M&A participation create grounds for building strategic forecasting models.

Fifth, Ukraine occupies a specific position as a territorial cluster of the global IT services market, characterized by a significant concentration of knowledge assets, demonstrated resilience of the IT sector under conditions of armed conflict, and the prospect of post-conflict integration into European value chains. Within the logic of the resource-based and knowledge-based theories, this forms a unique combination of investment opportunities: Ukrainian IT companies possess competencies that meet the criteria of VRIN resources and require access to the complementary assets of global players.

The scientific novelty of the research consists in: the conceptualization of investment deals in the IT services sector as a mechanism for the redistribution of technological competencies based on the integration of the resource-based, knowledge-based and innovation theories of the firm; the substantiation of the systematic limitations of classical FDI and M&A theories for explaining investment dynamics in the intangible asset sector; the development of a cascading model of the investment cycle describing the interaction of three investor types and providing grounds for forecasting; the identification of technological shock as a sector-specific generator of consolidation waves; and the substantiation of the Ukrainian IT sector's position through the categories of the resource-based view and the theory of complementary assets. Prospects for further research include the construction of predictive models for investment deals (target prediction, buyer prediction, matchmaking) with empirical verification on data from specific market segments; the quantitative assessment of factors determining deal probability at different phases of the technological cycle; a comparative analysis of the cascading model's effectiveness across different territorial clusters; and the adaptation of predictive models to contextual variables, including geopolitical shocks and regulatory transformations.

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**ECONOMETRIC ASSESSMENT OF EU ENERGY MARKET RESILIENCE**

**ЕКОНОМЕТРИЧНА ОЦІНКА СТІЙКОСТІ ЕНЕРГЕТИЧНОГО РИНКУ ЄС**

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***Abstract**. The article explores the EU Energy Union as a strategic mechanism for strengthening the resilience of European energy markets amid geopolitical instability and energy transition. Resilience is assessed in three areas: price stability and integration, security of supply through diversification, and resilience to transition risks. The assessment used σ- and β-convergence in electricity prices for households and industry (2013–2024), the Herfindahl–Hirschman Index (HHI) for electricity trading (2010–2023), and a synthetic stability index based on k-means clustering. The results show a clear segmentation: β-convergence is confirmed for industrial prices, whereas household end prices do not converge. Their dispersion increases sharply in crisis years. The concentration of partners in electricity trading declines on average after 2015, indicating a more diverse geography of flows. Countries were grouped into three clusters: 'Leaders,' 'Transit Hubs,' and 'Vulnerable Markets.' The number of vulnerable countries is gradually decreasing. Regulators can use the results received to prioritize investments in interconnectors and system flexibility. They will also help shape the future trajectory of Ukraine's power system synchronization with the EU market.*

*Keywords: EU Energy Union; ENTSO-E; energy market resilience; econometric modelling; electricity price convergence; Herfindahl–Hirschmann Index; synthetic stability index; cluster analysis; energy security.*

***Анотація.** Стаття розглядає Енергетичний союз ЄС як стратегічний механізм посилення стійкості європейських енергетичних ринків в умовах геополітичної нестабільності та енергетичного переходу. Стійкість оцінюється у трьох вимірах: цінова стабільність, ринкова інтеграція, безпека постачання через диверсифікацію, а також*

*стійкість до ризиків енергетичного переходу. Для оцінки використовувалися σ- та β-конвергенція цін на електроенергію для домогосподарств і промисловості (2013–2024), індекс Герфіндаля–Гіршмана (HHI) для торгівлі електроенергією (2010–2023), а також синтетичний індекс стабільності з кластеризацією k-means. Результати показують виразну сегментацію: β-конвергенцію підтверджено для промислових цін, тоді як кінцеві ціни для домогосподарств не зближуються, а їхня дисперсія різко зростає у кризові роки. Концентрація торговельних партнерів у торгівлі електроенергією в середньому знижується після 2015 року, що свідчить про ширшу географію перетоків. Країни згруповано у три кластери: «Лідери», «Транзитні хаби» та «Вразливі ринки». Кількість вразливих країн поступово скорочується. Регулятори можуть використати отримані результати для пріоритизації інвестицій у інтерконектори та гнучкість енергосистеми. Вони також сприятимуть формуванню подальшої траєкторії синхронізації енергосистеми України з ринком ЄС.*

***Ключові слова:*** *Енергетичний союз ЄС; ENTSO-E; стійкість енергетичного ринку; економетричне моделювання; конвергенція цін на електроенергію; індекс Герфіндаля-Гіршмана; синтетичний індекс стабільності; кластерний аналіз; енергетична безпека.*

**Introduction**. EU-wide stability has emerged as a central focus of European Union policy, reflecting a shift from prioritizing market efficiency to establishing robust market structures capable of withstanding extreme price volatility, geopolitical crises, and supply disruptions associated with war. The energy price shocks experienced by numerous member states during 2022-23 highlighted how the interconnectedness of EU electricity markets can transmit stress unevenly across countries and consumer groups. While wholesale electricity markets in the EU are extensively coupled, retail tariffs often remain fragmented due to nationally determined taxes, network charges, and emergency support measures. This article defines "market stability" through the lens of three separate factors: (i) price stability and integration, (ii) diversifying supply to ensure security of supply, and (iii) the resilience to transition-related risks.

Although numerous academic papers have explored issues of either integration or security in isolation, very few have compared the multiple indicators of stability both cross-nationally and over time. The existing body of research has identified limited convergence in wholesale markets and significant divergence in retail prices, consistent with the idea of "convergence clubs" rather than a single unified market. To address this empirical and analytical gap, this paper applies a multi-indicator econometric framework to link EU-wide instruments for energy union to observable market outcomes and provides an additional layer of analysis regarding the overall resilience of energy markets in Europe. The central theoretical assumption underlying the paper is that further regulatory integration (achieved through a series of regulatory packages implemented by the EU since 2015) will lead to greater price convergence and supply diversification, resulting in a more uniform and resilient European energy system.

**The purpose of the article.** In particular, the study investigates whether electricity prices have become more similar between member states; whether the diversity of cross-border trade in electricity has increased; and whether, when examining each indicator together, countries can be divided into three or more stable subgroups. The findings deliver practical guidance for policy officials on where to focus efforts, particularly on strengthening interconnectors and investing in system flexibility, and are especially relevant for Ukraine as it continues to align its power system with the EU market under sustained geopolitical pressure. The emergency synchronization of the Ukrainian and Moldovan power systems in March 2022 serves as a real-world stress test, underscoring how physical infrastructure and coordinated governance shape resilience under extreme conditions.

**Literature review.** Research on EU electricity market integration primarily focuses on price convergence and structural market coupling. Zachmann (2008) identifies only partial wholesale price convergence and ongoing regional segmentation resulting from congestion and limited cross-border capacity. Market Monitoring Report confirms progress in integration but also draws attention

to persistent structural bottlenecks and uneven cross-zonal capacity allocation *(ACER, 2024)*. Analyses of retail prices reveal even greater heterogeneity, demonstrating that EU countries frequently converge in "clubs," with household prices remaining structurally divergent *(Cassetta et al., 2022)*.

The literature on the 2022–2024 energy crisis spotlights the effects of systemic shocks on EU integration in the energy sphere. North Sea electricity studies report heightened volatility and temporary fragmentation *(Sæther and Neumann, 2024)*. Gas supply analyses document faster diversification and demand adaptation from 2022 to 2024 *(Zhou et al., 2025)*. Post-crisis reforms address institutional challenges *(SIEPS, 2024),* while Commission reports note stabilization via lower wholesale prices and reduced Russian gas reliance *(European Commission, 2024)*.

Ukrainian academic and policy literature mainly addresses the prospects for national integration. The DiXi Group and the Clingendael Institute (2024) present a policy-oriented roadmap for Ukraine's energy integration into the EU, while ExPro Consulting's White Paper outlines challenges related to electricity market synchronization and cross-border trade. Whereas academic work on "SMART integration" emphasizes regulatory harmonization and infrastructure stability *(Lutsenko, 2025; Zvarych and Kharkovskyi, 2025)*. Nevertheless, the majority of Ukrainian sources remain descriptive and focused on national issues.

In contrast, this article adopts a more extensive EU-Ukraine perspective. It assesses EU-wide market resilience using harmonized econometric tools and situates Ukraine's trajectory within the overall European energy architecture. The study fills a methodological gap between policy discourse and empirical resilience assessment.

**Methodology.** This study uses econometric methods to examine the resilience of the European Union (EU) energy market amid geopolitical instability and the ongoing energy transition. The empirical analysis follows a quantitative approach and draws on secondary data from official sources, primarily Eurostat and the World Bank.

The dataset features: (1) annual electricity prices for households and industrial consumers for 2013–2024 (Eurostat); (2) cross-border electricity trade volumes by partner countries for 2010–2023 (Eurostat); and (3) a set of structural indicators used to construct a synthetic resilience index for 2010–2022, namely energy import dependency (Eurostat), the share of renewables in gross final energy consumption (Eurostat), energy intensity (World Bank), $CO_2$ emissions per capita (World Bank), and diversification of the energy mix (Eurostat).

To achieve the research's purpose, a comprehensive set of methods is applied. Price stability and market integration are assessed using standard econometric tests of σ- and β-convergence for both household and industrial electricity prices: σ-convergence is measured through the cross-country dispersion/standard deviation of prices over time, while β-convergence is tested via regression analysis of the convergence hypothesis (the relationship between the initial price level and subsequent price changes). The degree of diversification in external electricity trade is measured using the Herfindahl–Hirschman Index (HHI), calculated from import and export shares across trading partners (higher HHI values indicate greater concentration and, consequently, lower diversification). To examine structural resilience and develop a country typology, a Synthetic Market Stability Index is constructed: all five components are first standardized (z-scores), and the index is then computed as the arithmetic mean of the standardized indicators. Next, k-means clustering with a fixed number of clusters (K = 3) is applied to identify "leaders", "transit hubs", and "vulnerable" markets based on their resilience profiles. Overall, the selected methodology delivers a comprehensive (multidimensional) measurement of EU energy-market resilience: combining convergence assessments, concentration indicators (HHI), and an integral index based on standardized components makes it possible to assess integration dynamics simultaneously, changes in vulnerabilities under external shocks, and structural cross-country differences, as well as to develop a comparative market typology to support further applied conclusions and policy recommendations.

**Main results of the research.** Given that the EU energy market plays a crucial role in ensuring regional stability and integration, the following analysis examines empirical evidence of its

resilience, focusing on price convergence, trade diversification, and structural transformation.

Econometric analysis exhibits statistically significant β-convergence of electricity prices for industrial end-users ($\beta = -0.138$; $R^2 = 0.153$). In member states where industrial electricity prices were initially elevated, price adjustments occurred more rapidly, showing a gradual alignment within the internal electricity market. This outcome corroborates previous findings of partial convergence in European wholesale markets and is in line with institutional reports that document deeper integration in competitive segments *(Zachmann, 2008; ACER, 2024).*

Household electricity costs, on the other hand, do not show statistically significant evidence of β-convergence. Retail markets remain structurally segmented. Household tariffs, unlike industrial rates, are still set by national regulatory bodies, such as taxes, network fees, and social compensation plans. Such elements weaken wholesale-to-retail price transmission and limit the integrative effects observed in industrial segments, which is consistent with research documenting "club convergence" rather than uniform retail harmonization *(Cassetta et al., 2022).*

The σ-analysis reveals that cross-country dispersion in household electricity prices consistently exceeds that observed for industrial tariffs over the period 2013–2024. This structural disparity underscores the ongoing segmentation between competitive and regulated markets.

The 2022–2023 energy crisis intensified dispersion across both segments, with the largest increase observed in the household sector. Countries that faced strong gas price shocks and had limited fiscal space saw greater price volatility *(Sæther and Neumann, 2024).* Governments with extensive support measures, by contrast, temporarily restrained retail price increases *(SIEPS, 2024).*

These patterns show that crisis conditions amplify structural asymmetries: integration mechanisms remain operative, but national policy space and fiscal capacity increasingly determine retail outcomes under stress.

The partner Herfindahl–Hirschman Index (HHI) shows that imports relied on a relatively concentrated set of trading partners in 2010–2014 (average import HHI ≈ 0.63). From 2015 onward, the index steadily fell, reaching about 0.54 over 2015–2023. This reduction demonstrates a broadening of cross-border electricity flows, reflecting a wider geography of interconnections and greater use of interconnections.

However, Member States diversified at varying rates. Highly interconnected systems in Western and Northern Europe maintained lower and more stable HHI values. In contrast, structurally limited systems, particularly peripheral markets or those with limited interconnection, sustained higher concentration levels and experienced greater HHI fluctuations during periods of stress.

Some national systems reduced their diversification under stress by reconcentrating their trade flows during the crisis. Where interconnector capacity or alternative corridors remain limited, market rules alone cannot prevent trade concentration under stress. These findings show that both physical infrastructure and regulatory integration are necessary for diversification.

Using the Synthetic Market Stability Index (constructed from standardised indicators of import dependence, renewable penetration, energy intensity, $CO_2$ emissions per capita, and trade diversification), the k-means clustering procedure identifies three structural groups:

- **Leaders:** systems distinguished by strong diversification, minimal import dependence, and advanced renewable energy penetration, mainly situated in Northern and Western Europe;
- **Transit Hubs:** intermediate systems presenting mixed structural characteristics and serving strategic cross-border roles, notably encompassing several Central European markets;
- **Vulnerable Markets:** systems characterized by high import dependence, limited diversification, and weaker transition indicators, typically corresponding to peripheral or isolated markets.

Over time, the number of countries classified as "vulnerable" declines modestly, while the intermediate cluster expands. This trend reveals gradual structural improvement and partial convergence of transition-related parameters.

For 2022, the clustering reveals a clear regional pattern: leaders are concentrated mainly in Northern and Western Europe, many Central European systems fall into the middle cluster, and several island (Cyprus, etc.) systems remain vulnerable.

Nonetheless, there is a lasting gap between structurally advanced Northern and Western

systems and more constrained peripheral markets, showing the multidimensional nature of resilience: progress along a single dimension (for instance, renewable penetration) does not automatically compensate for weaknesses in diversification or import dependence.

