

Typologies of Startup Support Ecosystems in the Age of Digital and Green Transitions: A Cluster-Based Comparative Analysis

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Abstract:

Startup ecosystems are increasingly shaped by the dual imperatives of digital transformation and sustainable development. Within these ecosystems support agencies can be seen as the main actors in structuring entrepreneurial dynamics and mediating the access to critical resources. Yet, the existing studies often rely on fragmented indicators or ranking methods which provide very limited insight on how these agencies jointly organize the ecosystem responses. This paper adopts an exploratory quantitative approach to identify typologies of startup support ecosystems based on institutional configurations of support agencies. Using secondary data from international sources, a multidimensional indicator framework capturing support infrastructure, digital transition capacity as well as sustainability orientation and governance quality is constructed. The Principal Component Analysis is employed to derive latent ecosystem dimensions followed by hierarchical cluster analysis to uncover different ecosystem profiles. The findings reveal heterogeneous startup support ecosystem typologies characterized by the different combinations of digital maturity, green orientation and institutional coordination with comparative insights drawn from Algeria and the UK.

Keywords: Startup ecosystems; Support and accompaniment agencies; Digital transition; Green transition; Cluster analysis; Institutional typologies.

Jel Classification Codes : L26 ; O31 ; Q55.

Résumé:

Les écosystèmes de startups sont de plus en plus façonnés par les impératifs conjoints de la transformation numérique et du développement durable. Dans ces écosystèmes, les agences de soutien jouent un rôle central dans la structuration des dynamiques entrepreneuriales et dans l'accès aux ressources critiques. Cependant, les études existantes s'appuient souvent sur des indicateurs fragmentés ou des méthodes de classement, offrant une compréhension limitée de la manière dont ces agences organisent collectivement les réponses aux transitions numérique et verte. Cet article adopte une approche quantitative exploratoire pour identifier des typologies d'écosystèmes de soutien aux startups, basées sur les configurations institutionnelles des agences. À partir de données secondaires internationales, un cadre multidimensionnel d'indicateurs est construit, intégrant l'infrastructure de soutien, la capacité de transition numérique, l'orientation durable et la qualité de la gouvernance. L'analyse en composantes principales permet d'extraire les dimensions latentes de

l'écosystème, suivie d'une analyse hiérarchique par clusters pour révéler différents profils d'écosystèmes, avec des comparaisons entre l'Algérie et le Royaume-Uni.

Mots clés: *Écosystèmes de startups ; Agences de soutien et d'accompagnement ; Transition numérique ; Transition verte ; Analyse par clusters ; Typologies institutionnelles.*

Jel Classification Codes : *L26 ; O31 ; Q55.*

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I. Introduction

Startup ecosystems have emerged as a critical analytical framework for understanding innovation driven growth, technological diffusion and entrepreneurial dynamism in the contemporary economies (Stam & Van De Ven, 2021; Kayser et al., 2023). These ecosystems go beyond the individual firms and involve a complex constellation of institutions, policies, networks and support mechanisms that jointly determine and shape the entrepreneurial outcomes (Alzamel, 2024). In recent years, two structural transformations have profoundly redefined the operating environment of startup ecosystems namely the acceleration of digital transformation and the increasing centrality of sustainability and green transition objectives within the economic policy agendas (Florek-Paszkowska & Ujwary-Gil, 2025).

Within this evolving context, support and accompaniment agencies including incubators, accelerators as well as public innovation agencies and the hybrid public-private structures occupy a strategic position (Hausberg & Korreck, 2020; Razika et al., 2025). These organizations do not simply provide technical or financial assistance to startups but they actively structure the ecosystem by coordinating actors, reducing uncertainty and aligning the entrepreneurial activities with the broader digital and environmental policy goals (Alzamel, 2024). As such, understanding how these agencies are configured and embedded within national ecosystems is very essential for assessing ecosystem adaptability and long term sustainability.

