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ШЛЯХИ ПОКРАЩЕННЯ ТА ЗМІЦНЕННЯ ІННОВАЦІЙНОГО ПОТЕНЦІАЛУ КОМПАНІЙ ТА УСТАНОВ З ВИКОРИСТАННЯМ КЛАСТЕРІВ: ЄВРОПЕЙСЬКИЙ ДОСВІД

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THE WAYS OF IMPROVING AND STRENGTHEN INNOVATION POTENTIALS OF COMPANIES AND INSTITUTIONS USING CLUSTERS: EUROPEAN EXPERIENCE

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Анотація. У статті досліджено сукупний вплив агломераційних економік, мереж співпраці та інституційної підтримки на розвиток інновацій і підвищення конкурентоспроможності європейської аерокосмічної промисловості. Використовуючи конфігураційний підхід, проаналізовано, як взаємодія зазначених чинників сприяє формуванню стійких та інноваційних аерокосмічних екосистем. Дослідження зосереджено на провідних європейських аерокосмічних кластерах, зокрема в Тулузі, Гамбурзі, Турині та Севільї, де основним прикладом виступає компанія Airbus SE.

Доведено, що географічна агломерація забезпечує суттєві конкурентні переваги завдяки формуванню спеціалізованих ринків праці, поширенню знань, зміцненню взаємодії з постачальниками та покращенню доступу до спільної інфраструктури. Показано, що співпраця між підприємствами, університетами, науково-дослідними установами та державними організаціями прискорює технологічні інновації через обмін знаннями, проведення спільних досліджень і розподіл ризиків. Інституційна підтримка з боку Європейського Союзу, національних урядів і регіональних кластерних організацій посилює ці переваги, стимулюючи дослідження та розробки, знижуючи інвестиційну невизначеність і сприяючи довгостроковій промисловій кооперації. Особливу увагу приділено ролі організаційної культури, цифрової трансформації, сталого розвитку та міжгалузевої співпраці як ключових чинників майбутньої конкурентоспроможності. Результати дослідження свідчать, що довгостроковий успіх європейської аерокосмічної промисловості визначається взаємодією агломераційних економік, мереж співпраці та ефективного інституційного управління, а не лише окремими організаційними можливостями. Стаття робить внесок у розвиток теорії регіональних інноваційних систем і пропонує практичні рекомендації для політиків та представників галузі щодо зміцнення глобального лідерства Європи у сфері аерокосмічних інновацій.

Ключові слова: європейська аерокосмічна промисловість, промислова агломерація, інноваційні мережі, інституційна підтримка, регіональна конкурентоспроможність.

Формул: 0; **рис.:** 1; **табл.:** 3; **бібл.:** 27

Abstract. This article examines the combined influence of agglomeration economies, collaborative networks, and institutional support on innovation and competitiveness within the European aerospace industry. Using a configurational perspective, it explores how the interaction of these factors contributes to the development of resilient and innovative aerospace ecosystems. The analysis focuses on leading European aerospace clusters, including Toulouse, Hamburg, Turin, and Seville, with Airbus SE serving as the principal case study. The study argues that geographical agglomeration creates significant competitive advantages by fostering specialized labour markets, facilitating knowledge spillovers, strengthening supplier relationships, and improving access to shared infrastructure. It further demonstrates that collaboration among firms, universities, research institutions, and public organizations accelerates technological innovation through knowledge exchange, joint research, and risk-sharing. Institutional support provided by the European Union, national governments, and regional cluster organizations reinforces these advantages by promoting research and development, reducing investment uncertainty, and encouraging long-term industrial cooperation. The article also highlights the growing importance of organizational culture, digital transformation, sustainability, and cross-sector

collaboration as key drivers of future competitiveness. The findings indicate that the long-term success of the European aerospace industry depends on the complementary interaction of agglomeration economies, collaborative networks, and effective institutional governance rather than on individual organizational capabilities alone. The study contributes to the literature on regional innovation systems while providing practical recommendations for policymakers and industry stakeholders seeking to strengthen Europe's global leadership in aerospace innovation.