**Table 1**

*EU energy market stability indicators*

| **Indicator** | **Method** | **Key result of the author's research** | **EU policy linkage** | **Target result 2030/2040** | **Status** |
|---|---|---|---|---|---|
| **Price dispersion (σ) of end-user electricity prices** (households vs industry, 2013–2024) | Cross-country standard deviation (σ) of end-user prices | σ, €/kWh<br><br>**Households:**<br>2013=0.0584<br>2016=0.0595<br>2020=0.0593<br>2022=0.0899<br>2023=0.1019<br>2024=0.0910<br><br>**Industry:**<br>2013=0.0309<br>2016=0.0187<br>2020=0.0180<br>2022=0.0477<br>2023=0.0580<br>2024=0.0435 | Internal electricity market rules (Directive (EU) 2019/944; Regulation (EU) 2019/943) | No binding EU-wide numeric "σ target"; tracked in market monitoring | - |
| **Price convergence (β)** (households vs industry, 2013–2024) | β-regression on log(price) | **Households: no convergence**β = 0.0010<br>p = 0.905<br>$R^2$ = 0.00006<br><br>**Industrial β-convergence confirmed:** β = −0.1375 p = 0.0000000007 $R^2$ = 0.153 | Internal electricity market rules (Directive (EU) 2019/944; Regulation (EU) 2019/943) | No binding EU-wide numeric "β target"; convergence is an expected outcome of deeper integration and grid reinforcement and is tracked by regulators | - |
| **Electricity trade partner diversification (HHI)** (imports/exports, 2010–2014 vs 2015–2023) | Partner-share HHI (imports and exports) | **Import HHI:** 0.63 → 0.54<br><br>**Export HHI:** 0.62 → 0.57 | Infrastructure and interconnection framework (TEN-E Regulation (EU) 2022/869) + market integrity/transparency (REMIT Regulation (EU) No 1227/2011) | **2030:** Electricity interconnection target **15% by 2030** (enables substitution/diversification). | Progress differs by Member States |
| **RES share in gross final energy consumption (EU-27)** | Cross-country descriptive comparison | **EU-27: 24.5% (2023)** | Renewable Energy Directive as revised in 2023/2413) | **2030:** EU binding renewables target **≥42.5%** (with ambition toward 45%). | - |
| **Synthetic "Market Stability Index" + clustering** | z-score standardisation of 5 indicators + composite index + k-means (K=3) | Three clusters were identified: Leaders (C1), Middle (C2), and Vulnerable Markets (C3). Over time, the | Energy Union governance & comparability (Regulation (EU) 2018/1999) + risk-preparedness (Regulation (EU) | **2030:**<br>**≥55% net GHG reduction by 2030**; **≥42.5% RES**, **11.7% energy efficiency improvement** (binding).<br><br>**2040: 90% net GHG** | - |

| | | | | | |
|---|---|---|---|---|---|
| | | number of "vulnerable" countries declines, and the middle cluster strengthens, indicating gradual convergence; however, a durable gap persists between leading systems and laggards. | 2019/941) + climate framework (Regulation (EU) 2021/1119) | **reduction** target under the EU's 2040 climate-target process. | |

*Note. Created by the author based on data from (EuroSat, World Bank, n.d.)*

**Place of Ukraine within the Energy Union framework.** Ukraine occupies a strategic position within the Energy Union architecture, serving both as a frontline test of energy resilience under wartime conditions and as the frontier for extending the Eastern European market.

A turning point was the synchronization of Ukraine's power system with continental Europe on March 16, 2022. Although originally scheduled as a gradual technical process, synchronization was completed under emergency conditions and established a stable operational connection with the continental grid. This physical interconnection demonstrated how infrastructure coupling can expand diversification options during crises.

The connection improved system stability and allowed the shift from emergency technical support to commercial operation. Cross-border electricity trade with EU Member States began later in 2022, transforming grid linkage into a practical instrument for diversification of supply and balancing resources at a time of severe domestic constraints.

Legal and institutional adjustments accompanied this process. As an EU candidate country and a Contracting Party to the Energy Community, Ukraine continues to align its energy legislation with the EU acquis. It has incorporated European market governance principles, strengthened transparency requirements, and introduced compatible monitoring and reporting procedures. These steps give interconnection a regulatory foundation, embedding it within the rules and practices of the EU internal energy market rather than leaving it as a purely technical arrangement.

Policy planning has advanced in parallel. The EU–Ukraine Association Agreement provides the legal framework for alignment, while national instruments translate commitments into concrete targets. Ukraine's National Energy and Climate Plan (NECP) for 2030 introduces structured target-setting and control mechanisms for implementation. The National Renewable Energy Action Plan sets a 27% target for renewables in gross final energy consumption by 2030. Longer-term priorities are outlined in the Energy Strategy of Ukraine to 2050 and the Low Emission Development Strategy 2050, both of which define pathways for decarbonization and system modernization that are consistent with broader European climate objectives.

Integration also moves beyond the electricity sector. The EU–Ukraine Memorandum of Understanding on biomethane, hydrogen, and other renewable gases, signed on February 2, 2023, established cooperation on certification standards, market rules, and future cross-border trade in renewable gases. By extending cooperation to emerging energy carriers, this system deepens compatibility with the developing EU internal market and fortifies Ukraine's role in the wider regional transition.

Future research may examine modelling the impact of new market flexibility technologies or long-term resilience under 2030–2040 decarbonization trajectories.

**Conclusions.** The findings prove that the resilience of the EU energy market is multidimensional, structurally differentiated, and segment specific. Integration advances through distinct channels, such as price convergence, trade diversification, and structural transformation. These processes, however, develop unevenly across consumer groups and national systems.

Empirical evidence shows that market mechanisms boost resilience when competitive structures are present, whereas institutional design and infrastructure lead to fragmentation.

**Price Dimension.** Industrial electricity prices show statistically significant β-convergence ($\beta = -0.1375$; $R^2 = 0.153$) and consistently lower σ-dispersion than household tariffs. Competitive segments respond to internal market instruments, including wholesale market coupling and cross-border exchanges, confirming that integration promotes gradual price alignment. By contrast, household prices show no statistically significant convergence and display heightened dispersion during the 2022–2023 crisis. National tax regimes, regulated network charges, public service obligations, and emergency interventions weaken the transmission of wholesale signals to final consumers. These results support the need for a differentiated resilience agenda. Where household segmentation persists, market integration reforms should be evaluated alongside national tariff structures and consumer protection mechanisms to ensure that wholesale integration translates into stable, predictable retail outcomes.

**Security of Supply and Diversification.** Partner-based Herfindahl–Hirschman Index (HHI) calculations show high concentration levels in 2010–2014 (approximately 0.63), followed by gradual diversification in 2015–2023 (around 0.54). This decline represents the expansion of cross-border electricity flows and partial strengthening of supply resilience. However, the 2022–2023 shock demonstrates that reconcentration can re-emerge quickly when interconnection capacity, internal grid reinforcement, or alternative trade corridors remain insufficient. Diversification depends not only on regulatory coordination but also on tangible infrastructure, balancing capacity, and storage availability. Where physical connections remain weak, particularly in island systems and structurally vulnerable markets, priority should be assigned to interconnector construction, network reinforcement, and system flexibility, including storage deployment.

**Structural Resilience.** The Synthetic Market Stability Index distinguishes three structural profiles: Leaders, characterized by diversified supply structures and stronger transition performance; heterogeneous Transit Hubs undergoing gradual improvement; and Vulnerable markets defined by high import dependence and limited diversification. Although the share of vulnerable systems declines over time and the intermediate group expands, structural asymmetries persist. Resilience increasingly depends on flexibility technologies, cross-border capacity expansion, and diversification embedded within decarbonization pathways.

These structural differences carry direct **policy implications**. Vulnerable systems require accelerated grid expansion, enhanced balancing resources, and storage integration. Transit Hub systems benefit from improved congestion management and deeper regional coordination. Leader systems may focus on regulatory refinement and market design optimization. A uniform integration approach cannot adequately address structurally asymmetric risk patterns throughout the Union.

The results also highlight **wider strategic opportunities**. Further synchronization and deeper market coupling with Ukraine enlarge the regional diversification set. Ukraine's integration serves not only as a national resilience strategy but also as a mechanism for extending Energy Union stability eastward, notably under stress, when alternative corridors and trading options become critical.

The Ukrainian case reinforces the central conclusion of this study: resilience strengthens most effectively when regulatory integration, infrastructure interconnection, and long-term transition policy evolve in a coordinated and mutually reinforcing manner rather than as isolated initiatives.

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**ANALYSIS OF EUROPEAN TERRITORIAL COOPERATION (ETC) ON POLAND'S EASTERN BORDER**

**АНАЛІЗ ЄВРОПЕЙСЬКОГО ТЕРИТОРІАЛЬНОГО СПІВРОБІТНИЦТВА (ЄТС) НА СХІДНОМУ КОРДОНІ ПОЛЬЩІ**

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***Abstract.*** *The article provides a comparative and critical analysis of European Territorial Cooperation (ETC) programmes implemented along Poland's eastern border in the financial perspectives 2014-2020 and 2021-2027. The study examines three programmes: Poland-Russia CBC 2014-2020, Poland-Belarus-Ukraine CBC 2014-2020, and Interreg NEXT Poland-Ukraine 2021-2027. It analyses their objectives, institutional design, thematic priorities, financial allocations, implementation mechanisms and achieved results, while situating them within the broader framework of EU cohesion and neighborhood policy.*

*The research demonstrates that while thematic continuity across programming periods reflects the structural needs of peripheral border regions, the geopolitical rupture caused by Russia's full-scale invasion of Ukraine in 2022 fundamentally transformed the operational logic of ETC. Cooperation with Russia and Belarus was suspended, funds were reallocated, and Interreg NEXT evolved from a neighborhood policy instrument into a strategic mechanism supporting Ukraine's reconstruction and European integration.*

*The findings indicate that ETC programmes significantly mitigate socio-economic marginalisation in peripheral regions yet remain structurally vulnerable to geopolitical shocks. The analysis highlights a critical threshold beyond which local cross-border pragmatism becomes subordinate to macro-political decisions. The article concludes that future ETC architecture at the EU's external borders requires enhanced institutional flexibility, geopolitical conditionality clauses, and reinforced infrastructural resilience.*

***Key words:*** *European Territorial Cooperation (ETC); Interreg; cross-border cooperation (CBC); EU cohesion policy; European Neighborhood Policy; Poland-Ukraine relations; Poland-Belarus relations; Poland-Russia relations; geopolitical shocks; border security; regional development; Ukraine reconstruction*

***Анотація.*** *У статті подано порівняльний та критичний аналіз програм Європейського територіального співробітництва (ЄТС), що реалізовувалися вздовж східного кордону Польщі у фінансових перспективах 2014–2020 та 2021–2027 років. Дослідження розглядає три програми: ТКС Польща-Росія 2014–2020, ТКС Польща-Білорусь-Україна 2014–2020 та Interreg NEXT Польща-Україна 2021–2027. Аналізуються їхні цілі, інституційний дизайн, тематичні пріоритети, фінансові асигнування, механізми реалізації та досягнуті результати в ширших рамках політики згуртованості та політики сусідства ЄС. Дослідження демонструє, що хоча тематична спадкоємність у різних періодах програмування відображає структурні потреби периферійних прикордонних регіонів, геополітичний розрив, спричинений повномасштабним вторгненням Росії в Україну у 2022*

*році, фундаментально змінив операційну логіку ЄТС. Співпраця з Росією та Білоруссю була призупинена, кошти перерозподілені, а програма Interreg NEXT еволюціонувала з інструменту політики сусідства на стратегічний механізм підтримки відбудови України та її європейської інтеграції. Результати свідчать про те, що програми ЄТС значно пом'якшують соціально-економічну маргіналізацію в периферійних регіонах, проте залишаються структурно вразливими до геополітичних потрясінь. Аналіз висвітлює критичний поріг, за яким місцевий транскордонний прагматизм стає підпорядкованим макрополітичним рішенням. У статті робиться висновок, що майбутня архітектура ЄТС на зовнішніх кордонах ЄС потребує підвищеної інституційної гнучкості, положень щодо геополітичної обумовленості та посиленої інфраструктурної стійкості.*

***Ключові слова:*** *Європейське територіальне співробітництво (ЄТС); Interreg; транскордонне співробітництво (ТКС); політика згуртованості ЄС; Європейська політика сусідства; українсько-польські відносини; польсько-білоруські відносини; польсько-російські відносини; геополітичні потрясіння; безпека кордонів; регіональний розвиток; відбудова України.*

**Introduction.** European Territorial Cooperation (ETC), implemented under the Interreg framework, constitutes one of the core instruments of the European Union's cohesion policy and a complementary mechanism of its neighborhood policy. At the EU's external borders, ETC has played a dual role: fostering socio-economic development in peripheral regions and simultaneously functioning as a soft-power instrument aimed at stabilising neighboring territories.

Poland's eastern border represents a particularly complex testing ground for this policy architecture. Historically marked by development asymmetries, institutional divergence and geopolitical sensitivity, it has been the site of intensive cross-border programming involving Russia, Belarus and Ukraine. However, the Russian Federation's aggression against Ukraine - initiated in 2014 and escalated in February 2022 - has radically altered the political and institutional landscape in which these programmes operate.

This article examines how three successive ETC programmes responded to evolving geopolitical realities: Poland-Russia CBC 2014-2020, Poland-Belarus-Ukraine CBC 2014-2020, and Interreg NEXT Poland-Ukraine 2021-2027. The analysis moves beyond a descriptive comparison to interrogate a broader structural question: to what extent can cross-border cooperation remain effective and resilient under conditions of geopolitical destabilisation?

The study adopts a comparative institutional perspective, assessing thematic continuity, financial structures, partnership models and implementation outcomes. Attention is paid to the transformation of the EU's eastern border from a space of developmental cooperation into a security-oriented frontier, and to the implications of this shift for the long-term viability of ETC as a policy instrument.

**Literature Review.** The study is based primarily on official programme documentation, legal acts of the European Union and strategic documents regulating European Territorial Cooperation (ETC), including Regulation (EU) 2021/1059 on Interreg *(European Parliament & Council of the European Union, 2021)*, programme documents of the Poland-Russia CBC 2014-2020, Poland-Belarus-Ukraine CBC 2014-2020 and Interreg NEXT Poland-Ukraine 2021-2027, as well as communications and reports of the European Commission and the Ministry of Funds and Regional Policy. These sources provide the formal institutional and financial framework within which the analysed programmes operate.

In addition, the analysis draws on selected thematic evaluations and impact studies concerning cross-border cooperation at Poland's eastern border *(e.g. Belica et al., 2024; Rybkowski et al., 2024a; 2024b)*, as well as earlier assessments of CBC effectiveness *(Olejniczak et al., 2007)*. Academic contributions addressing the role of cross-border cooperation in peripheral regions *(Studzińska & Bartnik, 2025; Wolodin & Wyporska, 2025)* and contemporary transformations of borders under geopolitical pressure *(Więckowski, 2025; Dybcio & Litvina, 2025)* complement the institutional perspective.

However, the existing literature reveals a significant limitation. Most scholarly works focus either on earlier programming periods or on general theoretical aspects of cross-border cooperation. There is a clear shortage of up-to-date academic analyses examining the structural consequences of the 2022 geopolitical rupture, including the suspension of cooperation with Russia and Belarus and the transformation of Interreg NEXT into an instrument supporting Ukraine's reconstruction. The rapidly evolving political context has outpaced the production cycle of peer-reviewed research, resulting in a gap between policy developments and academic reflection.

Consequently, this article relies to a considerable extent on programme documentation, evaluation reports and institutional sources, treating them not merely as descriptive materials but as primary empirical evidence for analysing the ongoing transformation of ETC at the EU's eastern border. The scarcity of comprehensive academic studies addressing the post-2022 reality underscores both the originality and the necessity of the present research.

