

*Bárbara Marín-Cambronero¹, Isabel Martínez-Rodríguez², María Jesús Ruiz-Fuensanta³,
Fernando E. Callejas-Albiñana⁴

REASSESSING EUROPEAN CLUSTER POLICIES: DETERMINANTS OF EFFECTIVE POLICY FORMULATION

ABSTRACT: This study examines the determinants of effective cluster policy design in Europe, with the aim of identifying how governance, funding, and stakeholder engagement shape outcomes. We analyse 21 policy instruments across eight territories using a mixed-methods approach: expert-panel benchmarking, descriptive analysis with Eurostat and ECCP/ESCA data (2018–2022), and hierarchical cluster analysis of seven design factors. The results reveal five distinct policy archetypes, differentiated by budget scale, ERDF/S3 alignment, duration, and co-financing rules. Most instruments are ERDF-funded and S3-aligned, and a simple “political effort” measure, policy budget as a share of national GDP, proves useful for comparing territories of different economic sizes. Between 2018 and 2022, all territories expanded their cluster base, though persistent barriers remain, including bureaucracy, trust deficits, and limited managerial capacity. The findings highlight the importance of coherent governance, sustained funding, and active stakeholder involvement, and provide actionable recommendations for tailoring policy tools to cluster maturity. By clarifying constructs and reporting replicable measures, the paper advances transparency in cluster-policy evaluation and offers practical insights for policymakers, regional development agencies, and cluster managers.

KEYWORDS: *Cluster policy; Industrial policy; Regional development; Benchmarking; Policy design.*

RECEIVED 10 October 2025; **ACCEPTED** 23 January 2026.

INTRODUCTION

Cluster initiatives have become one of the central pillars of European industrial and innovation policy, serving as strategic instruments to foster competitiveness, cohesion and sustainability across territories. The creation of clusters (Delgado et al., 2016; Porter, 1990) is recognised as a crucial strategic element for sustainable and competitive development (Prahalad and

¹ *Assist. Prof. PhD, Department of Economics, University of Castilla-La Mancha, Ciudad Real, Spain, email: barbara.marin@uclm.es

² Department of Economics, University of Castilla-La Mancha, Ciudad Real, Spain

³ Department of Economics, University of Castilla-La Mancha, Ciudad Real, Spain

⁴ Department of Economics, University of Castilla-La Mancha, Ciudad Real, Spain

Krishnan, 2008). Within the European Union, cluster initiatives are embedded in public policy frameworks that promote industrial modernisation, regional cohesion and innovation-driven growth, notably through Smart Specialisation Strategy (S3) agendas and European Regional Development Fund (ERDF) programmes. Clusters thus operate not only as market-based agglomerations but also as policy platforms that coordinate firms, research organisations and public actors around shared transformation goals. They strengthen economic sectors by fostering cooperation across technology, research, institutions, information and business.

Recent analyses underline the growing complexity of cluster policy frameworks in the 2020s, particularly in balancing innovation, cohesion and sustainability objectives (Parrilli, 2023). Evidence from the EU highlights clusters as key instruments for competitiveness, resilience and the twin transition (ECCP, 2024; European Commission, 2024). They are increasingly central to industrial, innovation and business policies, enabling strategic complementarity and long-term economic strengthening (Wilson et al., 2022). Current development efforts emphasise innovation collaboration, internationalisation, digital and green transitions, and the professionalisation of cluster management. Yet persistent challenges remain, including institutional fragmentation, discontinuity of funding priorities, uneven stakeholder engagement in lagging regions and limited mechanisms for policy evaluation. Research suggests that policy effects depend heavily on instrument design and governance, rather than being automatic outcomes of clustering (Lehmann and Menter, 2018).

European territories are therefore expected to integrate cluster priorities into their strategic plans. However, defining and operationalising cluster policy remains difficult due to uneven understanding of its scope (Aragón et al., 2014). This reinforces the need to coordinate multiple policies within a territory and to establish mechanisms that support policymaking and strategic alignment (Fixari and Pallez, 2016). The literature also questions whether vibrant clusters can be engineered top-down, stressing the importance of tailoring policy tools to local dynamics and maturity (Vernay et al., 2018).

The European network of industrial clusters is progressively evolving (Franco et al., 2021; Hollanders and Merkelbach, 2020). In many regions, clusters have moved beyond theoretical constructs to become consolidated realities and critical components of innovation ecosystems and economic development (Mindlin et al., 2016; Raines, 2017). While some

territories have supported clusters for over three decades (Wilson, 2019), cross-regional differences in maturity and implementation capacity persist. This context motivates comparative approaches that identify transferable design lessons and good practices (Lazzeretti et al., 2019). Against this background, this paper undertakes a benchmarking analysis complemented by descriptive exploration of 21 cluster policy instruments implemented by eight European territories (2018 baseline; 2022 update). The study draws on a panel of experts representing eight public bodies in the territories, who provided corroborated programme information and contextual knowledge, enabling identification of design factors associated with more effective implementation. A mixed-methods approach is adopted, combining expert-based benchmarking, Eurostat data and cluster-network indicators, complemented by Ward's hierarchical cluster analysis. The main aim is to reassess European cluster policy instruments by identifying design characteristics that contribute to effective implementation and to derive policy archetypes that inform decision-making.

This paper contributes by shifting attention from cluster outcomes to policy design, offering a comparative framework to understand how governance, strategic alignment, stakeholder engagement and budgetary effort shape cluster development. The findings are particularly relevant for policymakers, regional development agencies and cluster managers seeking to design more coherent and effective cluster support schemes. The article is organised as follows: Section 2 reviews the relevant literature; Section 3 explains the methodology; Section 4 presents the results and discussion; and Section 5 concludes with implications, limitations and policy recommendations.

LITERATURE REVIEW

European cluster policies aim to promote cooperation between companies and research institutions, strengthening existing clusters and facilitating the emergence of new ones (Izsak et al., 2016). Rooted in long-term strategies that align public and private actors with industrial and Research, Development and Innovation (R&D&I) agendas, clusters act both as drivers of innovation and industrial upgrading and as mechanisms for territorial resilience against external shocks (Bhawsar, 2023; European Commission, 2024). While cluster policy is widely regarded as a strategic tool for sustainable growth (Aragón et al., 2014), its effectiveness remains contested due to conceptual ambiguity and limited evaluation mechanisms (Kuberska

and Mackiewicz, 2022; Rocha et al., 2019). Critical perspectives question whether government-led initiatives can generate authentic ecosystems or whether clusters emerge more organically (Vernay et al., 2018). Successful implementation requires attention to quantitative and qualitative regional characteristics (Grashof, 2021) to avoid economic lock-ins and policy inefficiencies (Njøs and Jakobsen, 2016).