Keywords: European aerospace industry, industrial agglomeration, innovation networks, institutional support, regional competitiveness.

Formulas: 0; **Fig.:** 1; **Tab.:** 3; **bibl.:** 27

Introduction. Although governments and private organizations invest heavily in research and development (R&D), the commercialization of scientific knowledge remains a persistent challenge. Many firms and public research institutions have difficulties transforming research results into scalable, market-oriented innovations. This situation is often described as the “European Paradox” or the innovation commercialization gap. One of the main reasons for this gap is organizational, institutional, and geographical fragmentation, which can limit effective cooperation and the transfer of knowledge.

Small and medium-sized enterprises (SMEs) face additional constraints related to financial resources, technological infrastructure, and their ability to manage the risks associated with advanced innovation. At the same time, universities and public research institutions often place greater emphasis on scientific publications and academic excellence than on commercial applications. As a result, potentially valuable research outcomes may not reach the market or generate their full economic impact.

Overcoming these barriers requires closer and more structured cooperation between industry, academia, and government. The Triple Helix model provides an appropriate framework for such cooperation by emphasizing the interaction between universities, businesses, and public institutions. These partnerships can facilitate knowledge exchange, resource sharing, and coordinated innovation activities, while also supporting the commercialization of research.

The growing intensity of global competition further increases the importance of cross-border innovation clusters. Their development can contribute to industrial competitiveness, accelerate technology transfer, and strengthen the long-term

resilience of regional innovation ecosystems. In this context, European aerospace clusters provide a useful setting for examining how geographical concentration, cooperation networks, and institutional support interact to create conditions for innovation.

Literature Review. The concept of industrial clusters is strongly associated with the work of Michael Porter (1990, 1998), who described clusters as geographically concentrated networks of interconnected firms and institutions that can improve productivity and competitiveness. Subsequent research has expanded this understanding by placing greater emphasis on collaborative governance, institutional support, and coordinated innovation rather than geographical proximity alone.

Recent studies and European policy initiatives indicate that European clusters increasingly operate through public–private partnerships supported by professional management structures and long-term funding. These arrangements strengthen cooperation between businesses, universities, and research institutions and can improve knowledge transfer and innovation performance. Initiatives such as Horizon Europe and Euroclusters have also encouraged cross-border cooperation, digital transformation, and the development of more resilient value chains.

At the same time, the literature identifies continuing challenges. These include the difficulty of balancing public policy objectives with market-driven initiatives and the limited access of SMEs to shared Research and Technology Infrastructures (RTIs). These challenges are particularly relevant in knowledge-intensive industries, where innovation requires substantial investment, specialized expertise, and close interaction between different types of organizations.

Despite considerable progress in research on industrial agglomeration, regional innovation systems, and cluster development, several issues remain insufficiently explored.

First, previous studies have often examined agglomeration economies, collaborative networks, and institutional frameworks as separate sources of competitive advantage. Less attention has been given to how these factors interact simultaneously and how their combination influences innovation in the European aerospace sector.

Second, the aerospace industry is undergoing substantial structural changes. Digital technologies, environmental requirements, supply-chain realignments, geopolitical instability, and increasing R&D expenditure are changing the way aerospace clusters operate. These developments create a need for updated research examining the ability of existing cluster models to respond to changing technological and economic conditions.

Third, although established aerospace hubs such as Toulouse and Hamburg have been examined extensively, comparative research explaining why some European clusters achieve stronger innovation performance and long-term viability than others remains limited. A comparative examination of different regional cluster models can therefore provide a broader understanding of the conditions that support successful innovation ecosystems.

Aim and Methodology. This article adopts a qualitative research methodology based on a comparative multiple-case study approach to investigate how European cluster ecosystems enhance innovation capacity, knowledge transfer, and industrial competitiveness. The selection of a qualitative approach is appropriate because the research focuses on understanding complex interactions between firms, research institutions, government organizations, and cluster

management bodies rather than measuring isolated variables.