The purpose of this article is to analyse the evolution, effectiveness and institutional resilience of European Territorial Cooperation programmes implemented along Poland's eastern border in the 2014-2020 and 2021-2027 programming periods. The study seeks to assess how geopolitical disruption – particularly the suspension of cooperation with Russia and Belarus after 2022 – has transformed the strategic logic, operational mechanisms and developmental impact of these programmes.

**Main results of the research.** European Territorial Cooperation (ETC), commonly known as Interreg, is a fundamental pillar of the European Union's cohesion policy, aimed at supporting sustainable development and deepening integration in border regions *(European Parliament & Council of the EU, 2021)*. At the external borders of the European Union, in the 2014-2020 financial perspective, ETC was implemented through the European Neighbourhood Instrument (ENI). In the current programming period (2021-2027), this function has been taken over by the Interreg NEXT instrument. The main objective of these programmes is to reduce disparities in living standards and to jointly address cross-border challenges such as environmental, public health and security issues *(European Parliament & Council of the EU, 2021)*.

A characteristic feature of ETC programmes is their partnership model based on the principle of balance. EU Member States and neighbouring countries participating in the programmes have an equal say in the decision-making process, and projects can only receive funding if they are implemented by partners on both sides of the border. This structure, which requires balanced partnership and joint decision-making, naturally promotes mutual trust and stability in an unstable geopolitical environment. In border regions – historically marked by tensions or significant development disparities – this model of governance cooperation goes beyond mere administrative aspects, becoming a key element in creating lasting cross-border ties between local communities. This is particularly important in the face of dynamic geopolitical changes, where the ability to maintain and deepen trust-based relationships becomes a critical factor for regional stability. Although formally a regional policy instrument, these programmes also serve a broader geopolitical function, acting as a tool of soft power and conflict prevention, which is particularly important at the external borders of the European Union. Their significance therefore goes beyond the implementation of projects, building relationships that are intended to have the potential to withstand political tensions (at least to some extent).

The literature on the subject emphasises that CBC in peripheral border areas along the external borders of the European Union is one of the key factors enabling their socio-economic stabilisation. This need for stabilisation is the main motivation for stakeholders to engage in cooperation with partners outside the EU *(Studzińska & Bartnik, 2025)*. CBC is also a fundamental element of sustainable development. By stimulating economic growth in border regions, preserving natural and cultural heritage, improving cross-border accessibility and the quality of roads and border crossings, it contributes to the comprehensive development of regions *(Wolodin & Wyporska, 2025)*. Interreg programmes actively encourage entities located near national borders to engage in CBC to address common challenges such as environmental degradation, socio-economic disparities and infrastructure deficiencies, thereby supporting sustainable development *(Wolodin & Wyporska,*

*2025)*. The ETC not only implements development projects but fundamentally enables a more holistic and sustainable form of development that transcends national borders, making it more crisis-resistant and effective.

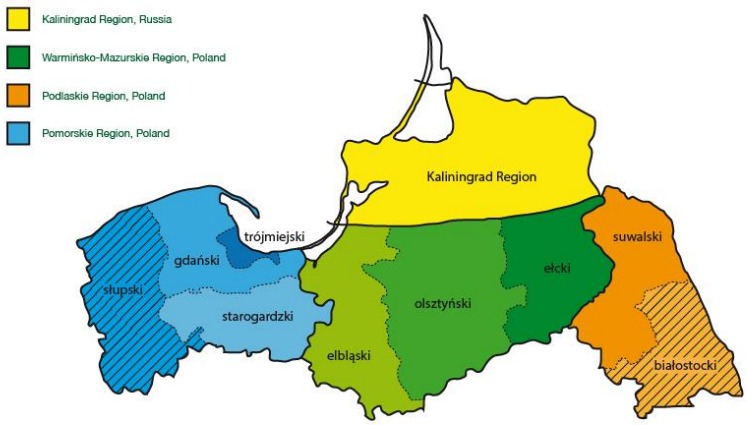
Regarding the external borders of the European Union, where the geopolitical context is often unstable, the EGTC cooperation model suggests that even in the face of tense high-level political relations, practical benefits and common challenges at the local level can drive cooperation. This observation is a hypothesis that will be tested later in this article, especially in the context of geopolitical escalation after 2022. The transformation of the function of the Polish Belarusian border from an axis of cooperation to a security barrier after 2021 (migration crisis) and 2022 (war) confirms the cyclical nature of borders. This necessitates a redefinition of ETC programmes from development instruments to crisis management tools, e.g. by including geopolitical clauses in programme documentation *(Więckowski, 2025)*.

The main objective of the Poland-Russia CBC Programme 2014-2020 was to support CBC in the social, environmental, economic and institutional spheres in the Polish Russian border area. The programme was formally approved by the European Commission on 21 September 2016 *(Poland-Russia Programme, 2014)*.

The geographical coverage of the programme included the following main subregions on the Polish side: Suwałki, Ełk, Olsztyn, Elbląg, Starogard, Gdańsk and the Tri-City. The adjacent area consisted of two subregions: Słupsk and Białystok. On the Russian side, the programme covered the entire Kaliningrad Oblast *(Poland-Russia Programme, 2014)*.

***Figure. 1.***

*Coverage of the Poland-Russia CBC Programme 2014-2020 by region*




*Source: Poland-Russia Programme. (2014).*

The thematic structure of the programme was based on four key thematic objectives, selected from a closed list indicated in the programme document for European Neighborhood Instrument programmes. These were *(Poland-Russia Programme, 2014)*:

- Thematic Objective 3: Promotion of local culture and protection of cultural heritage (priority "Heritage").
- Thematic Objective 6: Environmental protection and climate change adaptation (priority "Environment").
- Thematic Objective 7: Improving the accessibility of regions, developing transport and communication networks and systems (priority "Accessibility").
- Thematic Objective 10: Promotion of border management and border security (priority "Borders").

In the context of the implementation of the thematic objectives, an important phenomenon that reveals the existence of hidden barriers is the fact that no projects were submitted for the

thematic objective "Borders" *(Dybcio & Litvina, 2025)*. Although the institutions implementing the programme actively promoted border management and security, the lack of interest from potential beneficiaries in this area suggests fundamental discrepancies between the programme priorities and the actual needs or capacities of local partners or indicate existing political sensitivities that discourage cooperation in this specific area. Given the nature of the partners (Poland as an EU member and the Russian Federation), it is likely that cooperation in security-related areas was perceived as particularly difficult or less attractive for joint initiatives, even if it was formally included as a priority. This phenomenon points to a deeper, unspoken barrier that went beyond typical administrative obstacles. Even when formal opportunities for cooperation existed, certain areas, such as security and border management, were too sensitive for genuine cooperation with Russia, reflecting a deeper, unspoken political barrier that existed even before the full-scale invasion of Ukraine in 2022. This earlier political sensitivity was a harbinger of the eventual severing of ties.

The total budget for the Poland-Russia CBC Programme 2014-2020 was EUR 62,298,477. Funding came from three main sources: the European Regional Development Fund (€20,652,617), the European Neighbourhood Instrument (€20,993,243) and the Russian Federation's contribution to the Programme (€20,652,617). The maximum level of co-financing for eligible project costs was up to 90% *(Ministry of Funds and Regional Policy, 2022b)*.

The key mechanism for implementing the programme was the partnership principle. Each project had to involve at least two beneficiaries: one from Poland and one from the Russian Federation. One lead beneficiary was designated from among them to represent the entire partnership *(Dybcio & Litvina, 2025)*.

The programme provided for the implementation of various types of projects, including integrated projects (each beneficiary implemented part of the activities on its territory), symmetrical projects (similar activities were implemented in parallel in both countries) and single-country projects (implemented mainly or exclusively in one country, but benefiting both parties). Projects were also classified according to the nature of the activities: infrastructure (involving an infrastructure component worth between EUR 50,000 and EUR 2,500,000, or requiring a building permit), investment (involving fixed assets worth more than EUR 50,000) and soft (not defined as infrastructure or investment) (Formular of ENI CBC Poland-Russia Programme, 2014).

This article is being written in 2025, at a time when cooperation with Russia has been suspended for over three years due to the Russian Ukrainian war. The website of the Programme in question also not functioning. This means that the only source of information about the Programme is previous studies on the subject. On this basis, it can be concluded that a total of 31 projects were selected and co-financed under the Poland-Russia CBC Programme 2014-2020. There is no information on the amount allocated to support Russian beneficiaries. Therefore, the rest of this article only considers the value of projects on the Polish side.

**Table1.**

*Selected data on the Poland-Russia Programme 2014-2020*

| Thematic objective | Value of funds contracted to Polish beneficiaries [in EUR] | Number of projects co-financed |
|---|---|---|
| Heritage | 13.4 million | 16 |
| Environment | 10.1 million | 10 |
| Accessibility | 12.8 million | 5 |
| Borders | - | - |
| **TOTAL** | **36.3 million** | **31** |

*Source: Own study based on Rybkowski, 2024b.*

The Russian Federation's aggression against Ukraine, which began in February 2022, had immediate and far-reaching consequences for ETC programmes. In March 2022, the European Commission decided to suspend CBC with Russia and Belarus in all programmes, including those implemented under the European Neighborhood Instrument 2014-2020 *(Ministry of Funds and Regional Policy, 202e)*. Poland, as the Managing Authority for the Poland-Russia Programme 2014-

2020, in response to this decision and in a gesture of condemnation of the aggression, suspended payments to Russian and Belarusian partners *(Ministry of Funds and Regional Policy, 202e)*.

This decision meant the definitive end of cooperation with Russia and Belarus in programmes for the new programming period 2021-2027. The Ministry of Funds and Regional Policy (MFiPR) in Poland made a strategic decision to redirect the funds that were originally earmarked for the programme with Russia for 2021-2027. The European Regional Development Fund contribution of EUR 43.24 million has been allocated to other Interreg programmes, including: Lithuania-Poland (EUR 30 million), South Baltic (EUR 10 million) and Poland-Slovakia (EUR 3.24 million) *(Ministry of Funds and Regional Policy, 2023)*.

The immediate and decisive redirection of funds from the suspended programme with Russia to other Interreg programmes is more than just an administrative change. This action demonstrates the strategic ability of the European Union and Poland to maintain the idea of CBC within EU structures, while completely severing ties with aggressor states. This marks a strategic shift that transforms development funds into a tool for strengthening alliances and isolating adversaries, highlighting the Union's ability to adapt in the face of crisis.

Polish territories along the border with Russia, especially the Warmian-Masurian Voivodship, are among the least developed and are struggling with depopulation and economic decline. Cooperation with Russia was an important factor in their development *(Interreg Europe, 2025)*. After 2022, the situation deteriorated as the sudden halt in tourist traffic and "shopping tourism" had serious consequences for many businesses, leading to economic crises and bankruptcies. In addition, there was a decline in investment, disruption of supply chains and a general sense of uncertainty *(Interreg Europe, 2025)*. The full-scale invasion in 2022 led to an outright suspension of cooperation, revealing a critical threshold: while local actors can sustain cooperation to a certain degree of geopolitical turbulence, there is a point at which macro-political decisions overwhelmingly dominate local needs and established ties. This points to the inherent fragility of the ETC in its relations with partners with unstable politics. The militarisation of the Polish Belarusian border (construction of an electronic barrier on the Bug River in 2024) symbolises the transformation of the programme's concept from a neighbourhood policy to a security policy. This confirms the thesis that the ETC only functions in a stable institutional environment *(Więckowski, 2025)*.

The CBC Programme of the European Neighborhood Instrument Poland-Belarus-Ukraine 2014-2020 (PBU 2014-2020) was officially approved by European Commission Decision No C(2015) 9138 on 17 December 2015 *(ENI CBC Poland-Belarus-Ukraine Programme, 2023)*. Its overarching objective was to support cross-border development processes in the border area between Poland, Belarus and Ukraine. The programme aimed to promote economic and social development, address common challenges in the areas of the environment, public health and safety, and improve the conditions for the mobility of people, goods and capital *(ENI CBC Poland-Belarus-Ukraine Programme, 2023)*.

The programme pursued four main thematic objectives that reflected the identified regional needs:

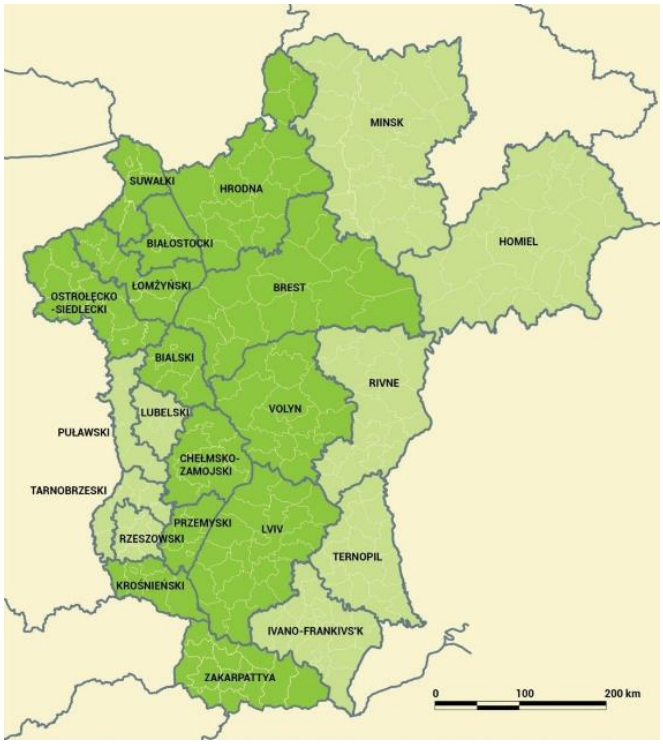
1. HERITAGE (promotion of local culture and preservation of historical heritage, including promotion and preservation of natural heritage);
2. ACCESSIBILITY (improving the accessibility of regions, developing sustainable and climate-resilient transport and communication networks and systems, including the development of information and communication technology infrastructure).
3. SECURITY (common challenges around security and safety, including support for the development of health and social services and addressing common security challenges).
4. BORDERS (promotion of border management and border security, mobility and migration management, including support for border efficiency and security, and improvement of border management operations, customs and visa procedures) (ENI CBC Poland-Belarus-Ukraine Programme, 2023).

The geographical scope of the programme was broad and covered NUTS3 units on the Polish

side and districts in Belarus and Ukraine. On the Polish side, these were the main subregions: Krosno and Przemyśl (Podkarpackie Voivodship), Białystok, Łomża and Suwałki (Podlaskie Voivodship), Biała Podlaska and Chełm-Zamość (Lubelskie Voivodship), Ostrołęka-Siedlce (Mazowieckie Voivodship). The adjacent subregions were Rzeszów and Tarnobrzeg (Podkarpackie Voivodship) and Puławy and Lublin (Lubelskie Voivodship). On the Belarusian side, the main area consisted of the Grodno and Brest regions, and the adjacent area consisted of the Minsk region (including the city of Minsk) and the Gomel region. In Ukraine, the main area covered the Lviv, Volyn and Zakarpattia regions, while the adjacent area covered the Rivne, Ternopil and Ivano-Frankivsk regions.