Cluster policy is closely tied to the Smart Specialisation Strategy (S3) (Hassink and Gong, 2019; Ketels et al., 2013). Applying these instruments in isolation may lead to inefficiencies, and recent analyses highlight the increasing complexity of frameworks in the 2020s, particularly in balancing innovation, cohesion and sustainability goals (Parrilli, 2023). From an evolutionary economics perspective, cluster policies must be continuously adapted to new scenarios and societal demands rather than treated as fixed instruments (Flanagan, Uyarra, and Wanzenböck, 2022). EU strategic papers emphasise clusters' expected contribution to the digital and green transitions and to Europe's open strategic autonomy, reinforcing the need for coherent, mission-oriented governance (Golebiowska-Tataj, 2024). Yet, focusing support solely on strategic sectors with high externalities risks reinforcing advantages in already advanced regions (Dominique et al., 2012).

To ensure inclusiveness and effectiveness, a Triple Helix approach is recommended, fostering collaboration between universities, research organisations and businesses (Etzkowitz and Leydesdorff, 1998; Pique et al., 2018) and promoting a culture of Open Innovation (Chesbrough et al., 2006; Gassmann et al., 2010). Empirical studies confirm that university–industry collaboration under cluster schemes contributes to academic knowledge creation and regional innovation (Okamuro, Ikeuchi, and Kitagawa, 2025). At the same time, cluster policies must address coordination problems within sectors and value chains to support cohesive regional development.

Empirical evidence demonstrates clusters' significant territorial effects. They enhance competitiveness and innovation at both micro and macroeconomic levels (Feroва and Tanenkova, 2017; Tremblay, 2016), though outcomes depend on policy design, structure and continuity (Lehmann and Menter, 2018). Clusters generate increased scientific output, patent registrations and formal partnerships (Kleibrink and Mateos, 2017), stimulate SME creation (Graf and Broekel, 2020), and foster entrepreneurship by enabling knowledge spillovers that can lead to new firms and industries (Audretsch et al., 2016). Cluster membership improves firm competitiveness through shared infrastructure and access to innovation ecosystems

(Haasnoot and de Vaal, 2022), while geographical agglomerations intensify knowledge flows and collaborative dynamics (Bittencourt et al., 2023).

Globalisation of production and R&D has further reshaped regional economies, increasing interactions between local and non-local factors (Grillitsch et al., 2019). Specialised clusters contribute to territorial marketing, attract investment and enhance competitiveness. Public-sector support often facilitates bottom-up dynamics (Izsak et al., 2016), contrasting with top-down industrial policies that privilege perceived “winners”. Cluster impacts are context-specific, requiring attention to life cycles and maturity levels. Comparative evidence from Asia highlights alternative governance approaches, such as super-cluster strategies emphasising state coordination and foreign direct investment, contrasting with incremental European practice (Kowalski, 2020). Cross-regional analyses reinforce the need to tailor designs to institutional and economic conditions (Sopoligová and Pavelková, 2017).

Different types of cluster policies have distinct impacts depending on context. Building on Andersson et al. (2004), five broad categories can be identified: intermediation policies fostering Triple Helix collaboration; demand-promotion policies stimulating firm R&D&I; training policies enhancing excellence through specialised human capital; international-promotion policies facilitating access to foreign markets and investment; and environment policies stabilising macroeconomic and institutional conditions. These channels illustrate how cluster initiatives support innovation systems and regional upgrading.

The scale of clusters in Europe is considerable. They account for around 23% of economic transactions, and in 55% of regions they manage between 30% and 60% of business activity (Ketels and Protsiv, 2017). In 2020, 2,950 regional clusters were identified, generating 61.8 million jobs, one in four across the EU (European Cluster Observatory, 2020). Updated ECCP evidence confirms continued growth in cluster organisations, their employment footprint and their role in interregional value chains (ECCP, 2024). Specialised clusters achieve up to 25% higher productivity than non-cluster firms, with growth rates above the business average (Hollanders and Merkelbach, 2020). Recent crises, notably COVID-19 and the war in Ukraine, have reinforced clusters’ salience for resilience and the twin transition (Franco et al., 2021; Bianchini, Damioli, and Ghisetti, 2023). Clusters are expected to support the emergence of more specialised and sustainable industries, particularly by reinforcing the role of SMEs, which represent 99% of the European business fabric and account for two-thirds of new private-sector jobs. Eurobarometer data (2020) shows significant variation in SME integration:

50% of SMEs in Sweden operate within clusters, compared to 38% in Belgium and 36% in Spain, while the EU-27 average remains at 14%, highlighting uneven participation across member states.

METHODOLOGY

This study applies a three-step mixed-methods design that combines (i) expert-panel benchmarking of cluster-policy instruments, (ii) descriptive quantitative analysis using secondary statistics and cluster-landscape indicators, and (iii) hierarchical cluster method to derive policy archetypes. The approach integrates qualitative knowledge with comparable quantitative measures, enabling cross-territorial learning and actionable recommendations for cluster-policy design.