Although research on startup ecosystems is increasing, two significant limitations persist. First, much of the existing research evaluates the ecosystem performance through fragmented indicators or program specific outcomes often focusing on startup survival rates and funding volumes or innovation outputs in isolation. While informative, such approaches provide very limited insight into the systemic configurations through which support agencies collectively shape the ecosystem dynamics, under conditions of digital and green transition. Second,

comparative studies are often based on ranking or benchmarking which implicitly presuppose that development trajectories in various ecosystems are homogeneous, thus obscuring structural heterogeneity between ecosystems with varied institutional logics.

This gap is mostly evident in comparative analyses between advanced and emerging economies. Countries such as the United Kingdom have developed relatively sophisticated, mature and diversified startup support infrastructures increasingly oriented toward digital innovation and the sustainability driven entrepreneurship. In contrast, other economies like Algeria are characterized by evolving institutional frameworks, stronger state involvement and transitional support mechanisms which indicate the different historical, regulatory and policy contexts. Instead of explaining and interpreting these differences in terms of linear development, analytical approaches that are able to capture specific ecosystem arrangements without imposing normative hierarchies are needed.

Responding to this need, the present paper adopts a typological perspective to examine startup support ecosystems in the age of digital and green transitions. Instead of evaluating individual programs or ranking countries the paper seeks to identify the coherent ecosystem typologies based on the institutional configurations of support and accompaniment agencies. Drawing exclusively on secondary data from international sources, a multidimensional indicator framework is constructed to capture the key aspects of support infrastructure, digital transition capacity as well as sustainability orientation and governance quality.

Methodologically, the study employs an unsupervised quantitative approach combining the PCA and hierarchical cluster analysis. The Principal Component Analysis is used to minimize the dimensional complexity of the indicator set and extract the underlying ecosystem dimensions while cluster analysis enables the identification of groups of countries sharing similar institutional configurations. This approach makes it possible to analyze and reveal ecosystem heterogeneity and discover the structural patterns that remain hidden in conventional evaluation frameworks.

In this context, the main research question guiding this study is as follows

How can startup support ecosystems be systematically classified into distinct typologies based on the institutional configurations of support and accompaniment agencies in the context of digital and green transitions?

The contribution of this paper is threefold. First, it advances the startup ecosystem literature by shifting the analytical focus from individual support instruments to system level configurations of support and accompaniment

agencies. Second, it integrates digital and green transition dimensions into a unified analytical framework, reflecting the dual transformation currently shaping entrepreneurial ecosystems. Third, the study offers policy relevant insights into how different institutional models of startup support can influence ecosystem adaptability and coherence, by providing a comparative interpretation with reference to Algeria and the United Kingdom.

II. Literature Review

II.1 Startup Ecosystems and the Role of Support and Accompaniment Agencies

Startup ecosystems have become an increasingly prominent concept for explaining the combination of factors that enable entrepreneurial activity and innovation-based growth (Yovera et al., 2025). Rather than focusing solely on individual firms, the ecosystem perspective emphasizes the interactions among a diverse set of actors including entrepreneurs, support organizations, financial institutions as well as universities and public authorities (Umar et al., 2025). Within this configuration, support and accompaniment agencies such as incubators, accelerators alongside technology parks and public innovation bodies are widely recognized as key intermediaries that facilitate resource mobilization, capability development and network formation for the startups (Eslamloo et al., 2025).

Existing studies highlight that these agencies perform multiple functions ranging from mentorship and capacity building to access facilitation for finance, markets and technological infrastructure (Cohen et al., 2019; Seitz et al., 2025). Beyond service provision they contribute to ecosystem structuring by coordinating actors, reducing the institutional uncertainty and aligning entrepreneurial activities with the national innovation strategies (Yovera et al., 2025). In emerging and transition economies, support agencies often play an even more pronounced and visible role compensating for institutional voids and market imperfections through state led or hybrid support mechanisms (Negri et al., 2025).