**Figure. 1.**

*Coverage of the Poland-Belarus-Ukraine CBC Programme 2014-2020*




*Source: ENI CBC Poland-Belarus-Ukraine, 2023.*

The programme's broad geographical scope, covering regions with varying levels of economic development and natural resources, was both an asset and a challenge. Although this breadth was intended to promote comprehensive cross-border development, it also made it difficult to tailor interventions precisely to specific regional needs. For example, an evaluation carried out for the 2004-2006 Programme revealed significant economic gaps between the Polish, Belarusian and Ukrainian sides, as well as differences in entrepreneurial activity and the R&D sector *(Olejniczak et al., 2007)*. Macroeconomic indicators for the area covered by the support on the Polish, Belarusian and Ukrainian sides remain diverse. This diversity, which persists despite the passage of time, suggests that a uniform approach, even within thematic priorities, may not have been optimally effective in such a heterogeneous area, potentially leading to varying outcomes and levels of satisfaction among partners from different countries.

The budget of the Poland-Belarus-Ukraine CBC Programme for 2014-2020 amounted to EUR 183 million, with the possibility of co-financing projects up to 90% of eligible cost *(ENI CBC Poland-Belarus-Ukraine Programme, 2023)*.

The key mechanism for implementing the programme was the Cross-Border Cooperation Strategy (CBCS), adopted in May 2014 at Lublin Castle. This document was innovative, as it was the first of its kind to be developed jointly by three countries, and was an extension of the Lublin Province Development Strategy for 2014-2020 (with a perspective until 2030). The CBCS aimed to

promote cooperation between local authorities and socio-economic partners and to assist partners from Ukraine and Belarus in implementing joint cross-border projects *(Onet.pl, 2023)*. To effectively implement the CBCS, a cross-border network of Contact Points was established. These points operated in each of the regions covered by the Strategy (Lviv and Volyn Oblast in Ukraine and Brest Oblast in Belarus). Their main task was to ensure the flow of information and the organisation of work within the network, as well as to support the establishment of cross-border partnerships.

The scope of the CBC Strategy indicates a high level of ambition and a progressive approach to the management of CBC, but in practice, significant challenges were encountered. First, the potential offered to the regions by their border location has not been fully exploited. This discrepancy between innovative strategic intentions and practical difficulties in implementation may be due to barriers such as administrative inefficiency, cognitive distances or political sensitivities. The literature also points to bureaucratic obstacles, complex regulatory frameworks, and differences in legal systems and standards as factors complicating joint projects. Political differences between Poland, Belarus, and Ukraine led to divergent priorities and approaches, particularly in the context of Belarus' political system and its relations with the European Union. Overcoming these barriers required dialogue and diplomacy *(Onet.pl, 2023)*. This suggests a gap between strategic planning and operational reality and highlights the limits of ECT's soft power in authoritarian contexts, where its effectiveness is severely limited when one of the partners prioritises political control.

The 2014-2020 Poland-Belarus-Ukraine programme pursued its objectives through a series of projects falling under four priorities. In total, the funds allocated to these projects amounted to EUR 169.9 million, with the largest share (almost one third) going to the priority related to accessibility. However, the largest number of projects was implemented for the purpose of heritage – as many as 93 projects out of 158 implemented. This indicates the significant importance of this issue for the parties receiving support. The number of projects and the value of funds allocated to support beneficiaries are presented in the table below.

**Table2.**

*Selected data on the Poland-Belarus-Ukraine Programme 2014-2020*

| Thematic objective | Value of funds contracted to beneficiaries [in EUR] | Number of projects co-financed |
|---|---|---|
| **HERITAGE** | **38.5** | **93** |
| **ACCESSIBILITY** | **55.9 million** | **21** |
| **SAFETY** | **44.3 million** | **30** |
| **BORDERS** | **31.2 million** | **14** |
| **TOTAL** | **169.9 million** | **158** |

*Source: Own study based on Rybkowski, 2024a.*

Despite its achievements, the programme faced significant challenges. The border and border regime were the most important barriers to cross-border interaction *(ENI CBC Poland-Belarus-Ukraine Programme, 2023)*. This applied to both the physical infrastructure and the procedures at border crossings. The scientific literature further emphasises that the lack of modernisation of road and rail infrastructure on the Ukrainian side limits the capacity of border crossings, which poses a significant challenge to cross-border mobility.

Low satisfaction with institutional cooperation was particularly evident on the Polish Belarusian border, although the potential for expanding cooperation between public authorities and non-governmental organisations was also observed on the Polish Ukrainian border *(Osikowicz, 2017)*. Cultural projects in the 2014-2020 PBU programme (e.g. Polish Belarusian borderland culture meetings involving the municipality of Tuczna (Poland) and the villages of Damaczów and Klejniki (Belarus) served as "symbolic bridges" between communities. The neutrality of the cultural issues addressed in the project, such as folklore and folk games, made it possible to avoid Polish Belarusian tensions and build trust between local communities. It is worth mentioning, however, that there were more activities of this type on the Polish Ukrainian border, where they effectively

helped to overcome historical grievances. On the other hand, the lack of projects concerning similar "neutral spaces" on the border with Belarus explains the low effectiveness of social cooperation – administrative projects that did not involve local communities prevailed.

Border infrastructure, both physical and procedural, was therefore a critical factor in the success or failure of the programme. Even with significant funding and clearly defined thematic priorities, bottlenecks at the border itself could seriously limit the overall impact and effectiveness of cooperation. The effectiveness of 'soft' projects, such as cultural exchanges or training, could be undermined if fundamental infrastructure challenges were not adequately addressed. Beyond physical barriers, socio-cultural barriers such as historical grievances, stereotypes and language differences could hinder effective communication and trust-building. The combination of these two types of barriers, exacerbated by geopolitical events, creates a complex network of obstacles. Addressing 'soft' barriers (through trust-building) becomes more difficult, if not impossible, when 'hard' barriers (physical infrastructure, security regimes) are actively reinforced due to political tensions. In such a situation, the physical border becomes a tangible reflection of deep political and social divisions.

As in the case of the Poland-Russia Programme, cooperation with Belarus under the PBU Programme 2014-2020 was suspended in March 2022. This decision was a direct response to the Russian Federation's invasion of Ukraine, in which Belarus played a supporting role. The suspension of payments to Belarusian partners was intended to protect the interests of Polish beneficiaries who were implementing cross-border projects before the outbreak of the war. Poland, in cooperation with the European Commission, actively sought solutions that would allow the planned activities on the Polish side of the border to be completed without the further participation of entities from Belarus.

The immediate and comprehensive suspension of cooperation with Belarus signals a profound and probably irreversible change in European Union policy. Although the 2014-2020 programme was aimed at building ties, the geopolitical reality forced a sudden interruption of these activities. This not only affected the projects being implemented at the time, but also fundamentally redefines future engagement. The redirection of funds and a clear focus on Ukraine in the current programming period (Interreg NEXT) demonstrates a clear strategic choice to consolidate cooperation with democratic partners, effectively isolating Belarus from future EU-funded cross-border initiatives. This has long-term consequences for the development trajectory of the border regions of Poland and Belarus and for the nature of their future interactions.

The Bug River, which forms a natural border between Poland, Ukraine and Belarus, has been the site of growing political tensions and a humanitarian crisis since 2022 *(Dybcio & Litvina, 2025)*. In response to the Belarusian government's support for illegal migration, Poland began construction of a 172-kilometre electronic barrier across the river in September 2024, prioritising border security over environmental concerns *(Dybcio & Litvina, 2025)*. The construction of the dam on the Bug (2023-2024) violated four Natura 2000 protected areas, fragmenting the migration corridors of animal species *(State Council for Nature Conservation, 2025)*. The Interreg NEXT Poland-Ukraine programme attempts to compensate for these losses through "green infrastructure" projects, but their effectiveness is limited due to a lack of coordination with Belarus. This confirms the thesis that ETC cannot be effective in conditions of unilateral action in the border area. This transformation of the border from an area of cooperation (albeit difficult) to a place of active geopolitical confrontation and militarisation represents a fundamental change in relations, moving from a 'neighbourhood policy' to a 'security border'.

The Interreg NEXT Poland-Ukraine 2021-2027 Programme is a direct continuation of the Poland-Belarus-Ukraine 2014-2020 Programme. However, the key change in the new perspective is the composition of the partners, which is a direct consequence of the changing geopolitical context. The exclusion of Belarus from the programme reflects the strategic decisions taken after the Russian Federation's invasion of Ukraine in 2022.

The overarching and new programme challenge is to support the reconstruction of Ukraine after the end of Russian aggression *(Interreg NEXT Poland-Ukraine Programme, 2024)*. This transformation of the programme from a neighbourhood instrument to a tool for reconstruction and

solidarity is more than just an administrative change. It is a profound redefinition of the programme's purpose. Interreg NEXT is transforming from a general cross-border development tool into a direct instrument for responding to crises, supporting post-conflict reconstruction and demonstrating the solidarity of the European Union. This shift in priorities reflects the urgent and unprecedented needs arising from the war, demonstrating the European Union's ability to adapt its funding mechanisms to immediate geopolitical imperatives, moving beyond the traditional framework of regional development towards crisis response and long-term stabilisation. The Interreg NEXT Poland-Ukraine programme is an example of how the EGTC can act as a flexible crisis response instrument, capable of rapidly reorienting its objectives and resources in response to dramatic geopolitical changes.

Beyond the priority of rebuilding Ukraine, the Interreg NEXT Poland-Ukraine Programme 2021-2027 continues and develops cooperation in other key areas. These include environmental protection, climate change adaptation, ensuring access to water and nature conservation. The programme also aims to improve access to healthcare, promote the sustainable use of the tourist attractions of the Polish Ukrainian border region, develop cooperation between administrations and communities at various levels, improve the functioning and protection of the Polish Ukrainian border, and increase cross-border mobility within the so-called Solidarity Corridors between the EU and Ukraine.

The programme focuses on six main thematic priorities *(Interreg NEXT Poland-Ukraine Programme, 2024)*:

- **Environment:** including adaptation to climate change, disaster risk prevention, access to water, sustainable water management, nature and biodiversity protection.
- Health**:** ensuring equal access to healthcare, supporting the resilience of healthcare systems.
- **Tourism:** strengthening the role of culture and sustainable tourism in economic development.
- **Cooperation:** increasing the efficiency of public administration, building mutual trust through people-to-people contacts.
- **Borders:** other actions for a safer and more secure Europe.
- **Accessibility:** developing and improving sustainable, climate-resilient, smart and intermodal mobility.

The geographical coverage of the programme on the Polish side includes the Voivodships of Podlaskie, Mazowieckie (only the subregions of Ostrołęka and Siedlce), Lubelskie and Podkarpackie. On the Ukrainian side, it covers the regions of Volyn, Lviv, Zakarpattia, Rivne, Ternopil and Ivano-Frankivsk.

The total area of the programme is 177,128 km², of which 57% is located in Ukraine. This geographical concentration, in contrast to the broader coverage of the previous PBU programme, is a direct response to new challenges. Focusing exclusively on Poland and Ukraine, combined with the clear objective of rebuilding Ukraine, allows for a more concentrated and potentially more effective allocation of resources and efforts. This reflects a strategic decision to prioritise depth of cooperation and direct support where it is most urgently needed, rather than spreading resources across a wider, currently politically divided border area. Such concentration can lead to more tangible and measurable results in the designated areas.

The budget for the Interreg NEXT Poland-Ukraine 2021-2027 Programme is EUR 262 million, of which EUR 235.9 million comes from the European Regional Development Fund (ERDF). The maximum level of project co-financing is 90% of eligible costs *(Interreg NEXT Poland-Ukraine Programme, 2024)*.

The first call for proposals under the programme took place in mid-2023 and concerned the priorities "Health" and "Environment". The Programme Monitoring Committee, as the key decision-making body, approved the results of the call for proposals under the Health priority in 2023. Out of 115 applications submitted, the Committee decided to fund 20 projects, while creating a reserve list of 28 projects for possible contracting in the future. Due to the very high quality of the applications submitted, the Monitoring Committee decided to transfer EUR 2.55 million from the

Cooperation priority (specific objective 6.2) to the Health priority. In addition, to enable the financing of a larger number of projects, the maximum level of co-financing was reduced from 90% to 83%. The total amount of co-financing allocated to the "Health" priority was EUR 39.92 million. The selection of projects under the Environment priority was planned for April 2024, also with a budget increased by EUR 2.55 million *(Interreg NEXT Poland-Ukraine Programme, 3rd Meeting 2023)*.

**Figure. 2.**
*Coverage of the Interreg NEXT Poland-Ukraine Programme 2021-2027*

*Source: https://pl-ua.eu/pl/pages/578 (accessed on 29 May 2025).*

Work is also underway on the preparation of non-competitive projects.

The Monitoring Committee's decision to reallocate funds between priorities and reduce the co-financing rate (from 90% to 83%) to finance a larger number of high-quality projects demonstrates a significant degree of programme flexibility. This is a key adaptation mechanism, particularly in the context of Ukraine's reconstruction, where needs are enormous and project quality can vary. It allows the programme to maximise its impact by supporting a larger number of viable initiatives, even if this means a slight reduction in the individual grant percentage. This suggests a pragmatic approach to resource allocation, prioritising breadth of impact over depth of funding for individual projects.

**Table 3.**
*Selected data on the Poland-Ukraine Programme 2021-2027*

| Priority | Value of funds contracted to beneficiaries [in EUR] | Number of projects co-financed |
|---|---|---|
| **Environment** | **90.2 million** | **45** |
| **Health** | **53.3 million** | **24** |
| **Tourism** | **3.9 million** | **1** |
| **Cooperation** | **0** | **0** |
| **Borders** | **0** | **0** |
| **Availability** | **0** | **0** |

*Source: Own study (European Parliament & Council of the European Union, 2021).*

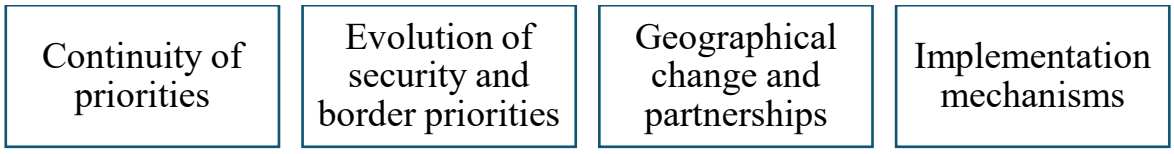
The Interreg NEXT Poland-Ukraine programme plays a strategic and key role in supporting Ukraine's reconstruction, which is clearly highlighted as one of its main objectives. Its activities go

beyond the traditional framework of CBC, becoming an instrument of direct support in the face of the effects of war. Programme activities, such as those covering health protection (e.g. expansion of hospital infrastructure and purchase of medical equipment), environmental protection, as well as improving the functioning and protection of the Polish Ukrainian border and increasing cross-border mobility within the Solidarity Corridors, directly contribute to the stabilisation and long-term development of Ukraine.