The research is guided by a configurationally perspective, which assumes that innovation performance is the result of the interaction between multiple complementary conditions rather than a single determining factor. Within this framework, cluster competitiveness is examined as an outcome of the combined influence of agglomeration economies, collaborative networks, institutional governance, technological infrastructure, and organizational capabilities.

This article adopts a pragmatic, qualitative, and exploratory approach to examine the practical mechanisms through which European cluster ecosystems enhance innovation capacity, knowledge exchange, and industrial competitiveness. A pragmatic philosophy is uniquely suited to analyzing these complex environments, as it allows for the integration of multiple complementary frameworks—specifically industrial cluster theory, regional innovation systems, and the Triple Helix model of university-industry-government collaboration. Rather than relying on isolated quantitative indicators to measure performance, the research investigates the collaborative relationships and interactions among diverse stakeholders, recognizing that successful innovation emerges from coordinated networks rather than solitary organizations. To analyze how these clusters have evolved from simple geographical industrial districts into strategically managed ecosystems, the study utilizes a three-dimensional framework focusing on agglomeration economies (the local benefits of shared infrastructure, specialized labor, and proximity), collaborative networks (the relationships driving knowledge and technology transfer), and institutional governance (the role of policy, funding, and strategic coordination in sustaining long-term innovation).