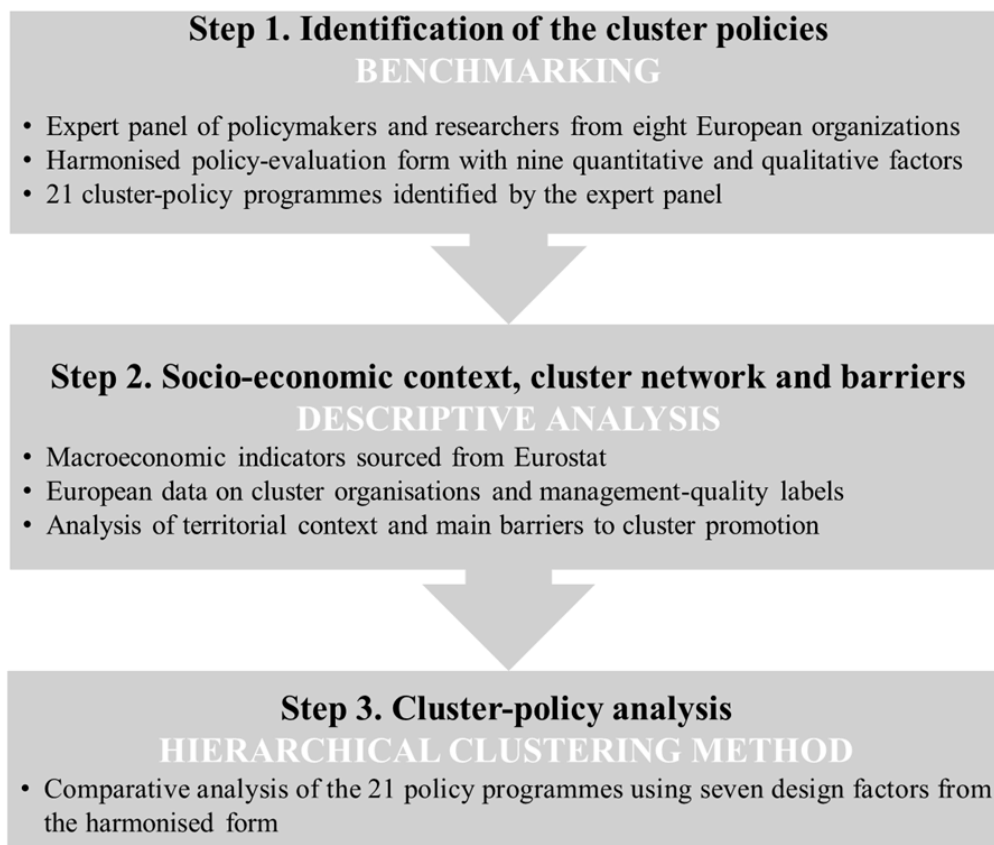


Figure 1: Research design and three-step analytical procedure

Source: Author's elaboration

Step 1. Identification of the cluster policies

Step 1 established the core dataset of cluster policies across the eight territories analysed. Data collection was conducted within the Interreg Europe project Fostering Clusters Interregional Collaboration and Integration into International Value Chains (ClusterFY, 2017-2022). The project consortium consisted largely of organisations with direct responsibilities in cluster, industrial and/or innovation policy: Agency for Science, Innovation and Technology (MITA, Lithuania); Northern Netherlands Provinces Alliance (SNN, the Netherlands); Municipality of Hudiksvall (MH, Sweden); Polish Agency for Enterprise Development (PARP, Poland); South Muntenia Regional Development Agency (SMRDA, Romania); University of Castilla-La Mancha (UCLM, Spain); Slovak Innovation and Energy Agency (SIEA, Slovakia); and Centre for Research and Technology Hellas (CERTH, Greece).

Expert panel composition and benchmarking procedure

Each partner institution nominated one delegated focal point to act as the primary expert for its territory and to coordinate data collection. These eight focal points formed the core expert panel (one per territory). Each focal point was supported by two to three collaborators within the same institution, who assisted with document retrieval, verification with relevant authorities and in-situ validation. In total, the panel comprised eight primary experts and between 16 and 24 supporting contributors. The panel combined diverse professional backgrounds: policy officers from regional development agencies, senior staff from national innovation agencies, municipal authorities with direct responsibilities in industrial policy, and academic researchers specialising in cluster governance. This ensured both territorial competence and policy-relevant expertise, as well as a balance between practitioner and scholarly perspectives. Experts were recruited through purposive sampling based on three criteria: (i) institutional mandate in cluster, industrial or Smart Specialisation (S3) policy; (ii) demonstrated professional experience in policy design, implementation and/or evaluation; and (iii) coverage of the eight study territories.

Partners identified and benchmarked 21 policy instruments aimed at fostering cluster development through cooperation-enhancing, competitiveness-oriented or innovation-supporting measures. For each instrument, partners collected primary programme documentation (legal texts, calls, guidelines, public budgets) and completed a harmonised benchmarking form (see Table 1). The form contained structured fields covering funding parameters, governance arrangements, alignment with S3, and territorial scope, enabling

systematic comparison across instruments. Intermediate cross-partner workshops were held to monitor progress, resolve coding ambiguities and ensure uniform interpretation of the form.

Table 1: Harmonised policy-evaluation form

Nature of information	Evaluated factor	Valuation scale
Quantitative information	[A] Total budget (€) Investment per policy instrument	Below-average or above-average Geometric mean 8,378,432 €
	[C] Duration of the programme (year)	From one to five years
	[E] Minimum funding per project (€) thresholds set empirically from the observed range (€1,000–€1,000,000 per project), covering the smallest to the most financially intensive programmes; coded as below-average or above-average	Below-average or above-average Geometric mean 68,117 €
	[G] Maximum funding per project (€) thresholds set empirically from the observed range (€10,000–€7,500,000 per project), covering the smallest to the most financially intensive programmes; coded as below-average or above-average	Below-average or above-average Geometric mean 316,446 €
Qualitative information	[B] ERDF funding	Yes, or not
	[D] Aligned with the S3	Yes, or not
	[F] Territorial scope	Regional or national
	[H] Aim and objectives	Descriptive
	[I] Eligible projects and costs	Descriptive

Source: Authors' elaboration

In addition, classifying territories by the maturity of their cluster-policy frameworks is a pivotal element of Step 1, because the expert-panel benchmarking relies on a shared baseline for comparison. Cluster-policy instruments are strongly path-dependent: the same design feature (e.g., budget scale, duration, ERDF/S3 alignment or co-financing rules) reflects different policy logics and feasibility conditions in developed, in-transition and lagging contexts. Establishing these categories at the outset makes the Step-1 dataset interpretable across heterogeneous territories, avoids one-size-fits-all readings, and provides the developmental lens needed to derive meaningful policy archetypes and stage-specific recommendations in later steps.

Table 2 summarises the territories and their level of cluster-policy progress, alongside the corresponding panel institutions.

Table 2: Classification of the analysed territories

Level of progress in cluster policies	Territory	Expert Panel
Developed Territories that have a long-standing history of implementing successful cluster policies and possess valuable knowledge based on their experience	Gävleborg (Sweden)	MH - Municipality of Hudiksvall
	Northern Netherlands (Netherlands)	SNN - Northern Netherlands Provinces Alliance
In transition Territories that have recently made notable efforts in cluster matters and are currently in the process of implementing policies to promote clusters	Lithuania	MITA - Agency for Science, Innovation and Technology
	Slovakia	SIEA - Slovak Innovation and Energy Agency (Slovakia)
	Poland	PARP - Polish Agency for Enterprise Development
Lagging Territories that need to undertake greater political involvement and make significant efforts to promote the cluster phenomenon in their areas of action	Central Macedonia (Greece)	CERTH - Centre for Research and Technology Hellas
	Sud-Muntenia (Romania)	SMRDA - South Muntenia Regional Development Agency
	Castilla-La Mancha (Spain)	UCLM - University of Castilla-La Mancha

Source: Authors' elaboration.

Step 2: Socio-economic context, cluster network, and barriers

Step 2 complemented expert benchmarking with secondary quantitative indicators and contextual qualitative evidence. First, Eurostat data for 2018 (the baseline year in which the policy instruments were active) were used to capture macro-economic conditions, including gross domestic product (GDP) and research and development (R&D) expenditure as a share of GDP (public and private). These variables provide a comparable reference for assessing each territory's socio-economic capability and their relative policy effort. We operationalise political effort as the total cluster-policy budget in 2018 divided by territorial GDP in the same year, expressed as a percentage. This size-neutral indicator is theoretically justified by the view that policy inputs should be evaluated in relation to the resources and production base they are intended to influence: the same nominal budget implies very different levels of commitment, and potential leverage, across large and small economies.