An example of a specific project implemented under this programme is "Improving safety in the border area between Poland and Ukraine in the field of rescue services". This project, implemented by the City of Augustów as the main partner and the Main Branch of the State Emergency Service of Ukraine in the Volyn Oblast, has a budget of over EUR 1.7 million. It includes the purchase of specialised equipment for fire brigades, the organisation of training courses for firefighters in Poland and Ukraine, as well as conferences and family picnics *(City of Augustów, 2024)*. This is a concrete example of how the programme responds to urgent needs around security and infrastructure.

The clear focus on the reconstruction of Ukraine and the inclusion of the "Solidarity Corridors" *(Ministry of Finance, 2022)* also raises the status of the Interreg NEXT programme beyond that of a typical CBC programme. It positions it as a strategic element and catalyst for Ukraine's broader European integration. By addressing immediate post-conflict needs (health, environment) while improving infrastructure and mobility, the programme lays the fundamental groundwork for future economic and social ties, in line with the long-term vision of Ukraine's potential membership of the European Union. This marks a transition from simple “neighbourly” cooperation to a more deeply integrated, future-oriented partnership.

An analysis of three ETC programmes on the EU's eastern border (Poland-Russia 2014-2020, Poland-Belarus-Ukraine 2014-2020, Interreg NEXT Poland-Ukraine 2021-2027) reveals both elements of continuity and significant developments, particularly in response to the changing geopolitical context. The following aspects were compared in this section:




All three programmes consistently focused on similar thematic areas, reflecting the fundamental needs of border regions. Socio-economic development, environmental and cultural heritage protection, and improving the accessibility of regions were constant elements. Some of the objectives were present in both the 2014-2020 programmes and the new 2021-2027 perspective. The continuity of thematic priorities across all programmes and periods indicates the enduring, fundamental needs of border regions that transcend political changes. The table below presents the priorities that were present in each of the programmes analysed.

**Table 4.**

*Priorities present in the analysed programmes*

| Priorities | POLAND-BELARUS-UKRAINE 2014-2020 | POLAND-RUSSIA 2014-2020 | POLAND-UKRAINE 2021-2027 |
|---|---|---|---|
| **Security** | ✓ | | |
| **Heritage** | ✓ | ✓ | |
| **Accessibility** | ✓ | ✓ | ✓ |
| **Borders** | ✓ | ✓ | ✓ |
| **Environment** | | ✓ | ✓ |
| **Tourism** | | | ✓ |
| **Cooperation** | | | ✓ |
| **Health** | | | ✓ |

*Source: own study based on: Rybkowski et al., 2024a; Rybkowski et al. 2024b.*

The 2014-2020 programmes included the priorities of Borders and Security. However, in the case of the Poland-Russia Programme, there was a lack of projects submitted around Borders, which indicated difficulties in achieving this objective. In the Interreg NEXT 2021-2027 programme, the priorities of Borders and Cooperation remain, but with a new, clear emphasis on improving operations and protecting the Polish Ukrainian border, as well as increasing cross-border mobility within the Solidarity Corridors. This change reflects the urgent security and logistical needs in the context of the war in Ukraine.

All programmes are based on the fundamental principle of cross-border partnership, requiring the participation of at least two beneficiaries from different countries. The new Interreg NEXT perspective also introduces a more diversified approach to project types, covering strategic large infrastructure projects, regular projects and small project funds, with the aim of optimising the allocation of funds.

The most significant evolution is the transition from trilateral cooperation (Poland-Belarus-Ukraine) and bilateral cooperation (Poland-Russia) to exclusively bilateral cooperation between Poland and Ukraine in the new financial perspective. This is a direct consequence of the suspension of cooperation with Russia and Belarus after 2022.

The suspension of cooperation with Russia and Belarus in 2022 and the subsequent transformation of the Interreg NEXT programme to exclude them reveal the extreme sensitivity of partnerships to geopolitical shocks. This means that while the problems in border regions remain unchanged, the actors involved in solving them are highly dependent on the broader international political climate. This highlights the critical distinction between the stability of regions' development needs and the instability of political alliances. In this context, the border acts as a barometer of geopolitical change, reflecting tensions and reorientations in international politics.

The key parameters of the individual programmes analysed are indicated below.

**Table 5.**

*Comparison of key parameters of the ETC programmes analysed*

| PARAMETER | POLAND-RUSSIA 2014-2020 | POLAND-BELARUS-UKRAINE 2014-2020 | POLAND-UKRAINE 2021-2027 |
|---|---|---|---|
| **Programming period** | **2014-2020** | **2014-2020** | **2021-2027** |
| **Total budget (EUR)** | **62.3 million** | **183 million** | **262 million** |
| **Geographical coverage** | • Poland (Pomeranian, Warmian-Masurian, Podlaskie)<br>• Russia (Kaliningrad Oblast) | • Poland (Podlaskie, Mazowieckie – part, Lubelskie, Podkarpackie)<br>• Ukraine (Lviv, Volyn, Zakarpattia, Rivne, Ternopil, Ivano-Frankivsk)<br>• Belarus (Grodno, Brest, Minsk, Gomel) | • Poland (Podlaskie, Mazowieckie - part, Lubelskie, Podkarpackie)<br>• Ukraine (Lviv, Volyn, Zakarpattia, Rivne, Ternopil, Ivano-Frankivsk) |
| **Main Thematic Objectives/Priorities** | Heritage, Environment, Accessibility, Borders | Heritage, Accessibility, Security, Borders | Environment, Health, Tourism, Cooperation, Borders, Accessibility |
| **Managing Authority** | Ministry of Development, then Ministry of Funds and Regional Policy of the Republic of Poland | Ministry of Funds and Regional Policy of the Republic of Poland | Ministry of Funds and Regional Policy of the Republic of Poland |
| **Partnership** | At least 1 entity from Russia and 1 entity from Poland | At least 2 entities from different countries: Poland, Belarus and/or Ukraine | At least 1 entity from Ukraine and 1 entity from Poland |
| **Status** | Suspended (from March 2022) | Suspended with Belarus (from 03.2022) | In progress |

*Source: Own work based on: Rybkowski et al., 2024a; Rybkowski et al. 2024b.*

Experience gained from the implementation of ETC programmes on the eastern border of the European Union allows for the identification of the main challenges and factors supporting effective CBC.

An assessment of the impact of ETC programmes in the 2014-2020 financial perspective on the development of the regions covered by the support allows us to conclude that, despite the existing barriers, cross-border initiatives have played a significant role in mitigating the social and economic marginalisation of peripheral areas, particularly in the voivodships of Podlaskie, Lubelskie and Warmian-Masurian, through investments in infrastructure, promotion of cultural heritage and the development of tourism.of peripheral areas, particularly in the provinces of Podlaskie, Lubelskie and Warmian-Masurian, through investments in infrastructure, promotion of cultural heritage and stimulation of local entrepreneurship *(Belica et al., 2024)*. This is confirmed by the literature on the subject, which indicates that CBC is considered a key factor in the socio-economic stabilisation of peripheral border areas *(Studzińska & Bartnik, 2025)*. This is despite the existence of several barriers, such as the negative impact of the border itself or, in the case of non-EU partners, the limited decision-making capacity of local authorities. By supporting joint initiatives, ETC programmes contribute to alleviating marginalisation and stimulating local development *(Studzińska & Bartnik, 2025)*.

Among the limitations to CBC are administrative barriers, differences in legal systems between partners, and difficulties arising from the unstable geopolitical context, which have partially hampered the full exploitation of the potential of these programmes *(Belica et al., 2024)*. An analysis of materials available on the website of the Ministry of Funds and Regional Policy and European Commission reports confirms that investments in the modernisation of border crossings under the Poland-Belarus-Ukraine 2014-2020 programme contributed to shorter clearance times, which had a positive impact on trade and economic exchange, especially in the Lublin and Podkarpackie regions *(European Commission, 2022)*. In the case of the Poland-Russia programme, the impact on regional development was limited by the suspension of cooperation after 2022, which led to the interruption of projects and a decline in economic activity in the Warmian-Masurian Voivodship, where the local economy was largely dependent on tourism and trade with the Kaliningrad *Oblast (Ministry of Funds and Regional Policy, 2023)*. Such sudden changes in funding and partnerships highlighted the fragility of CBC in the face of geopolitical crises, forcing a rapid strategic reorientation to protect the interests of Polish regions *(Ministry of Funds and Regional Policy, 2023)*.

However, the most significant constraint is the border itself, both in physical and procedural terms, where the lack of modernisation of road and rail infrastructure, especially on the Ukrainian side, significantly hinders cross-border mobility, affecting the effectiveness of projects requiring intensive exchange of people and goods *(Belica et al., 2024)*. Significant development disparities between Polish regions and areas of Belarus and Ukraine complicate the harmonisation of activities, leading to uneven benefits for partners, which is particularly evident in the varying levels of entrepreneurial activity and research and development sector development *(Belica et al., 2024)*. Administrative inefficiency, resulting from differences in legal systems and organisational cultures, and cognitive distances, i.e. differences in ways of thinking and approaches to management, constitute structural barriers limiting the long-term effectiveness of cooperation *(Belica et al., 2024)*.

In the case of Belarus, the formal nature of participation, based mainly on administrative activities of regional authorities, reduced the flexibility and depth of cooperation *(Belica et al., 2024)*. Socio-cultural barriers, such as historical grievances, stereotypes and language differences, further hampered trust-building and effective communication, especially in relations with Belarus *(Rybkowski et al., 2024b)*.

On the other hand, a factor conducive to cooperation is the institutionalised form of cross-border partnerships, which facilitates the transfer of knowledge and good practices between regions *(Interreg NEXT Poland-Ukraine Programme, 2024)*. Financial support from the European Union, provided by the European Regional Development Fund and the European Neighbourhood Instrument, is a key motivation for beneficiaries, especially in regions struggling with

marginalization *(European Commission, 2022)*. Shared cultural and historical values, especially in Polish Ukrainian relations, support the building of lasting relationships, which in many cases have survived initial geopolitical tensions *(Interreg NEXT Poland-Ukraine Programme, 2024)*. The strong need to counteract the marginalisation of border regions further motivates local actors to engage in cross-border projects, even in the face of administrative or political difficulties *(Belica et al., 2024)*.

The analysis indicates that the success of CBC depends on the balance between pragmatic benefits and the ability to overcome structural and geopolitical barriers, with the suspension of cooperation with Russia and Belarus after 2022 highlighting the boundary beyond which local pragmatism gives way to macro-political decisions *(Ministry of Funds and Regional Policy, 2023)*.

**Conclusions.** An analysis of ETC programmes on the eastern border of the European Union allows us to formulate key conclusions for the future shaping of these initiatives.

Greater resilience of programmes to geopolitical shocks is essential, which requires the inclusion of precise rapid response mechanisms, such as clauses allowing for the suspension of cooperation with unstable partners, flexible reallocation of funds and redefinition of objectives in response to sudden changes in the international environment *(Ministry of Funds and Regional Policy, 2023)*. The decision by the Ministry of Funds and Regional Policy to reallocate €43.24 million from the Poland-Russia programme to other Interreg programmes, such as Lithuania-Poland, South Baltic and Poland-Slovakia, is an example of an effective approach that has allowed cross-border activities to continue despite the breakdown of cooperation with Russia *(Ministry of Funds and Regional Policy, 2023)*.

Diversifying partnerships, with an emphasis on cooperation with countries with stable politics and shared democratic values, reduces the risk of dependence on partners with unpredictable foreign policies *(European Commission, 2022)*.

Continuing investment in the modernisation of border infrastructure, such as border crossings, roads and digital systems, remains the foundation for effective cross-border mobility and the success of soft projects, such as cultural exchanges and training, as confirmed by reports pointing to limitations resulting from inadequate infrastructure on the Polish Ukrainian border *(Belica et al., 2024)*.

The Interreg NEXT Poland-Ukraine 2021-2027 programme opens new opportunities for deepening CBC, particularly in the context of Ukraine's reconstruction after the conflict with Russia. The key direction is to continue supporting Ukraine's reconstruction in strategic areas such as healthcare, critical infrastructure, environmental protection and social development, which is in line with the priorities of the programme *(Interreg NEXT Poland-Ukraine Programme, 2024)*. An example is the project "Improving safety in the border area between Poland and Ukraine in the field of rescue services", implemented by the City of Augustów and Ukrainian rescue services, which includes the purchase of equipment and the organisation of training courses, responding to urgent safety needs *(Interreg NEXT Poland-Ukraine Programme, 2024)*.

Investments in Solidarity Corridors, including the development of transport infrastructure and the digitisation of border procedures, are essential to increase cross-border mobility and Ukraine's economic integration with the European Union, supporting the long-term vision of Ukraine's potential EU membership *(European Commission, 2022)*. Strengthening cooperation between public administration and civil society organisations is key to overcoming socio-cultural barriers and building mutual trust, which can be achieved through projects promoting people-to-people contacts *(Interreg NEXT Poland-Ukraine Programme, 2024)*. The programme should also support initiatives related to climate change adaptation and biodiversity protection that respond to both local needs and broader EU policy objectives for sustainable development *(Interreg NEXT Poland-Ukraine Programme, 2024)*.