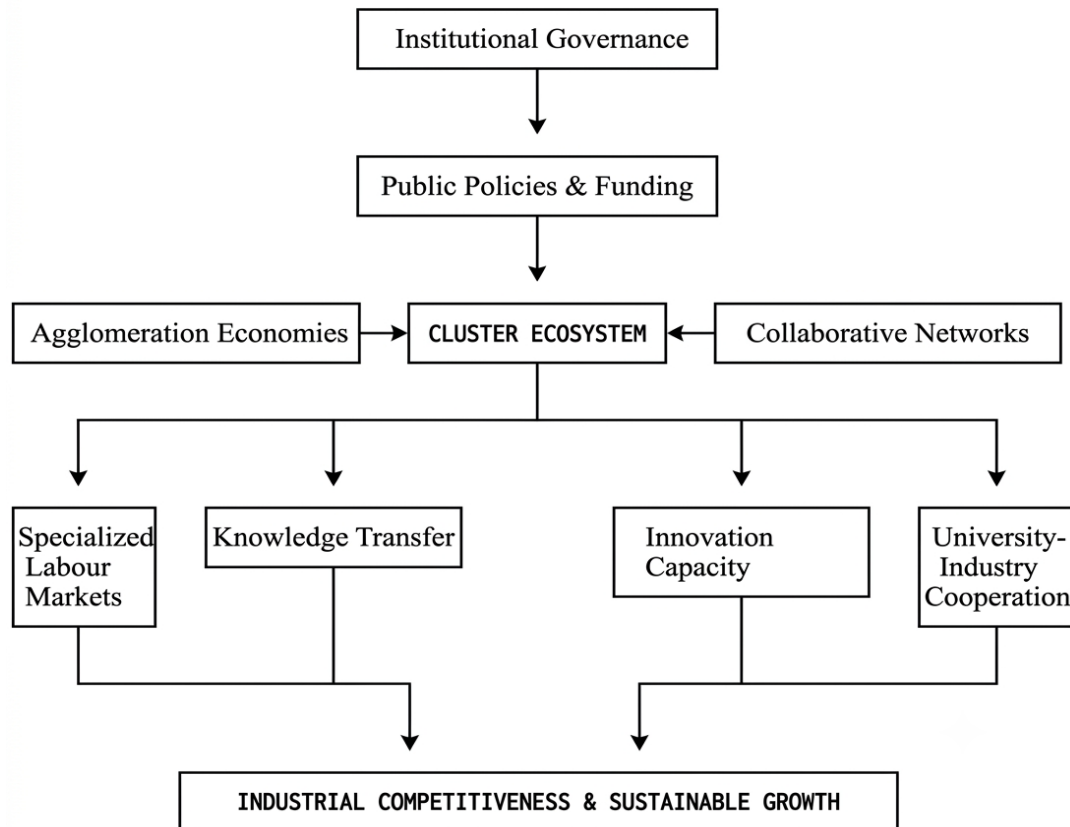


Figure 1. European Aerospace Cluster Competitiveness by Key Factor

Source: Developed by the author based on the analytical framework of the study

To adapt to a comparative multiple-case study strategy within high-technology sectors to explore the complex interactions among organizations, institutions, and regional innovation structures. The aerospace industry serves as the empirical focus due to its knowledge-intensive nature, which demands substantial research investment, advanced technology, complex supply chains, and deep industry-science cooperation. To capture diverse regional innovation models that share a foundation of strong industrial specialization and institutional support, the research examines four major European aerospace clusters: Toulouse Aerospace Valley (France), Hamburg Aviation (Germany), Piedmont Aerospace Cluster (Italy), and Andalusia Aerospace Cluster (Spain). Within this framework, Airbus SE is utilized as a central industrial benchmark, illustrating how a multinational enterprise engages with regional suppliers, universities, and government bodies to drive the transition from localized industrial

hubs toward fully interconnected European value chains.

The methodology relies primarily on secondary qualitative data gathered from academic literature, institutional reports, industry documents, and public databases, which offers a comprehensive view of how European cluster ecosystems function across various organizational levels. The data collection was structured around three primary categories. First, scholarly publications were analyzed to establish a theoretical foundation rooted in concepts like industrial clusters, regional innovation systems, and university-industry knowledge transfer. Second, European Union policy documents and publications from entities such as the European Commission, the European Cluster Collaboration Platform (ECCP), Horizon Europe, and Euroclusters programs were evaluated to map out broader European cluster strategies. Finally, industry-specific materials, including aerospace cluster reports, Airbus

publications, and regional innovation strategies, were reviewed to evaluate the

practical, real-world execution of these cluster frameworks.

Table 1

Data Sources and Analytical Purpose

Data Source	Examples	Purpose of Analysis
Academic literature	Porter, regional innovation studies, cluster research	Establish theoretical foundation
European Commission reports	ECCP, Horizon Europe, Euroclusters	Examine policy frameworks and funding mechanisms
Cluster organization reports	Aerospace Valley, Hamburg Aviation, Andalusia Aerospace	Evaluate governance structures
Industry publications	Airbus reports, aerospace innovation documents	Analyze industrial practices
Statistical databases	Eurostat, OECD innovation indicators	Provide contextual economic evidence

Source: Adapted from Asheim & Gertler (2005)

The gathered data was evaluated using thematic and comparative analysis methods to identify recurring patterns, relationships, and the specific mechanisms through which cluster environments generate innovation advantages. The analytical framework was organized around five distinct pillars: geographical concentration, knowledge networks, governance structures, financial support mechanisms, and technological readiness. Geographical concentration was assessed by looking at the density of specialized companies, suppliers, skilled talent, and supportive infrastructure, while knowledge

networks focused on collaborative efforts between businesses, universities, and research institutions. Governance structures were measured by the effectiveness of cluster management, stakeholder engagement, and strategic coordination. Additionally, financial mechanisms were examined through public-private investment frameworks and participation in European funding initiatives, while technological readiness focused on advancements in digital transformation, sustainability goals, and access to state-of-the-art research infrastructure.