Empirically, using a budgeted to GDP ratio mitigates scale effects and outlier bias, allowing meaningful comparison across heterogeneous territories and policy systems. In this

way, political effort captures not only whether cluster policies exist, but the relative priority they receive within national or regional development strategies, supporting cross-territorial benchmarking of policy design and governance. Second, cluster-landscape indicators were extracted from the European Cluster Collaboration Platform (ECCP) database. The cluster inventory was updated to 2022 to examine whether the policy instruments benchmarked in 2018 aligned with subsequent changes in the territorial cluster base. Third, during Step 2 the expert panel reported the main barriers affecting cooperation in their ecosystems (regional or national), allowing comparison of implementation constraints across territories. These qualitative inputs inform the policy recommendations derived from the results.

Step 3: Cluster-policy analysis

Step 3 performed a joint comparative analysis of the 21 instruments through hierarchical cluster analysis using Ward's method. The analysis relied on seven design factors from the benchmarking form (A, B, C, D, E, F and G; see Table 1), selected because they capture the principal structural and funding features of the instruments. The objective was to identify groups of policies sharing similar design logics, enabling derivation of policy archetypes and design criteria associated with more effective implementation. Because territories differ markedly in economic size and funding scales, ratio-based quantitative indicators (except factor C) were summarised using the geometric mean. The geometric mean was computed by multiplying all positive values and taking the n-th root of the product, which provides an appropriate average for multiplicative data and limits distortion from extreme observations. In addition, two additional factors (H and I; see Table 1) were collected for descriptive purposes and to support qualitative interpretation of the clusters, but they were not included in the hierarchical clustering.

RESULTS AND DISCUSSIONS

Results are presented following the three analytical stages described in the Methods section, moving from descriptive benchmarking to contextual exploration and finally to the hierarchical clustering of policy-design features.

Step 1. Identification of the cluster policies

The 21 policy instruments benchmarked in this study (see Table 3) amount to a total budget of €343,375,000, covering the 2015–2020 period, with the ERDF as the predominant funding source. Twelve instruments operate at national level, while nine have a regional scope, as expected, regional instruments display smaller budgets than national schemes. Overall, ERDF funding accounts for 76% of the analysed programmes. All nine regional instruments with budgets above the geometric mean (€8,378,432) rely on ERDF support. Most national instruments are also above this threshold (nine out of twelve), and likewise ERDF-funded. By contrast, the four instruments not financed by ERDF are also not aligned with S3 priorities, consistent with EU conditionality linking ERDF cluster support to S3 frameworks in 2014–2020 and continuing in 2021–2027.

Table 1: European cluster policies identified by the expert panel

Territory	Policy programme (analysis code)	Scope
Castilla La-Mancha, Spain	<ul style="list-style-type: none"> • Collaborate Adelante (ES1) Order 23/06/2016, [2016/7109] 	Regional
Spain	<ul style="list-style-type: none"> • Interconnect (ES2) Order ECC/1780/2013, of 30 September 2018-2020 • Innovative Business Clusters (ES3) Order IET/1009/2016 of 20 June 	National
Region of Central Macedonia, Greece	<ul style="list-style-type: none"> • Support of clusters for the promotion of Entrepreneurship, Competitiveness, and Extroversion (GR1) Regional Operational Programme (ROP) of Central Macedonia Region 2017-2020 	Regional
Lithuania	<ul style="list-style-type: none"> • Inoklaster (LT1) European Union Structural Funds Investment Programme, 2014 – 2020 • Business Cluster (LT2) European Union Structural Funds Investment Programme, 2014 – 2020 • InoGeb (LT3) European Union Structural Funds Investment Programme, 2014 – 2020 	National
Northern Netherlands, Netherlands	<ul style="list-style-type: none"> • Open Innovation Call (NL1) ROP Northern Netherlands 2014-2020 • Human Capital (NL2) ROP Northern Netherlands 2014-2020 • Knowledge Development (NL3) ORP Northern Netherlands 2014-2020 	Regional
Poland	<ul style="list-style-type: none"> • Internationalisation Key National Clusters (PL1) Operational Programme (OP) 2014-2020 Intelligent Development 	National
Region of Mazovia, Poland	<ul style="list-style-type: none"> • Supporting and developing clusters and cluster initiatives (PL2) ROP Mazovia 2024-2020 	Regional

Romania	<ul style="list-style-type: none"> • Research, Technological Development, and Innovation to Support the Economic Competitiveness and Business Development (RM1) Competitiveness Operational Programme 2014-2020 Priority axis 1; Action 1.1.1 	National
Sud-Muntenia, Romania	<ul style="list-style-type: none"> • Promotion of technological transfer Innovation Entities (RM2) ROP Sud-Muntenia 2024-2020 Investment priority 1.1 Component A • Investments for SMEs to implement a research-innovation result in a partnership with a TTE (technological transfer entities) (RM3) ROP Sud-Muntenia 2024-2020 Investment priority 1.1 Component C 	Regional
Sweden	<ul style="list-style-type: none"> • Vinnväxt - Regional Innovation System (SU1) 2018-2028 • S3 pilot – Smart Specialisation through clusters (SU3) Operational Programme 2014-2020 	National
Gävleborg, Sweden	<ul style="list-style-type: none"> • Strengthening Research, Technological Development, and Innovation (SU2) 2014SE16RFOP006 ROP 2014-2020 Investment for growth and Jobs 	Regional
Slovakia	<ul style="list-style-type: none"> • Promote Industrial cluster organizations (EQ1) De minimis aid scheme (Scheme DM – 13/2017) 2017-2020 • Support the improvement of innovations performance of business entities and clusters (EQ2) De minimis aid scheme (Scheme DM - 10/2017) 2017-2020 • Support the development of the creative industry (EQ3) De minimis aid scheme (Scheme DM – 1/2018) 2018 – 2020 	National

Source: Authors' elaboration

Step 2: Socio-economic context, cluster network, and barriers

The socio-economic exploration reveals two broad territorial trajectories. Lithuania, Poland and Romania have a relatively recent history of cluster-policy implementation, whereas Spain and Sweden have pursued such policies for more than two decades. Nevertheless, regional capacity remains a decisive conditioning factor: Spain illustrates major within-country asymmetries between leading regions (e.g., Catalonia or the Basque Country) and lagging ones (e.g., Castilla-La Mancha). Similar internal concentration patterns are observed in Romania (Bucharest) and Lithuania (Vilnius). In smaller and more centralised systems such as Lithuania and Slovakia, cluster competences are less fragmented, enabling a more concentrated financial impulse and unified strategic direction. Eurostat data for 2018 (Table 4) show an average R&D intensity of 1.22% of GDP across territories (geometric mean), with Sweden (3.32%) and the Netherlands (2.13%) leading and Romania (0.50%) and Slovakia (0.83%) lagging behind. Enterprise-sector R&D intensity provides an additional proxy for private innovation capacity and helps contextualise policy effort: territories with higher

business R&D (notably Sweden and the Netherlands) display stronger absorptive conditions for cluster-policy instruments, whereas lower values in Romania, Lithuania and Slovakia suggest a greater reliance on public support to stimulate innovation activity.