Experience from the implementation of ETC programmes in the 2014-2020 and 2021-2027 perspectives shows that the success of these initiatives depends on their ability to adapt to a rapidly changing geopolitical context. Flexibility in the management of funds and priorities, as demonstrated in the case of the Interreg NEXT Poland-Ukraine programme, is essential to maintain

their relevance and effectiveness in the face of global challenges *(Interreg NEXT Poland-Ukraine Programme, 2024)*. In the context of the European Union's eastern border, where geopolitical instability remains a constant challenge, such an approach becomes an indispensable element of effective cohesion and neighbourhood policy, enabling the achievement of development objectives and supporting stabilisation and integration in the region *(European Commission, 2022).*

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# GREEN OUTSOURCING IN GLOBAL VALUE CHAINS: FROM TRANSACTION COST MINIMISATION TO ENVIRONMENTAL CAPABILITY RECOMBINATION

# «ЗЕЛЕНИЙ» АУТСОРСИНГ У ГЛОБАЛЬНИХ ЛАНЦЮГАХ СТВОРЕННЯ ВАРТОСТІ: ВІД МІНІМІЗАЦІЇ ТРАНСАКЦІЙНИХ ВИТРАТ ДО РЕКОМБІНАЦІЇ ЕКОЛОГІЧНИХ МОЖЛИВОСТЕЙ

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***Abstract***. *The governance of outsourcing decisions in multinational enterprises has been theorised extensively through transaction cost economics, property rights theory, and the resource-based view. However, these frameworks, developed largely without reference to environmental constraints, provide insufficient guidance for firms navigating the demands of supply chain decarbonisation, scope 3 emissions accountability, and green value chain transformation. This article identifies a fundamental theoretical gap and proposes a conceptual extension to address it.*

*The concept of ecological asset specificity, the degree of mutual dependency created through joint environmental investment and regulatory interdependence between supply chain partners, as a distinct governance variable absent from Williamson's original typology were introduced. It is argued that this omission has practical consequences: firms that have made significant co-investments in supplier environmental capability face governance risks, including environmental asset stranding and regulatory exposure, that existing contractual frameworks cannot adequately anticipate or mitigate.*

*Drawing on Gereffi, Humphrey, and Sturgeon's global value chain governance typology, it is demonstrated that modular governance architectures, though widely adopted for their flexibility advantages, create structural disincentives for the relational investment that genuine environmental capability development requires. Relational governance, by contrast, provides the organisational*

*conditions under which innovation offsets of the kind described by Porter and van der Linde can be realised at the supply chain level.*

*The article culminates in a reconceptualisation of green outsourcing as a form of environmental capability recombination – a strategic practice through which MNEs assemble and develop environmental resources across organisational and national boundaries. This framing, grounded in Verbeke's internalisation theory, repositions outsourcing from a cost arbitrage instrument to a platform for sustainability-driven competitive advantage. Theoretical and managerial implications are discussed, and directions for future empirical research are identified.*

***Keywords:*** *green outsourcing; ecological asset specificity; global value chains; environmental capability recombination; transaction cost economics; outsourcing governance; supply chain decarbonisation; multinational enterprises; relational governance; sustainable supply chain management*

***Анотація***. *Теоретичне осмислення аутсорсингових рішень багатонаціональних підприємств традиційно спирається на економіку трансакційних витрат, теорію прав власності та ресурсно-орієнтований підхід. Однак ці концепції, сформовані переважно без урахування екологічних обмежень, не забезпечують достатньої теоретичної основи для компаній, що стикаються з викликами декарбонізації ланцюгів постачання, обліку викидів третього рівня та екологізації глобальних ланцюгів створення вартості. У статті ідентифіковано фундаментальну теоретичну прогалину та запропоновано концептуальне розширення для її усунення.*

*Введено поняття екологічної специфічності активів – ступеня взаємозалежності, що виникає внаслідок спільних екологічних інвестицій та регуляторної взаємозалежності між партнерами по ланцюгу постачання – як окремої змінної управління, відсутньої в оригінальній типології Вільямсона. Стверджується, що ця прогалина має практичні наслідки: компанії, що здійснили значні спільні інвестиції в екологічний потенціал постачальників, стикаються з управлінськими ризиками, включаючи знецінення екологічних активів та регуляторні ризики, які чинні контрактні механізми не спроможні належним чином передбачити або мінімізувати.*

*Спираючись на типологію управління глобальними ланцюгами вартості Гереффі, Гамфрі та Стерджона, доведено, що модульні архітектури управління, попри їхні переваги в частині гнучкості, формують структурні антистимули для реляційних інвестицій, необхідних для розвитку реальних екологічних можливостей. Реляційне управління, навпаки, забезпечує організаційні умови для реалізації інноваційного офсету, описаного Портером і ван дер Лінде, на рівні ланцюга постачання.*

*У статті запропоновано переосмислення зеленого аутсорсингу як форми рекомбінації екологічних можливостей – стратегічної практики, за допомогою якої БНП формують та розвивають екологічні ресурси через організаційні та національні кордони. Цей підхід, заснований на теорії інтерналізації Вербеке, репозиціонує аутсорсинг від інструменту арбітражу витрат до платформи для досягнення конкурентних переваг на основі сталого розвитку.*

***Ключові слова:*** *зелений аутсорсинг; екологічна специфічність активів; глобальні ланцюги створення вартості; рекомбінація екологічних можливостей; економіка трансакційних витрат; управління аутсорсингом; декарбонізація ланцюгів постачання; багатонаціональні підприємства; реляційне управління; управління сталими ланцюгами*

*постачання*

**Introduction.** There is something quietly paradoxical about the way outsourcing is still theorised. Decades of scholarship (from Coase's foundational question about why firms exist at all, through Williamson's meticulous anatomy of transactional hazards, to the sprawling literature on global value chains) has produced a remarkably coherent picture of how multinational enterprises (MNEs) decide what to make and what to buy. This traditional understanding of the firm as an alternative to the market mechanism remains a cornerstone of international business studies (*Buckley & Casson, 1976*). The logic is elegant: firms internalise activities when the costs of market exchange outweigh the costs of internal coordination, and they externalise when the reverse holds. What this picture largely omits, however, is the environment – not as backdrop, but as a genuinely transformative variable in the governance of cross-border production. This omission was perhaps forgivable in 1937, or even in 1985. It is considerably harder to justify today.

The intensification of climate-related regulation, the mainstreaming of ESG frameworks within institutional investment, and the growing consumer and civil society pressure on supply chain transparency have collectively altered the conditions under which outsourcing decisions are made. Modern corporations are now evaluated not just on financial performance, but as "corporate citizens" responsible for their impact across global networks (*Crane & Matten, 2016*). Firms no longer choose suppliers solely on the basis of cost, capability, or contractual risk. Increasingly, they must weigh the environmental profile of their partners, the carbon intensity of logistics corridors, the regulatory exposure associated with particular jurisdictions, and the reputational consequences of being upstream from a pollution scandal. This necessitates a shift towards integrating social and environmental responsibility into the core of international business strategy (*Kolk, 2016*). The make-or-buy decision, in other words, has acquired an ecological dimension that existing theory has not yet adequately absorbed.

This article argues that what is needed is not a wholesale replacement of the transactional cost framework or its descendants, but a deliberate extension – one that introduces the concept of ecological asset specificity as a distinct governance variable, and that reframes outsourcing not merely as a mechanism for cost arbitrage, but as a potential instrument for the recombination of environmental capabilities across global value chains. By focusing on the creation of "sustainable value", firms can align their environmental efforts with long-term competitive differentiation (*Hart & Milstein, 2003*). The concept of green outsourcing, as developed here, is intended to occupy precisely this theoretical space: between the classical logic of make-or-buy and the emerging imperatives of sustainable production.

**The article aims** to develop a conceptual extension of classical outsourcing theories by introducing the notion of ecological asset specificity and reconceptualising green outsourcing as a strategic instrument for environmental capability recombination within the global value chains of multinational enterprises.

**Literature review.** Any serious engagement with outsourcing theory must begin with Ronald Coase, not out of ritual deference, but because his 1937 question, why does the firm exist if the price mechanism can coordinate economic activity, remains the most productive starting point for thinking about organisational boundaries. This fundamental inquiry was later expanded into the theory of the multinational enterprise, positing that firms exist to exploit advantages across borders that markets cannot efficiently coordinate (*Hymer, 1976*). Coase's answer, that firms emerge when internal coordination is cheaper than market exchange, introduced the concept of transaction costs into economics and, by extension, into the study of international business (*Coase, 1937*). The

decision to outsource, at its most basic level, is a decision about which side of that cost equation a particular activity falls on.

However, Coase's original framework was remarkably spare. Transaction costs were conceived primarily in terms of search, negotiation, and enforcement – the frictions involved in using the price mechanism. What the framework did not anticipate was the degree to which externalities (costs imposed on parties outside the transaction) would eventually become internalised through regulation, litigation, and reputational pressure, and would thereby re-enter the calculus of the firm. In our current state of "World 3.0", global integration is incomplete, and firms must navigate the complex realities of semi-globalized markets (*Ghemawat, 2011*). Environmental costs are the most consequential example of this dynamic. When a firm outsources manufacturing to a supplier with weak environmental controls, the pollution generated is, in classical Coasian terms, an externality – it falls outside the transaction. In the contemporary regulatory environment, however, this externalisation is increasingly incomplete. Geographic and administrative distances between partners can no longer be used to obscure environmental impacts (*Ghemawat, 2001*). Supply chain due diligence legislation, carbon border adjustment mechanisms, and mandatory scope 3 emissions reporting are progressively forcing firms to account for the environmental conduct of their suppliers as if it were their own. The transaction, in effect, has expanded.

Oliver Williamson built the most influential predictive model on Coasian foundations, identifying the key variables that determine whether market exchange or internal hierarchy is the more efficient governance structure for a given transaction (*Williamson, 1985*). The choice of governance is often guided by the need to combine ownership-specific assets with location-specific advantages through internalisation (*Dunning, 1980*). The three principal dimensions of Williamson's framework (asset specificity, uncertainty, and transaction frequency) remain analytically powerful, and the logic they generate is well established: high asset specificity raises the risk of opportunism and thus favours internalisation; low specificity and high standardisation favour market governance; intermediate cases produce hybrid arrangements of various kinds. Furthermore, because many MNEs operate primarily on a regional rather than a global scale, these governance choices are often embedded in regional production networks (*Rugman, 2005*).

Asset specificity is the most consequential of these variables. Williamson distinguished several types: site specificity, physical asset specificity, human asset specificity, dedicated assets, each capturing a different way in which resources become locked into particular transactional relationships, creating dependency and the attendant risk of hold-up. What Williamson's taxonomy does not include, however, is what might be called ecological asset specificity: the degree to which a firm's environmental capabilities, certifications, or compliance infrastructure are adapted to particular partners, processes, or regulatory contexts. This lack of theoretical accounting is problematic in "emerging markets", where institutional voids require firms to build their own systems of governance and compliance (*Khanna & Palepu, 2010*).

Consider a firm that has invested in a supplier's capacity to meet specific emissions standards, funded the transition to renewable energy in that supplier's facilities, or co-developed proprietary waste reduction technologies within a supply chain relationship. These investments exhibit all the hallmarks of asset specificity. They are relationship-specific, difficult to redeploy, and create genuine mutual dependency. Yet they fall outside Williamson's original categories. This exclusion overlooks the fact that internationalization is a process of gradual knowledge development and increasing commitment to sustainable practices (*Johanson & Vahlne, 1977*). The practical consequence of this omission is significant. Firms that have developed deep environmental

relationships with their supply chain partners face governance challenges that the transaction cost framework, as originally formulated, cannot adequately characterise. MNEs from emerging economies, for instance, may use international expansion as a "springboard" to acquire the green capabilities they lack at home (*Luo & Tung, 2007*).

The risk is not merely opportunism in the conventional sense, but something more structurally complex: the possibility that environmental investments made within an outsourcing relationship will be stranded if the relationship breaks down, or that a partner's environmental non-compliance will create regulatory or reputational exposure that cannot be contractually anticipated or fully mitigated. To mitigate these risks, modern firms may require a "Chief External Officer" to manage the interface between the firm and its complex external environment (*Doh et al., 2014*). These are transactional hazards of a new kind, and they require theoretical accommodation. The new internalisation theory emphasizes that managing such cross-border relationships is a dynamic capability central to corporate success (*Verbeke & Kano, 2015*).

Grossman and Hart's (1986) property rights theory introduced a further dimension to the make-or-buy question: the allocation of residual control rights. Where Williamson focused on the costs of writing and enforcing contracts, Grossman and Hart began from the observation that all contracts are necessarily incomplete (no agreement can anticipate every contingency) and that the ownership of assets determines who holds decision-making authority in the gaps. Ownership, on this view, is not merely a legal formality but a governance mechanism that shapes incentives and, consequently, investment behaviour. For outsourcing theory, this insight translates into a fundamental trade-off. When a firm retains ownership of an activity, it retains control but also bears the full cost of coordination. When it outsources, it surrenders some degree of control in exchange for the supplier's incentive to invest and innovate. Grossman and Hart's framework implies that the optimal allocation of ownership rights depends on whose investments are more critical to the value of the relationship.

The environmental dimension introduces a new layer of complexity here. Environmental compliance and the development of green capabilities require specific investments – in technology, processes, and organisational routines. They are difficult to specify contractually and whose value is highly sensitive to regulatory change. A supplier that invests in low-carbon manufacturing capacity does so partly in anticipation of future regulatory requirements; the value of that investment depends on policy trajectories that neither party fully controls. In this context, the allocation of residual control rights over environmental assets becomes a non-trivial governance question. Who bears the risk of a carbon tax that renders a particular production process uneconomical? Who captures the value of green certifications that enhance the buyer's market position? These are precisely the kinds of questions that arise in the gaps of incomplete contracts, and Grossman and Hart's framework provides useful analytical tools for thinking about them, even if it does not, in its original form, engage with environmental specifics. Furthermore, as the global order shifts, these contractual gaps are increasingly filled by evolving ethical principles and institutional pressures that redefine the responsibilities of multinational corporations (*Kirste, 2024*).

Barney's (1991) resource-based view redirected attention from the transaction to the firm, arguing that sustainable competitive advantage derives from resources that are valuable, rare, inimitable, and non-substitutable (the VRIN criteria). Applied to outsourcing, RBV generates a familiar prescription: retain activities that involve VRIN resources, outsource those that do not. The firm's strategic logic, on this account, is one of focusing internal effort on the sources of differentiation and purchasing everything else from whoever can supply it most efficiently. This logic is not wrong, but it is incomplete in ways that the environmental transition has made

increasingly visible. The RBV framework treats environmental capabilities primarily as a potential source of competitive advantage – a view that Porter and van der Linde (1995) developed with considerable sophistication, arguing that stringent environmental regulation can stimulate innovation offsets that enhance rather than erode competitiveness.

What the framework does less well, however, is account for the interdependence of environmental capabilities across organisational boundaries. Green competitive advantage, in practice, is rarely the product of a single firm's internal resources; it is typically embedded in supply chain relationships, in shared standards and verification systems, in the accumulated trust and joint investment of long-term partnerships. A firm cannot simply decide to outsource its way to environmental sustainability any more than it can outsource its way to technological leadership – the capability is partly relational, and the make-or-buy decision must be made with that relational character in mind. This is the theoretical gap that the present article seeks to address. Transaction cost economics, property rights theory, and the resource-based view each illuminate important aspects of the outsourcing decision, but none of them provides an adequate framework for the environmental governance challenges that contemporary MNEs face. What is needed is an integrative approach – one that retains the analytical rigour of these traditions while extending them to incorporate ecological asset specificity, the governance of incomplete environmental contracts, and the relational foundations of green capability development. Such an approach is essential for addressing the dual challenges of climate change and sustainable development within the framework of global value chains (*Kolk & Pinkse, 2012*). The next sections develop this approach in the context of global value chain governance. Recent scholarship has already begun to use the global value chain framework to specifically tackle and analyse global environmental crises (De Marchi & Gereffi, 2023).

**Main results of the research.** The framework developed by Gereffi, Humphrey, and Sturgeon (2005) remains one of the most productive conceptual tools available for analysing how outsourcing relationships are structured across national boundaries. Their five-fold typology (market, modular, relational, captive, and hierarchy) was originally constructed around three determinants: the complexity of transactions, the ability to codify them, and the capabilities of the supplier base. As global trade evolves, these contours of capitalism continue to redefine how lead firms and suppliers interact (*Gereffi, 2018*). What is striking, in retrospect, is how directly these determinants map onto the governance challenges posed by environmental compliance and how little the original framework engaged with this correspondence.

We consider the complexity first. Environmental governance introduces a particular kind of transactional complexity that differs qualitatively from the technical complexity that Gereffi and colleagues had in mind. When a buyer firm seeks to impose emissions standards, deforestation commitments, or chemical use restrictions on a supplier, it is not simply specifying a product attribute, it is attempting to influence a production process that may be embedded in local regulatory contexts, energy systems, and labour practices that the buyer neither controls nor fully understands. The information asymmetries involved are substantial. The modular governance structure, in which suppliers produce to the buyer's specifications using their own general-purpose equipment and capabilities, is, in principle, well suited to the diffusion of environmental standards, because the codifiability of technical specifications is precisely what makes modular relationships function.