Table 2

Analytical Dimensions and Indicators

Analytical Dimension	Key Indicators
Agglomeration Effects	Firm concentration, supplier networks, skilled workforce
Knowledge Networks	Research partnerships, technology transfer, innovation projects
Governance Quality	Cluster management, strategic planning, stakeholder coordination
Funding Mechanisms	Public investment, private participation, EU programmes
Future Competitiveness	Digitalization, sustainability, technological resilience

Source: Developed by the author based on the analytical framework of the study

The final stage of analysis involved synthesizing the findings into a strategic framework explaining how European cluster models can support innovation development. The framework aims to identify transferable practices that may benefit regions seeking to strengthen their own innovation ecosystems. To ensure the reliability and validity of the research findings, a three-pronged validation strategy was implemented. First, data triangulation was achieved by cross-referencing insights from a diverse mix of academic literature, government records,

industry documentation, and cluster publications, effectively minimizing the bias inherent in using a single source. Second, analytical validity was strengthened through a comparative case study design that examined multiple European regions—specifically aerospace hubs in France, Germany, Italy, and Spain—offering a more comprehensive understanding of varied cluster development models than a single-case focus could provide. Finally, theoretical consistency was preserved by directly aligning empirical findings with recognized academic concepts such as Porter's

cluster theory, the Triple Helix model, and regional innovation systems, ensuring the study remains both practically relevant and grounded in established scholarly dialogue.

Despite providing valuable insights into European cluster ecosystems, this research has several limitations.

First, the article relies mainly on secondary data sources. Although institutional reports and academic publications provide extensive information, they may not fully capture informal relationships, organizational culture, and everyday collaboration processes occurring within clusters.

Second, the research focuses primarily on aerospace clusters, which represent highly specialized and research-intensive environments. Therefore, some findings may not be directly transferable to less technology-intensive industries.

Third, European cluster policies continue to evolve due to changing economic, technological, and geopolitical conditions. Future developments in areas such as artificial intelligence, sustainability, and supply-chain resilience may influence the effectiveness of existing cluster strategies.

Future research could address these limitations through primary data collection methods, including interviews and surveys

involving cluster managers, SMEs, researchers, and policymakers. Such studies would provide deeper insights into the practical implementation of collaborative innovation models.

Results. Current Development of the European Aerospace Industry: Following the severe disruptions of the COVID-19 pandemic, the European aerospace sector has staged a robust recovery. Over the past three years, rising aircraft demand, expanded R&D budgets, and strong public backing for sustainable aviation have combined to bolster the industry's global standing. Industry leaders such as Airbus, Safran, Leonardo, and Rolls-Royce have scaled up manufacturing while directing significant capital toward digital integration, artificial intelligence, and green aviation initiatives. Recent figures reflect steady gains in revenue, workforce size, and R&D funding. Furthermore, European Union initiatives like Horizon Europe and Clean Aviation have accelerated joint innovation by funding collaborative ventures across academia, research centers, and private enterprise. Ultimately, these trends underscore that long-term competitiveness in aerospace now relies far more on well-coordinated innovation networks than on the isolated efforts of Individual companies.

Table 3

Recent Development of the European Aerospace Industry

Indicator	2022	2023	2024
Industry Turnover (€ billion)	270	295	326
Direct Employment (million)	0.95	1.02	1.10
R&D Investment (€ billion)	20	22	25

Source: Compiled from recent European aerospace industry reports

Economic Characteristics of European Aerospace Agglomerations: Recognized industrial hubs such as Toulouse, Hamburg, Turin, and Seville thrive due to dense networks of producers, suppliers, academic institutions, and research facilities, which foster an ideal environment for knowledge sharing, workforce mobility, and technological advancement. While physical proximity successfully lowers transaction costs and

encourages teamwork among organizations, the findings clearly indicate that simply clustering together is insufficient for driving innovation. Ultimately, the most effective aerospace regions are those that merge geographic closeness with robust institutional backing and deeply integrated collaborative partnerships.

Collaborative Innovation Networks: This research highlights that innovation across

European aerospace clusters is driven primarily by collective partnership rather than isolated organizational initiatives. Major industry players like Airbus, along with universities, specialized suppliers, research centers, and public agencies, engage in sustained alliances that streamline knowledge transfer and technological advancement. These joint networks help offset R&D expenses, speed up innovation cycles, and grant partners access to niche technical expertise. Supported by European funding initiatives that incentivize cross-border cooperation, organizations across different nations can co-develop cutting-edge aerospace solutions. Ultimately, collaborative innovation has established itself as a primary driver of competitive advantage within the European aerospace industry.