The EU-27 average in 2018 was 2.18%, exceeded only by Sweden. These patterns are consistent with Step-1 maturity categories, as developed territories also exhibit stronger innovation investment. Importantly, GDP size does not map directly onto R&D effort: Spain has the largest GDP yet allocates a comparatively modest share to R&D, whereas Sweden and the Netherlands invest more intensively from smaller economic bases. Business R&D intensity is highest in Sweden (2.07%) and the Netherlands (1.21%), reinforcing the joint importance of public and private inputs in cluster formation and upgrading.

Table 2: Socioeconomic data by territory

	GDP (Million €)	R&D Investment (%GDP)	Enterprise sector R&D investment (%GDP)
Spain	1,203,859 €	1.24%	0.61%
Netherlands	773,987 €	2.13%	1.21%
Poland	499,004 €	1.20%	0.64%
Sweden	470,673 €	3.32%	2.07%
Romania	206,072 €	0.50%	0.29%
Greece	179,558 €	1.21%	0.51%
Slovakia	89,875 €	0.83%	0.41%
Lithuania	45,515 €	0.93%	0.35%
Geometric mean	275,435 €	1.22%	0.62%

Source: Authors' elaboration, based on Eurostat 2018

To compare public commitment to cluster policies across territories with very different economic sizes, Table 5 reports a size-neutral indicator of political effort, defined as the total 2018 budget allocated to cluster-policy instruments divided by territorial GDP in the same year, expressed as a percentage (cluster policy budget/GDP). This size-neutral percentage allows meaningful comparison across heterogeneous economies by controlling for scale effects. It captures relative prioritisation rather than absolute capacity and should be interpreted alongside private absorptive conditions (e.g., enterprise R&D intensity) and institutional maturity. A higher value indicates stronger policy emphasis but does not, by itself, imply superior outcomes. This operationalisation captures the relative priority given to cluster policies within national or regional development strategies, allowing meaningful benchmarking beyond nominal budget levels.

Political effort is highest in Lithuania (0.10%) and Slovakia (0.053%), suggesting that transition territories are devoting comparatively large shares of their economic base to advancing cluster policy, potentially facilitated by centralised governance. Romania (0.024%) also shows relatively high effort. By contrast, Greece records the lowest value (0.002%), indicating limited policy prioritisation. Developed territories such as Sweden (0.011%) and the Netherlands (0.007%) show moderate intensity, reflecting larger GDP bases and more consolidated policy mixes.

Table 3: Political effort in cluster policies

	Cluster policy budget	Political Effort
Spain	59,500,000 €	0.005%
Netherlands	52,000,000 €	0.007%
Poland	33,075,000 €	0.007%
Sweden	51,500,000 €	0.011%
Romania	50,300,000 €	0.024%
Greece	4,000,000 €	0.002%
Slovakia	47,400,000 €	0.053%
Lithuania	45,600,000 €	0.100%
Geometric mean	35,077,192 €	0.01%

Source: Authors' elaboration, based on Eurostat 2018

The potential effectiveness of political effort is explored by examining cluster-landscape data from the European Cluster Collaboration Platform (ECCP), comparing changes in the total number of clusters over time. According to ECCP records, the number of clusters increased in all territories between 2018 and 2022, with particularly strong expansion in the Netherlands and Lithuania. Sweden is the only case showing a decline in registered clusters (see Figure 2).

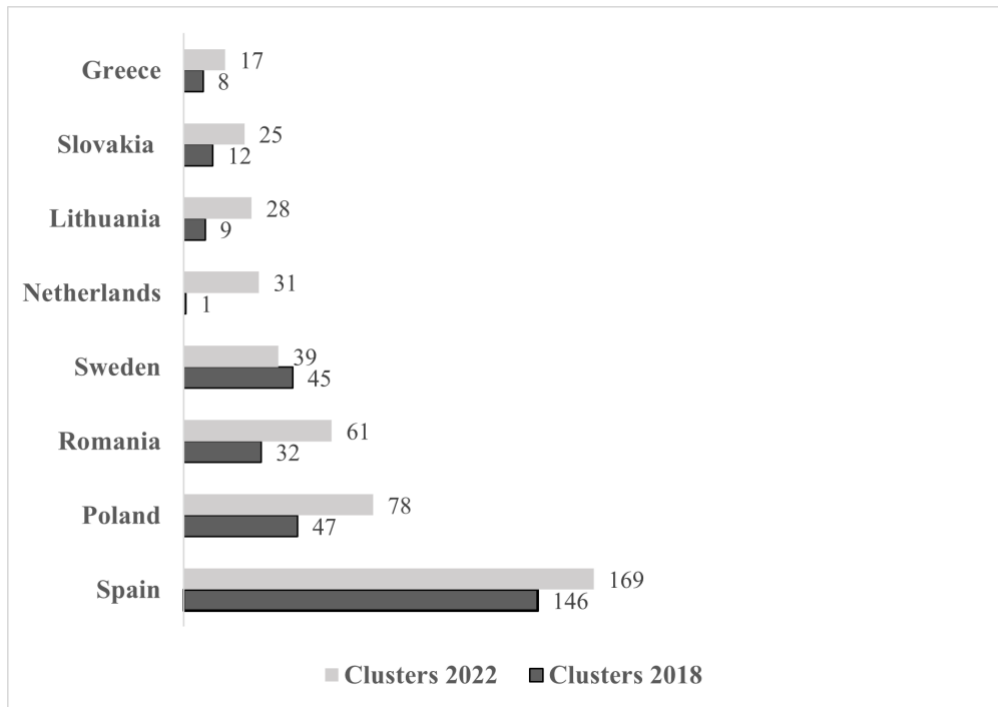


Figure 2: Total number of cluster by territory, 2018-2022

Source: Author's elaboration

It is also important to assess the quality of cluster organisations using European Cluster Excellence Initiative (ECEI) labels awarded through the ESCA system⁵. In 2022, the highest shares of labelled clusters were observed in Slovakia (64% of 25 clusters) and Romania (60% of 61 clusters), whereas Greece (29%), Poland (26%) and the Netherlands (25%) recorded the lowest proportions. Nevertheless, all territories show a clear increase in both the number of labelled clusters and the overall level of certification between 2018 and 2022 (see Figure 3). It should be noted that ECEI/ESCA labelling signals professional cluster management and increases visibility to partners and new business opportunities, but it is not a formal requirement for operating as a cluster organisation or for accessing European funding.