If a buyer can write a clear, verifiable environmental standard into its supplier code of conduct, and if third-party auditing can provide credible verification, then the modular logic should apply: the supplier either meets the standard or loses the contract. In practice, however, this model has

proven considerably less effective than its theoretical promise suggests. The proliferation of sustainability audits across global supply chains has generated extensive evidence of their limitations – audits are episodic, they are often gamed, and they create incentives for superficial compliance rather than genuine capability development (*Kolk et al., 2017*). The codification problem, it turns out, is harder than it looks when the object being codified is not a dimensional tolerance, but a process outcome embedded in a complex organisational and regulatory environment. This is further complicated by the global trends in climate change litigation, which create new legal pressures for firms to provide substantive, rather than just procedural, evidence of environmental due diligence (*Setzer & Higham, 2021*).

Relational governance, by contrast, offers a different set of possibilities. In relational value chain relationships, coordination is achieved not through codified specifications alone, but through mutual dependence, reputation, and the accumulated trust of repeated interaction. This form of governance is increasingly seen as a vital mechanism for multinational enterprises to contribute to the Sustainable Development Goals (SDGs) by fostering deeper, more inclusive partnerships (*Kolk, Kourula, & Pisani, 2017*). Dyer and Singh (1998) argued that relational rents, the returns generated by inter-firm collaboration that could not be achieved by either party acting independently, arise from relation-specific assets, knowledge-sharing routines, complementary capabilities, and effective governance mechanisms. These are precisely the conditions under which meaningful environmental capability development becomes possible. By aligning corporate sustainability with inclusive development, MNEs can ensure that environmental gains do not come at the expense of social equity in host countries (*Kourula, Pisani, & Kolk, 2017*). A buyer that invests in a supplier's environmental management system, co-funds the transition to renewable energy in that supplier's facilities or embeds its own engineers in the supplier's process improvement teams is doing something categorically different from a buyer that ticks compliance boxes through annual audits. It is building a shared environmental capability – one that is, in Barney's (1991) terms, genuinely difficult to imitate because it is embedded in the specific history and trust of the relationship. The captive governance structure, in which small or less capable suppliers are dependent on a single dominant buyer, raises a different set of environmental governance questions. On one hand, the power asymmetry in captive relationships gives buyers considerable leverage to impose environmental requirements on suppliers who have few alternatives. On the other hand, the same asymmetry that makes compliance demands enforceable also tends to suppress the supplier innovation that genuine environmental improvement requires.

A supplier that is structurally dependent on a single buyer has limited incentive to invest in environmental capabilities that exceed that buyer's requirements, because the returns to such investment cannot be captured across a diversified customer base. The result is a compliance-without-capability dynamic that is pervasive in labour-intensive global supply chains and that represents, arguably, the most significant structural obstacle to the greening of global value chains. Addressing these obstacles requires MNEs to take on greater responsibilities for governance and human rights across their entire value network (*Zagelmeyer, 2020). Sturgeon's (2002*) account of modularity in value chains provides an important complement to the Gereffi governance typology. To understand these dynamics, it is critical to distinguish between value chains, which focus on value creation, and production networks, which represent the physical and organisational linkages between firms (*Sturgeon, 2001*).

Sturgeon argued that the modularisation of production, the decomposition of complex activities into standardised, independently developable components, enables firms to externalise manufacturing without losing coordination at the system level. The strategic logic is compelling:

modularity reduces the coordination costs of outsourcing, accelerates innovation by allowing parallel development across the supply network, and creates the flexibility to switch suppliers in response to cost or quality changes. From an environmental perspective, however, modularity is a double-edged instrument. The same flexibility that allows a firm to re-source production rapidly in response to a cost shock also allows it to exit environmental commitments with limited friction. This structural tension highlights that the environmental impact of MNEs is not just a byproduct of production, but a direct consequence of how their global networks are governed (*Steenbergen & Saurav, 2023*).

If a supplier relationship is genuinely modular, if the buyer can switch to an alternative supplier at low cost because interfaces are standardised and relationship-specific investments are minimal, then the buyer has limited incentive to invest in that supplier' environmental development, and the supplier has limited incentive to exceed compliance minima. Modularity, in other words, can systematically undermine the relational conditions under which serious environmental capability building becomes possible. This tension is not merely theoretical. It manifested acutely during the COVID-19 pandemic, when the fragility of tightly optimised modular supply chains became visible (*Akinbolajo, O., 2024*). Firms that had prioritised flexibility and cost efficiency over depth of relationship found themselves unable to influence supplier behaviour when circumstances demanded rapid adaptation. The environmental parallel is instructive: firms that have treated their supply chains as modular assemblies of interchangeable components are discovering that the transition to lower-carbon production requires precisely the kind of deep, relationship-specific investment that modularity was designed to avoid. The architecture of the value chain, it turns out, is not neutral with respect to environmental outcomes.

The conceptual history of outsourcing in the international business literature is, at one level, a story of progressive sophistication – from the simple cost logic of early transaction cost economics to the relational rents of Dyer and Singh (1998), the modularity arguments of Sturgeon (2002), and Verbeke's (2013) reconceptualisation of internalisation as a dynamic capability. However, beneath this sophistication, the dominant metaphor has remained remarkably consistent: outsourcing as *arbitrage*. The firm identifies a differential – in labour costs, in expertise, in regulatory conditions, and exploits it by relocating an activity to wherever the differential is most favourable.

The green transition challenges this metaphor at a fundamental level. Environmental capability is not, in most cases, a fixed attribute of a location or a supplier that a firm can simply appropriate through a contractual relationship. It is, rather, a capability that must be actively developed – through investment, through knowledge transfer, through the kind of sustained organisational learning that requires genuine commitment from both parties. This commitment must also address the broader social dimensions of sustainability, ensuring that environmental initiatives do not overlook critical issues such as child labour or ethical working conditions in complex supply chains (*Engelbertink & Kolk, 2021*).

A firm cannot outsource to a green supplier if no such supplier exists. In many industries and many geographies, no such supplier yet exists at the scale or capability level required. The strategic logic of green outsourcing is therefore not primarily one of arbitrage but of *recombination* – the deliberate assembly and re-configuration of environmental capabilities across organisational and national boundaries to generate sustainability outcomes that no single firm could achieve independently. This recombination process is fundamentally shaped by the "competitive advantage of nations", as the institutional and resource-based quality of the host country determines the baseline for supplier environmental performance (*Porter, 1990*). This distinction carries significant

theoretical weight. Verbeke (2013) introduced the concept of recombination capabilities in a different but related context, arguing that the capacity to combine firm-specific advantages with location-specific advantages from multiple national environments is a defining characteristic of the successful contemporary MNE. The argument developed here extends this logic: green outsourcing, properly conceived, is a form of environmental capability recombination – a strategic practice through which MNEs assemble, develop, and deploy environmental resources across their value chains in ways that create both competitive and sustainability value.

Porter and van der Linde's (1995) seminal argument about the relationship between environmental regulation and competitive advantage provides an important theoretical anchor for the concept of green outsourcing. Their central claim, that well-designed environmental regulation can trigger innovation offsets that more than compensate for compliance costs, challenged the prevailing assumption that environmental protection and economic competitiveness exist in fundamental tension. Firms that responded to regulatory pressure by genuinely rethinking their resource use, rather than simply installing end-of-pipe controls, discovered efficiency gains, product improvements, and new market opportunities that their less innovative competitors had not anticipated. What Porter and van der Linde described at the level of the firm has a direct analogue at the level of the supply chain. When a dominant buyer firm (an MNE with the leverage and the incentive to drive environmental improvement through its supply network) imposes meaningful environmental requirements on its suppliers and provides the technical and financial support to meet them, it can trigger precisely the kind of innovation dynamic that Porter and van der Linde identified.

The key word here is *meaningful*: requirements that are genuinely demanding, that push suppliers beyond current practice, and that are accompanied by sufficient investment and time horizon to make adaptation feasible. The five characteristics of effective environmental standards that Porter and van der Linde identified: flexibility in means, stringency in ends, realistic transition periods, a focus on resource productivity rather than pollution control, and first-mover positioning, apply with equal force to the design of supply chain environmental programmes.

This has direct implications for the make-or-buy decision. A firm that treats environmental compliance as a procurement criterion, screening suppliers against a minimum standard and switching to alternatives when they fail, is likely to generate compliance behaviour rather than capability development. A firm that treats green outsourcing as a long-term capability investment, accepting the higher coordination costs of relational governance in exchange for the deeper environmental transformation that only relational governance can sustain, is engaged in something strategically different. The choice between these approaches is, at its core, a governance choice that maps directly onto the Gereffi typology: modular governance can enforce compliance; relational governance can build capability.

Kolk and Pinkse's (2008) taxonomy of corporate climate strategies provides a useful empirical grounding for the more abstract arguments developed above. Their six-fold classification – cautious planners, emerging planners, internal explorers, vertical explorers, horizontal explorers, and emission traders, captures the range of strategic postures that MNEs have actually adopted in response to climate pressure, and each posture implies a different relationship between internalisation and outsourcing as instruments of environmental strategy. The vertical explorers are most directly relevant here. These are firms that focus their environmental efforts on their supply chains (upstream toward raw material suppliers, downstream toward customers) because their own direct emissions are relatively low while the emissions embedded in their supply chains are substantial. For a vertical explorer, green outsourcing is not a peripheral concern but the central mechanism of environmental strategy. The governance challenges described in the previous section,

how to move beyond compliance auditing toward genuine capability development, how to structure relational investments that yield innovation offsets, how to allocate residual control rights over environmental assets, are, for vertical explorers, first-order strategic questions.

What Kolk and Pinkse's taxonomy also reveals, however, is the degree to which most firms have not yet made this transition. The majority of their sample fell into categories that combine modest ambitions with limited supply chain engagement. The implication is not simply that firms are failing to live up to their environmental rhetoric, though that is often true, but that the strategic frameworks available to managers do not yet provide adequate guidance for the governance of green value chains. Transaction cost economics tells them to minimise transactional hazards; the resource-based view tells them to protect core competencies; the global value chain literature tells them about governance structures. None of these frameworks, taken individually, tells them how to design an outsourcing architecture that simultaneously delivers environmental capability development, competitive differentiation, and transactional efficiency. The concept of green outsourcing, as developed in this article, is an attempt to begin filling that gap.

Verbeke's (2013) concept of deep internalisation, the retention of high-value activities within the firm, combined with the selective externalisation of others through carefully designed outsourcing arrangements, offers perhaps the most useful integrative framework available for thinking about green outsourcing at the level of the MNE. Verbeke's argument is that the boundary between internalisation and outsourcing should not be drawn on the basis of cost alone, or even on the basis of asset specificity in the Williamsonian sense, but based on a holistic assessment of how the configuration of internal and external activities shapes the firm's overall capacity to create and capture value. Applied to environmental strategy, this logic generates a clear implication: MNEs should internalise the environmental capabilities that are most central to their competitive differentiation and most difficult to develop through arm's-length relationships, and should outsource environmental functions where external partners can develop and maintain the required capabilities more effectively than internal teams, provided that the governance of those outsourcing relationships is designed to ensure genuine capability development rather than mere compliance. The distinction, to return to the central argument of this article, is between outsourcing as environmental arbitrage and outsourcing as environmental recombination. The former is a procurement decision; the latter is a strategic one, and it requires a correspondingly more sophisticated governance architecture.

The argument developed across the preceding sections can be stated with some precision: the classical make-or-buy framework, and its various theoretical elaborations, provides an insufficient basis for governing outsourcing decisions in an era defined by environmental constraint. This is not a trivial observation. Transaction cost economics, the property rights approach, and the resource-based view have each made genuine and lasting contributions to the understanding of organisational boundaries – contributions that retain their analytical value and that this article has no interest in discarding. The claim, rather, is one of incompleteness. These frameworks were constructed to explain how firms minimise governance costs and protect competitive assets in conditions of market imperfection. They were not constructed to explain how firms build, transfer, and recombine environmental capabilities across the complex, multi-tiered networks that constitute contemporary global value chains.

**Table 1.**

*Theoretical frameworks and their environmental governance implications*

| Framework | Primary governance logic | Environmental variables in original formulation | Extension required for green outsourcing |
|---|---|---|---|
| Transaction cost economics (*Coase, 1937; Williamson, 1985*) | Minimise costs of market exchange; internalise when internal coordination is cheaper. Asset specificity, uncertainty, and frequency determine governance structure. | Absent<br>Externalities treated as outside the transaction; no environmental cost category. | Ecological asset specificity<br>Joint environmental investments create mutual dependency and hold-up risk not captured by existing specificity typology. |
| Property rights theory (*Grossman & Hart, 1986*) | Allocate residual control rights to the party whose investment most affects joint value. Ownership determines incentives under incomplete contracts. | Absent<br>Environmental assets not conceptualised; no treatment of regulatory contingencies in residual control allocation. | Environmental residual control<br>Allocation of ownership over green certifications, carbon assets, and co-developed environmental IP under regulatory uncertainty. |
| Resource-based view (*Barney, 1991*) | Internalise VRIN resources that underpin competitive advantage; outsource non-core activities. | Partial<br>Environmental capability can qualify as VRIN but framework does not address its relational or cross-boundary character. | Interdependent green capability<br>Recognition that environmental competitive advantage is often embedded in supply chain relationships, not solely in firm-internal resources. |
| Relational view (*Dyer & Singh, 1998*) | Generate relational rents through relation-specific assets, knowledge sharing, complementary resources, and effective governance. | Partial<br>Trust and joint investment logic applicable to environmental co-development but not explicitly applied to sustainability outcomes. | Green relational rents<br>Relational governance as the necessary condition for environmental capability building beyond compliance; shared environmental investment as rent-generating mechanism. |
| GVC governance typology (*Gereffi, Humphrey & Sturgeon, 2005*) | Governance form determined by transaction complexity, codifiability, and supplier capability. Five types: market, modular, relational, captive, hierarchy. | Significant gap<br>The framework does not address environmental complexity or ecological codifiability as determinants of governance. | Environmental governance matrix<br>Modular governance enables compliance; relational governance enables capability development. Environmental complexity and ecological asset specificity as additional governance determinants. |

The concept of ecological asset specificity, introduced in this article, is intended to perform a precise bridging function. By extending Williamson's (1985) typology to include a category of asset specificity defined not by technical or physical lock-in but by environmental co-investment and regulatory interdependence, it becomes possible to apply the governance logic of transaction cost economics to environmental relationships without abandoning the framework's analytical structure. The implication is not merely theoretical: it suggests that firms and their supply chain partners who have made joint investments in environmental capability: shared emissions monitoring systems, co-developed green production processes, jointly funded renewable energy transitions, face a genuine hold-up problem that existing contract design has not yet learned to address. The stranding of environmental investments when supply chain relationships dissolve is a real and growing source of value destruction, and it deserves the same theoretical attention as physical and human asset

specificity.