Institutional Advantages: Institutional backing serves as another crucial driver of innovation success within the sector. Strategic frameworks across European Union programs, national industrial policies, and regional development organizations offer essential funding, financial capital, regulatory consistency, and infrastructure needed to sustain long-term technological advancement. This robust institutional framework lowers financial risks for investors while actively encouraging partnership among private enterprises, academic institutions, and public research bodies. Furthermore, higher education centers play a vital role in human capital development, continuously providing the specialized engineers, scientists, and technical experts necessary to sustain the aerospace workforce.

Configurational Analysis: A central finding of this study is that no individual driver on its own accounts for the competitive strength of European aerospace clusters. Rather, high-level innovation performance emerges from the synergistic interaction of three interconnected elements: industrial agglomeration, joint innovation networks, and strong institutional backing. While geographic concentration promotes knowledge sharing and access to specialized talent, collaborative partnerships speed up technological learning,

and institutional support supplies critical funding, financial stability, and strategic policy coordination. Missing any single component drastically diminishes a regional aerospace ecosystem's capacity to innovate. Ultimately, this configurational approach expands traditional cluster frameworks by proving that long-term competitiveness stems from the complementary interplay of economic, organizational, and institutional drivers rather than physical proximity alone.

Discussion of Findings: The results align with Porter's foundational arguments on the value of industrial clusters while simultaneously validating Boschma's assertion that physical closeness alone cannot maintain long-term innovation. Furthermore, the findings strengthen Cooke's Regional Innovation Systems theory by proving that structured institutional collaboration substantially boosts technological progress. Rather than analyzing these drivers in isolation as previous research has done, this study unifies industrial agglomeration, joint innovation networks, and institutional backing into a single cohesive model. This holistic approach offers a far more complete explanation of the forces driving competitive advantage throughout the European aerospace industry.

Conclusions. This study evaluated how industrial agglomeration, joint innovation networks, and institutional backing collectively influence performance in the European aerospace sector. Utilizing a configurational analytical approach, the findings confirm that long-term competitiveness depends on the combined synergy of economic, organizational, and institutional elements rather than mere physical closeness. Premier European hubs—such as Toulouse, Hamburg, Turin, and Seville thrive by combining specialized workforce pools and cutting-edge research facilities with active collaboration across industry, academia, research bodies, and public agencies. These interconnected relationships foster knowledge sharing, technological development, and continuous innovation, thereby bolstering Europe's global market standing.

Additionally, institutional support delivered via European Union programs, national policy frameworks, and regional initiatives plays an essential role in mitigating investment risks, incentivizing joint research, and accelerating technological progress. Recent industry shifts further highlight that digital integration, green aviation, and international partnerships are becoming critical determinants of sustained competitive advantage. The central contribution of this research is the formulation of an integrated framework that links agglomeration, network collaboration, and institutional governance, proving that innovation capacity stems from the complementary interaction of these factors rather than their separate effects.

While limited by its focus on established European hubs and reliance on secondary data, the study offers practical insights for policymakers and industry leaders working to optimize regional innovation systems. Future research could expand on these findings by incorporating primary empirical evidence, broader international comparative cases, or quantitative configurational techniques across diverse aerospace regions. Ultimately, preserving Europe's competitive edge in aerospace will necessitate sustained investments in joint innovation, institutional coordination, and sustainable industrial growth.

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Ethical Statement. The author confirms that this research was conducted in accordance with recognized standards of academic integrity and research ethics. The study relies exclusively on secondary data obtained from academic publications, institutional reports, industry documents, and publicly available sources and did not involve human or animal participants. Therefore, formal ethical approval was not required.

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Author Contributions. The author was fully responsible for the conceptualization of the study, literature review, methodological design, data collection and analysis, interpretation of results, preparation of the manuscript, revision of the text, and final approval of the submitted version.

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