⁵ The European Cluster Excellence Initiative (ECEI), implemented through the European Secretariat for Cluster Analysis (ESCA) and currently operated within the EUCLES labelling system, provides a standardised benchmarking and quality-labelling scheme for cluster management organisations worldwide. It awards three labels: Bronze, Silver and Gold, after external assessment by trained, independent ESCA/EUCLES experts using a common set of management-quality indicators. The Bronze Label is granted after a structured benchmarking interview assessing cluster structure, governance, strategy, financing, services and achievements against 36 indicators. The Silver Label is awarded following a follow-up audit that verifies improvements made after bronze benchmarking, including an on-site validation. The Gold Label is the highest distinction and requires a full on-site assessment of advanced excellence standards. As of October 2022, there were 1,255 Bronze-labelled clusters from 46 countries, 170 Silver-labelled clusters from 26 countries and 133 Gold-labelled clusters from 18 countries. Here, "countries" refers to all countries in which labelled cluster organisations are located (EU and non-EU), not only EU Member.

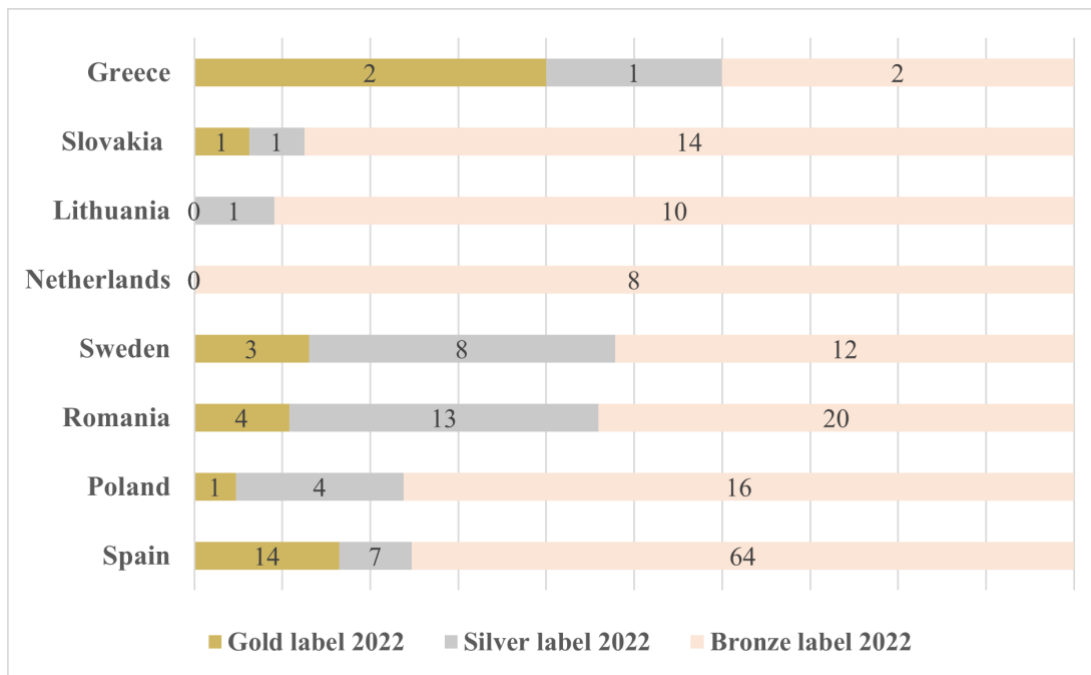


Figure 3: Cluster Excellence Label 2022 by territory

Source: Author's elaboration

Expert feedback highlights barriers that vary by maturity level. Developed territories prioritise internationalisation and integration into global value chains. Territories in transition require stronger support for commercialisation of products and services. Lagging regions face weak Triple Helix coordination and low awareness of cluster benefits. Four constraints recur across all territories: limited trust among actors, excessive bureaucracy for accessing funds, discontinuity of priorities and R&D efforts, and shortages of specialised cluster-management skills.

Step 3: Cluster-policy analysis

Step 3 applies hierarchical cluster analysis using Euclidean distances and Ward's minimum-variance linkage to identify subgroups within the 21 policy programmes. Ward's method iteratively merges instruments so as to minimise within-cluster variance and maximise between-cluster heterogeneity, making it suitable for detecting distinct design logics in a heterogeneous policy set (Morissette and Chartier, 2013; Yim and Ramdeen, 2015).

The clustering uses seven benchmarking factors (A, B, C, D, E, F and G; Table 2). Five policy groups⁶ emerged (with three instruments excluded), as shown in Figure 4.