The recombination framing, drawn from Verbeke's (2013) treatment of dynamic capabilities and extended here to the environmental domain, adds a further dimension. Recombination is not merely about protecting existing environmental assets from opportunistic appropriation; it is about actively assembling environmental capabilities from multiple organisational and geographical sources to generate sustainability outcomes that exceed what any single firm could achieve alone. This is, in essence, what the most sophisticated green supply chain programmes attempt to do. And it is why the governance architecture of such programmes matters so profoundly. The difference between a compliance audit and a genuine capability-building partnership is not merely a difference of ambition; it is a difference of governance form, and governance form determines what kinds of environmental value can be created.

One of the more uncomfortable implications of the analysis concerns the widely celebrated principle of modular supply chain design. Modularity, the decomposition of production into standardised, independently developable components, has been presented in the international business literature primarily as a source of strategic flexibility and innovation velocity (Sturgeon, 2002). From an environmental governance perspective, however, modularity creates a structural disincentive for the kind of relational investment that deep environmental capability development requires. If the defining feature of a modular relationship is that partners are interchangeable, that switching costs are low and interfaces are standardised, then neither buyer, nor supplier has adequate incentive to make the long-term, relationship-specific environmental investments that genuine sustainability transformation demands.

This tension has practical implications that extend well beyond the theoretical register. The firms most deeply committed to supply chain decarbonisation, those engaged with science-based targets initiatives, scope 3 emissions reduction programmes, and supplier capability development at scale, are, almost without exception, firms that have moved away from modular toward relational governance in strategically critical supply chain segments. Apple's deep-tier supplier engagement on renewable energy, Unilever's long-term commodity supplier partnerships on agricultural sustainability, and IKEA's co-investment in supplier energy efficiency all reflect a similar underlying logic: that environmental transformation requires governance depth, and governance depth requires a degree of relational commitment that modularity systematically precludes.

The implication for theory is that the environmental transition may be forcing a partial reversal of the modularisation trend that characterised global value chain development in the 1990s and 2000s. Firms that built their supply chains on the flexibility logic of modularity now face the environmental governance logic of relationality. And the two are not easily reconciled. Navigating this tension is, arguably, one of the defining strategic challenges of the current period for MNEs engaged in global production.

The governance architecture of green outsourcing is not a neutral procurement matter, and treating it as such is one of the more consequential mistakes MNEs currently make at scale. Firms that route environmental ambition through compliance audits are not simply choosing an imperfect instrument. They are choosing a governance form that structurally forecloses the deeper supplier engagement that decarbonisation actually requires. The harder implication is this: relational governance costs more in time, coordination, and the loss of the switching flexibility that modular supply chains were built to preserve. MNEs that want genuine environmental capability development in their supply chains need to decide, segment by segment, whether they are willing to pay that cost and most existing strategic frameworks do not explicitly force that decision.

Second, the allocation of residual control rights over environmental assets, the question that Grossman and Hart's (1986) framework raises but does not resolve in the environmental context, deserves far more careful contractual attention than it currently receives. Joint environmental investments of the kind described above create genuine questions about ownership: who captures the value of a green certification earned through shared investment? Who bears the cost if a regulatory change strands an environmental asset? Who controls the intellectual property generated by joint process innovation? Standard supplier contracts do not adequately address these questions, and the gap between what firms invest in environmental supply chain relationships and what their contracts protect is a significant, underappreciated governance risk.

Third, and perhaps most fundamentally, the concept of green outsourcing as environmental capability recombination suggests that MNEs should be thinking about their supply chains not merely as cost structures to be optimised or risk exposures to be managed, but as platforms for the assembly and development of environmental capabilities that can generate competitive advantage in a progressively decarbonising global economy. This is a different strategic logic from anything that classical outsourcing theory anticipated, and it requires a correspondingly different set of managerial frameworks and governance tools.

**Table 2.**

*Green outsourcing decision framework: governance form and environmental strategy by corporate climate type*

| Corporate climate strategy type | Recommended governance form | Outsourcing configuration | | Primary environmental outcome |
|---|---|---|---|---|
| | | Key governance instruments | Make-or-buy logic | |
| Cautious planners Monitoring only; no concrete action | Market | Minimum environmental clauses in supplier contracts; periodic compliance questionnaires | Buy on cost; environmental criteria as threshold, not selection driver | Risk reduction; avoidance of reputational exposure from non-compliant suppliers |
| Emerging planners Emissions targets set; no implementation | Modular | Supplier codes of conduct; third-party certification requirements; annual ESG audits | Buy standardised; environmental compliance as codified specification | Compliance attainment; audit-based verification of supplier environmental performance |
| Internal explorers Strong internal focus; energy efficiency | Hierarchy | Internalisation of energy-intensive processes; selective outsourcing of low-emission peripheral activities | Make where emissions are concentrated; buy where environmental impact is negligible | Scope 1 and 2 emissions reduction; direct energy efficiency gains in controlled operations |
| Vertical explorers Supply chain environmental focus | Relational | Co-investment in supplier environmental capability; joint emissions monitoring; long-term partnership contracts; shared green R&D | Buy from committed partners; governance depth traded for flexibility; ecological asset specificity high | Scope 3 emissions reduction; environmental capability recombination across the value chain; innovation offsets |
| Horizontal explorers Cross-market | Modular Relational | Green product licensing; environmental joint | Buy green capability from adjacent-market specialists; | New market entry through environmental differentiation; green |

| | | | | |
|---|---|---|---|---|
| environmental opportunity | | ventures; outsourcing to green-specialist partners in adjacent markets | build where proprietary environmental advantage is sought | revenue stream development |
| Emission traders Carbon market participation; offset focus | Captive Market | Emissions trading agreements; offset project outsourcing; carbon credit procurement from captive or spot-market suppliers | Buy emissions reductions externally; internalise trading strategy and carbon accounting | Net emissions position management; regulatory compliance through market mechanisms rather than operational transformation |

Source: (*Kolk & Pinkse, 2008*)

**Conclusions.** The governance of outsourcing decisions in multinational enterprises has long been theorised through frameworks whose explanatory power, while considerable, was not designed for the environmental conditions that now define the competitive and regulatory landscape. Transaction cost economics, the resource-based view, and global value chain governance each illuminate important dimensions of the make-or-buy calculus, yet none of them was constructed with supply chain decarbonisation, scope 3 accountability, or the co-investment dynamics of green capability development in mind. The result is a structural mismatch between the theoretical tools available to practitioners and scholars and the governance challenges they are asked to address.

This article has attempted to close part of that gap by introducing ecological asset specificity as a distinct governance variable and by situating green outsourcing within a recombination capability framework derived from internalization theory. The argument has not been that existing frameworks are wrong. It has been that they are, in the current moment, incomplete, and that their incompleteness has costs that show up not in theoretical discussions but in the governance decisions of firms that have committed to environmental transformation without adequate conceptual scaffolding.

The article's central contributions can be summarised in three propositions. First, ecological asset specificity constitutes a distinct and theoretically significant category within the Williamsonian framework, characterised by mutual dependency arising from joint environmental investment and the regulatory interdependence of supply chain partners operating in overlapping or linked compliance environments. Second, the governance form of outsourcing relationships is not neutral with respect to environmental outcomes: modular governance can enforce compliance, but it cannot sustain capability development, while relational governance, with its attendant costs of coordination and commitment, is the necessary condition for the kind of deep environmental transformation that genuine supply chain decarbonisation requires. Third, green outsourcing is most productively understood not as a variant of cost arbitrage but as a form of environmental capability recombination – a strategic practice through which MNEs assemble, develop, and deploy environmental resources across organisational and national boundaries to generate sustainability outcomes that no single actor could achieve independently.

These propositions do not supersede the classical frameworks they extend. Coase's (1937) insight about the nature of the firm, Williamson's (1985) transactional logic, Barney's (1991) resource architecture, and Verbeke's (2013) recombination capability all remain analytically indispensable. This article argues that they are insufficient, taken individually or collectively, to address the environmental governance challenges the contemporary period has placed before multinational enterprises. Extending them – carefully, with attention to what each framework

actually explains and where each leaves explanatory gaps – is the most productive available path toward a theory of outsourcing adequate to the demands of the green transition.

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# REVIEW OF THE MONOGRAPH BY YEVHENIIA TIKHOMYROVA AND ALONA TIKHOMYROVA «INFORMATION DISORDER: THE POLITICAL AND PSYCHOLOGICAL DIMENSION OF CLIMATE CHANGE»

# РЕЦЕНЗІЯ НА МОНОГРАФІЮ ЄВГЕНІЇ ТИХОМИРОВОЇ ТА АЛЬОНИ ТИХОМИРОВОЇ «ІНФОРМАЦІЙНИЙ БЕЗЛАД: ПОЛІТИКО-ПСИХОЛОГІЧНИЙ ВИМІР ЗМІНИ КЛІМАТУ»

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The monograph by Yevheniia Tykhomyrova and Alona Tykhomyrova, *Information Disorder: The Political and Psychological Dimension of Climate Change*, is a thorough interdisciplinary scholarly work deserving special attention from both the Ukrainian and international academic communities. The study reveals one of the key phenomena of our time – information disorder, which, amid digitalization, media platformization, and the intensification of global political conflicts, becomes a systemic factor influencing the formation, course, and content of climate discourse. Given that addressing climate change has become one of the critical issues in international politics, upon which global security, economic development, and societal resilience depend, the investigation of the interrelations between climate disinformation, psychological vulnerability, and political processes is highly relevant.

The monograph is distinguished by a high level of conceptual clarity and theoretical depth. The authors systematize existing approaches to the study of information disorder and propose an updated analytical framework for examining climate disinformation, drawing on the latest political, psychological, and communication research. Of particular value is the fact that the study consistently integrates perspectives on the structure of climate discourse, which in the global scholarly field is still investigated largely in a fragmented manner and within the boundaries of individual disciplines.

The first chapter of the monograph «Information chaos regarding climate change: interpretation and related concepts» is devoted to the conceptual and theoretical foundations of the study of information disorder. The authors provide a detailed analysis of established definitions of disinformation, misinformation, and malinformation, while emphasizing that within climate discourse these categories acquire specific characteristics. One of the chapter's key achievements is a thorough comparison of the leading contemporary paradigms for interpreting climate change. Y.Tykhomyrova and A.Tykhomyrova comprehensively explain how the Anthropocene paradigm shapes the notion of humanity's collective responsibility by drawing attention to global processes of industrialization and technological development. Within the Capitalocene framework, the analysis focuses on the systemic logic of capitalist development, which creates opportunities for political lobbying, economic interests, and information interventions. The third paradigm, Natural Climate Variability, is examined in detail as an ideological resource that is systematically employed by denialists to contest the anthropogenic factor. The authors demonstrate how the interaction of these three approaches generates a conflict between scientific knowledge and informational

distortions, thereby creating the preconditions for the spread of climate disinformation in the global information space.

The second chapter of the monograph «The landscape of misinformation about climate change: the denialist perspective» is devoted to the examination of the landscape of climate disinformation, the structure of its production, and the mechanisms of its dissemination. Climate disinformation is conceptualized as a structured, goal-oriented, and systematically organized instrument of influence, the production of which involves both state and non-state actors, including corporations, political parties, networked communities, informal groups, media institutions, and technological platforms. The authors provide a systematic classification of the actors engaged in the creation of manipulative climate-related messages. The chapter offers a thorough analysis of how states may exploit climate-related issues for geopolitical positioning, the reinforcement of their own ideological doctrines, or the formation of distorted perceptions of climate impacts in other countries. At the same time, significant attention is paid to non-state structures, such as business groups, industrial corporations, think tanks, networks of digital trolls, and pseudo-environmental organizations. The study emphasizes that denialist narratives are often supported by the interests of major industrial sectors, particularly energy companies, which have strong economic incentives to block or slow down environmental reforms. Y.Tykhomyrova and A.Tykhomyrova provide a detailed account of the mechanisms of financing and coordination of denialist campaigns, emphasizing that these campaigns are predominantly not spontaneous, but institutionally organized.

The third chapter «A proactive approach to combating climate change misinformation» examines the psychological foundations of information perception and the mechanisms that determine audiences' vulnerability to climate disinformation. The authors demonstrate a profound command of political psychology, enabling them to integrate cognitive models with the analysis of climate narratives. They substantiate how cognitive biases—such as confirmation bias, motivated reasoning, the availability heuristic, and the backfire effect—influence the audience's capacity to accept or reject scientifically grounded information. An important component of the chapter is the analysis of the role of emotions, including fear, anxiety, anger, and apathy. Notably, psychological models are not presented in isolation but are embedded within a political context, which allows climate disinformation to be viewed as a dynamic process that is simultaneously informational, political, and psychological in nature. Y.Tykhomyrova and A. Tykhomyrova convincingly demonstrate that emotional responses may both amplify susceptibility to manipulation and, conversely, stimulate constructive mobilization, depending on how communicators and political actors shape their narratives.

Particular attention is given to the analysis of psychological «inoculation» models and prebunking, which have become widely adopted in contemporary research on countering disinformation. The authors convincingly demonstrate that preventive strategies aimed at building resilience to manipulative influences produce significantly stronger effects than reactive methods of debunking. In this regard, the monograph constitutes an important intellectual resource for professionals working in the fields of strategic communications, media literacy, and climate policy.

An important achievement of the study is the typology of strategies for countering climate disinformation proposed in the fourth chapter of the monograph «Strategies for dispelling and refuting climate misinformation». This typology encompasses the individual level (critical thinking, psychological resilience), the institutional level (media strategies, political regulation, scientific communication), and the technological level (algorithmic content labeling, artificial intelligence for disinformation detection), as well as educational practices, cultural strategies, digital literacy, technological solutions, and psychological models of resistance. Y.Tykhomyrova and A.Tykhomyrova emphasize that none of these approaches is sufficient in isolation and that only their comprehensive integration can create the conditions necessary for reducing the impact of manipulative content. The study further underscores the fundamental importance of cross-sectoral cooperation, in particular the synergy among the state, the academic community, civil society, and business, in countering climate disinformation.

The style of presentation is marked by academic clarity, and the structure is designed to ensure

a coherent progression from abstract concepts to applied strategies. At the same time, the study possesses substantial practical value: the proposed recommendations may be applied in the activities of public authorities, journalists, think tanks, environmental organizations, and international agencies for the development of national communication strategies in the field of climate policy, including within the Ukrainian context.

It should be noted that the monograph opens up avenues for further research. Promising directions include expanding the analysis of international institutions combating disinformation, deepening the study of the economic interests of denialist corporations, and incorporating new empirical data on the impact of disinformation on Ukrainian society in the context of war.

In conclusion, the monograph by Y. Tykhomyrova and A. Tykhomyrova, *Information Disorder: The Political and Psychological Dimension of Climate Change*, represents a high-quality interdisciplinary study that makes a significant contribution to the development of both Ukrainian and international scholarship in the fields of climate policy and communications, information security, and political psychology. It is distinguished by the depth of its analysis, originality, relevance, and practical significance. This publication is recommended for use in educational, research, analytical, and practical activities by a wide range of specialists working in international relations, climate policy, strategic communications, disinformation counteraction, and information resilience.

**Conflict of Interest:** Olena Shevchenko is a member of the Editorial Board of the journal. The manuscript was subjected to an independent evaluation process, and the final decision was made without the author's involvement.

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