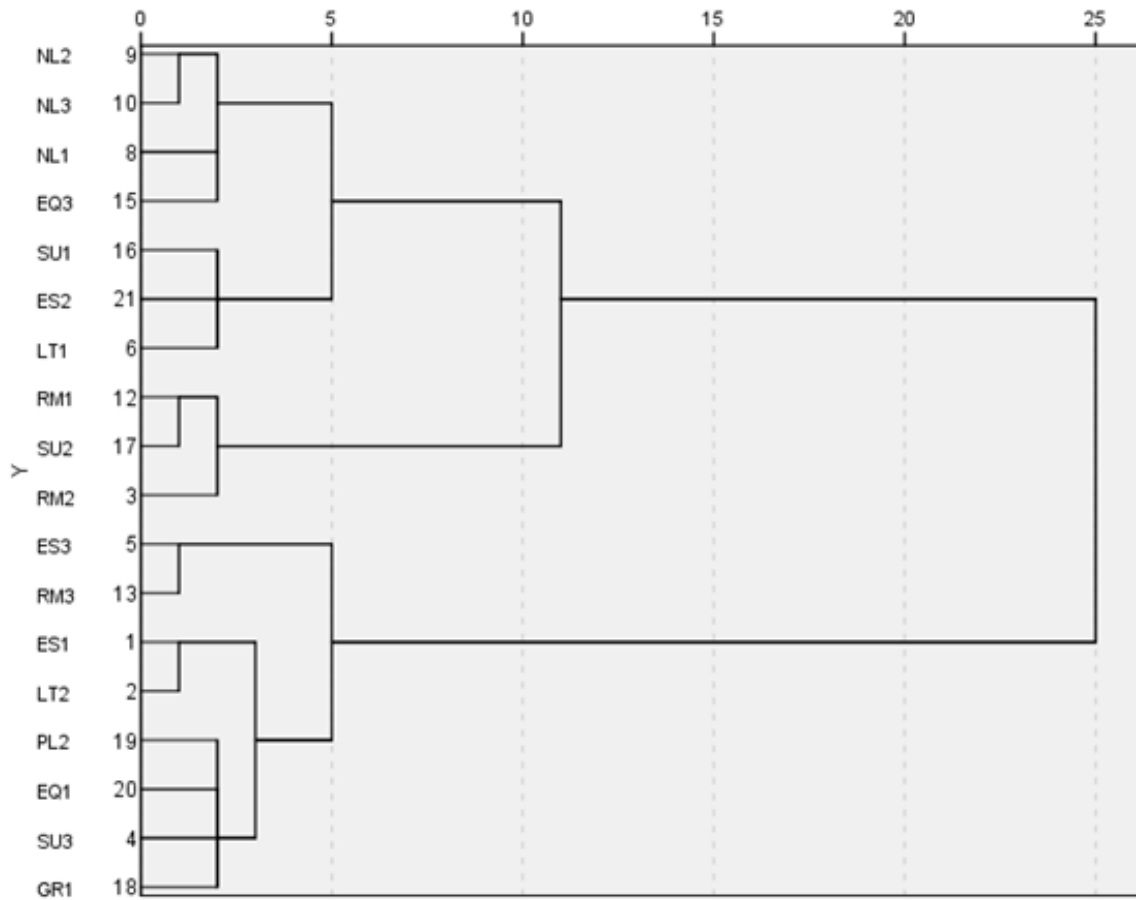


Figure 4: Cluster policy dendrogram

Source: Author's elaboration

Their characteristics are summarised in Table 6.

Table 4: Characteristics of the cluster policy groups

Group / Code	Main characteristics of grouping
Group 1 (NL2; NL3; NL1; EQ3)	Medium-to-large ERDF-funded, S3-aligned programmes (€14m+), running over 3–4 years. They cap maximum project funding, focus on SME innovation and networking, and require substantial co-financing (typically 40–60% private resources).

⁶ See Table 3 for more information about the policy programme (analysis code).

Group 2 (SU1; ES2; LT1)	High-budget national programmes (€18m+), implemented through competitive calls. Projects are co-financed on a 50/50 basis, with individual budgets of €0.5–4m and long eligibility horizons (3–10 years). They primarily support innovation projects led by existing clusters and, secondarily, the formation of new clusters in S3 priority sectors.
Group 3 (RM1; SU2; RM2)	Long-term ERDF-funded, S3-aligned programmes (five years) financing shared R&D infrastructure and upgrading of common facilities (up to €3m per project). Funding approval requires a strategic project plan.
Group 4 (ES3; RM3)	Short-term ERDF-funded, S3-aligned schemes (one year) supporting operational and organisational costs of mature clusters (e.g., staff, utilities, equipment, intangible assets) through competitively awarded subsidies.
Group 5 (ES1; LT2; PL2; EQ1; SU3; GR1)	Small-budget programmes (below the geometric mean; ≤€4m), mostly non-ERDF and weakly connected to S3 priorities. They fund relatively small projects with higher public shares (up to 70%) and focus on soft measures such as information transfer, expert services, cluster promotion, and participation in international projects and networks.

Source: Authors' elaboration.

Across groups, instruments converge around innovation support and competitive allocation, but they differ systematically in budget intensity, time horizon, target maturity and ERDF–S3 alignment. Eligible costs are broadly organised into six recurrent categories: R&D infrastructure; feasibility studies; personnel; equipment; contractual research/knowledge and patents; and networking, promotion and marketing providing a common operational frame for cluster-policy implementation.

DISCUSSION

The five archetypes derived from the hierarchical clustering confirm that EU cluster policies are not a uniform toolkit but a differentiated set of instruments whose logic varies systematically with budget scale, duration, co-financing requirements and ERDF–S3 alignment. This heterogeneity reinforces recent arguments that cluster policy in the 2020s has become increasingly complex and must reconcile innovation, cohesion and sustainability objectives under diverse territorial conditions (Parrilli, 2023). It also echoes earlier findings that policy performance depends less on the mere existence of support and more on how instruments are configured and governed over time (Lehmann and Menter, 2018). Across the sample, most instruments are ERDF-funded and aligned with Smart Specialisation Strategy priorities, confirming the structural coupling between cluster policy and S3 highlighted in earlier work (Hassink and Gong, 2019; Ketels et al., 2013). Groups 1–4 represent variants of this ERDF–S3 policy mix, differing mainly in time horizon and target maturity: from

medium-term SME innovation and networking support (Group 1), to high-budget national calls supporting both established and emergent clusters in S3 sectors (Group 2), to long-term infrastructure-oriented schemes requiring strategic project plans (Group 3), and short-term operational support for mature clusters (Group 4). By contrast, Group 5 aggregates small-budget, often non-ERDF and weakly S3-connected instruments oriented towards softer coordination and internationalisation activities. This split resonates with critical perspectives showing that governance capacity and strategic anchoring determine whether public initiatives lead to authentic ecosystems or remain symbolic gestures (Vernay et al., 2018; Kuberska and Mackiewicz, 2022).

Political effort, operationalised as the ratio of cluster-policy budgets to territorial GDP, provides a more meaningful measure of public commitment across heterogeneous economies. The finding that transition territories such as Lithuania, Slovakia and Romania show higher political-effort shares than larger developed economies illustrates that relative prioritisation can diverge from absolute resource endowments. This supports the argument that cluster policy should be interpreted through intensity and strategic priority, not nominal scale alone (Lehmann and Menter, 2018). At the same time, higher political effort does not automatically translate into stronger outcomes; it operates within wider innovation systems and private-sector absorptive capacity. The contrast between high political effort and lower business R&D intensity in some territories underlines that cluster development depends on a combined public–private policy mix, consistent with Triple Helix and open-innovation perspectives (Etzkowitz and Leydesdorff, 1998; Chesbrough et al., 2006; Gassmann et al., 2010).

Experts consistently identified trust deficits, bureaucracy, discontinuity of priorities and shortages of specialised cluster-management skills as cross-cutting barriers. These findings mirror recurrent coordination and evaluation challenges in multi-actor, multi-level cluster settings (Aragón et al., 2014; Fixari and Pallez, 2016; Rocha et al., 2019). They also reinforce calls from evolutionary and problem-oriented policy perspectives to treat cluster instruments as adaptive, learning-based frameworks rather than fixed toolkits (Flanagan et al., 2023). In practice, this implies that sustained governance coherence and iterative monitoring are as critical as funding volumes, particularly in lagging and transition territories where institutional fragmentation is more acute. Finally, the maturity lens supports comparative arguments beyond Europe. Asian “super-cluster” strategies rely on strong state

coordination and foreign-investment leverage (Kowalski, 2020), whereas European practice is more decentralised and tied to cohesion and S3 conditionality. Systematic Europe–Asia comparisons show that policy categories are shared, but governance logics differ, reinforcing the need for context-aware design rather than one-size-fits-all prescriptions (Sopoligová and Pavelková, 2017).

CONCLUSION

This study advances cluster-policy research by shifting the analytical focus from outcomes to instrument design, using a mixed-methods assessment of 21 programmes across eight European territories. The resulting typology of five policy archetypes demonstrates that European cluster support is not a homogeneous toolkit, but a differentiated policy mix structured by funding scale, time horizon, co-financing rules and ERDF–S3 alignment. Introducing a political-effort indicator (cluster-policy budget as a share of GDP) enables a size-neutral comparison of public commitment across heterogeneous economies. Together, these contributions provide a replicable framework for cross-territorial learning and more transparent evaluation of cluster-policy configurations.

Policy implications

The findings suggest three implications for cluster-policy design in Europe.

- First, instruments should be matched to territorial maturity and capability. Long-term, infrastructure- and capability-building schemes are most suitable where governance capacity and cluster critical mass are already present, while early-stage ecosystems benefit more from softer intermediation and network-building tools, consistent with the need for life-cycle-sensitive policies (Parrilli, 2023; Vernay et al., 2018).
- Second, strategic alignment and continuity matter. The predominance of ERDF-funded and S3-aligned instruments among the more resource-intensive archetypes indicates that cluster policies gain traction when embedded in broader industrial-innovation frameworks and supported by stable funding over time (Hassink and Gong, 2019; Lehmann and Menter, 2018).
- Third, governance quality and professionalisation are necessary complements to funding. Rising ESCA/ECEI label uptake signals growing attention to management

standards, yet expert evidence shows that trust-building, reduced administrative burden and specialised managerial capacity remain prerequisites for effective policy leverage (Aragón et al., 2014; Fixari and Pallez, 2016).

In line with these implications, Figure 5 synthesises the main barriers identified by the expert panel and the corresponding policy responses. Specifically, trust deficits call for intermediation policies that establish capable intermediary organisations linking territorial actors; excessive bureaucracy highlights the need for governance policies that streamline and co-design instruments with stakeholders; short-term and discontinuous R&D&I priorities require coordination policies to align S3, industrial and innovation agendas under a long-term strategy; low participation in global value chains points to promotion policies supporting cluster internationalisation and interregional partnerships; and skills gaps in cluster management justify training policies focused on professionalisation, networking and dissemination.

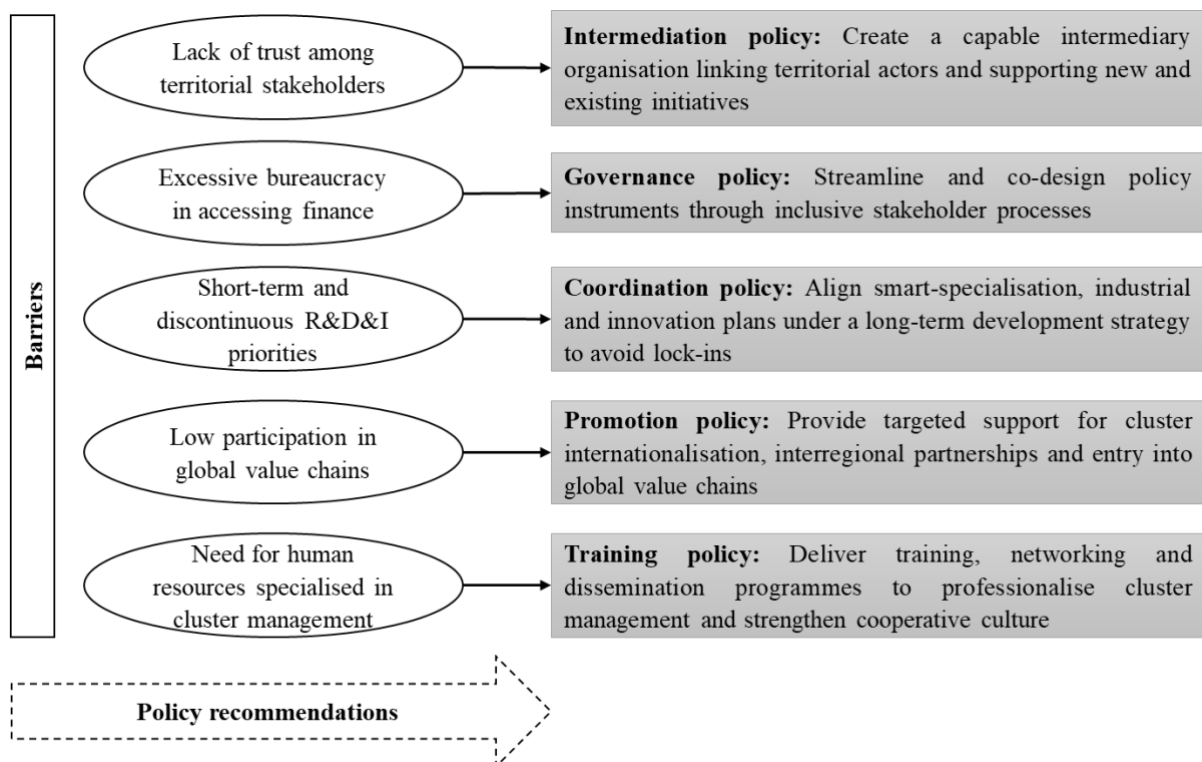


Figure 5: Key barriers to cluster development and policy recommendations

Source: Authors' elaboration.

Overall, the study confirms that cluster development depends on a combined public-private policy mix and on regionally embedded capabilities rather than on nominal resource scale alone. Political effort is informative when interpreted alongside governance coherence and private-sector absorptive capacity. By clarifying design archetypes and connecting them to implementation barriers, the article provides actionable guidance for policymakers, regional development agencies and cluster managers seeking to strengthen cluster upgrading under the twin transition and competitiveness agendas.

Limitations of the research

This study has several limitations. First, the comparison of national and regional instruments may be affected by differences in territorial scope and budget size, although ratio-based indicators (e.g. geometric means) were used to mitigate scale distortions. Second, the Eurostat data employed were provisional at the time of extraction, so minor deviations from revised figures may exist, though they are unlikely to alter cross-territorial patterns. Third, expert-panel benchmarking relied on purposive sampling within the ClusterFY consortium; while this ensured policy-relevant expertise, it may not capture the full diversity of European cluster policies. Fourth, cluster-landscape and excellence indicators were drawn from administrative databases (ECCP, ECEI/ESCA), which evolve over time and have since transitioned to EUCLES, requiring caution in future replications. Future research should therefore broaden data collection, incorporate longitudinal programme evaluations, and extend cross-country comparisons beyond Europe. Refining evaluation methods to integrate both design and performance dimensions would strengthen the robustness of comparative insights and advance the study of cluster-policy instruments.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the valuable contributions provided by the partner institutions participating in the ClusterFY project, whose information and collaboration were essential to the development of this study. The publication of this article was supported by the University of Castilla-La Mancha through the funding line 250121CONV “Observatorio Ciudad Real Avanza”.

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