However, much of the literature examines support and accompaniment agencies at the organizational level, assessing their effectiveness through indicators such as startup survival rates, employment creation or funding raised. While these analyses offer valuable insights they tend to overlook how different support agencies interact, combine and integrate to form broader configurations at the ecosystem level. As a result, the systemic role of support agencies in shaping startup ecosystems remains insufficiently theorized and empirically explored particularly from a comparative perspective.

II.2 Digital Transition and the Transformation of Startup Support Ecosystems

Digital transformation has fundamentally reshaped the entrepreneurial processes by changing the way startups are created, supported and scaled (Bejjani et al., 2023). Advances in digital infrastructure, platform technologies and data-driven governance have enabled new forms of the entrepreneurial support including virtual incubation, online mentorship as well as digital matchmaking and e-government services tailored to startups (Usman & Sun, 2023; Máté et al., 2024). As a result, support and accompaniment agencies are being further pressured to refine and adapt their operational models and service delivery mechanisms to ensure the effectiveness in a digitally intensive environment (Czaja & Kafel, 2025).

The literature suggests that digitally advanced ecosystems benefit from more adequate efficient coordination, lower transaction costs and enhanced scalability of support services (Bejjani et al., 2023). Digital tools also enable support agencies to reach a broader and more diverse population of entrepreneurs potentially improving inclusiveness and ecosystem connectivity (Gumbo & Moos, 2025). At the ecosystem level, digital transition is therefore not limited to technological adoption but it reflects deeper institutional changes in how support is well organized, governed and delivered (Colovic et al., 2024).

Nevertheless, the degree of digital integration within the startup support ecosystems varies considerably across countries (Kayser et al., 2023). While advanced economies tend to have mature and sophisticated digital support infrastructures that are deeply integrated into coherent policy frameworks, emerging economies face several issues related to digital readiness, institutional capacity and uneven distribution of access to digital resources (Kayser et al., 2023; Gumbo & Moos, 2025). Existing studies frequently analyze digital entrepreneurship outcomes but pay limited attention to how digital transition reshapes the institutional configurations of support agencies themselves leaving an important gap in ecosystem level understanding.

II.3 Green Transition and Sustainability-Oriented Startup Support

In parallel with digital transformation sustainability and green transition objectives have become central to the contemporary economic and innovation policies (Lamperti et al., 2025). Startup ecosystems are increasingly expected to contribute to the environmental goals through the promotion of green technologies, sustainable business models and eco innovation (Omri & Al-Qasir, 2025). In this context, support and accompaniment agencies play a critical and significant role in orienting the entrepreneurial activity toward sustainability by

providing targeted incentives, specialized mentorship and access to green finance mechanisms (Brás & Robaina, 2025).

Research on sustainability oriented entrepreneurship emphasizes the importance of institutional support in reducing the risks associated with green innovation which often involves higher uncertainty, longer development cycles and regulatory complexity (OECD, 2022). Public agencies mostly are seen as pivotal in aligning startup support with the environmental policy objectives and in fostering coordination between innovation and sustainability agendas (Ninh & Hue, 2025).

Despite this growing attention the integration of green transition dimensions in the startup ecosystem analyses still fragmented. Many studies focus on the green startups as a specific subset of the entrepreneurial activity without examining how sustainability considerations are embedded within the broader ecosystem of the support and accompaniment agencies. Consequently, very few is known about how different ecosystems structurally integrate green orientation alongside digital transformation or how these dual transitions interact at the institutional level.

II.4 Toward a Typological Approach to Startup Support Ecosystems

While the startup ecosystem literature has expanded rapidly, it still dominated by evaluative and ranking based approaches that implicitly assume the linear development trajectories (Komlósi et al., 2024). Such approaches often conceal and obscure structural diversity and fail to recognize and capture the coexistence of multiple viable ecosystem models shaped by distinct institutional, policy and developmental contexts (Correia et al., 2024). This limitation is specifically salient and significant in comparative analyses between advanced and emerging economies where differences are frequently interpreted and considered as deficits instead of alternative configurations (Hess et al., 2025).

Typology building offers a very promising alternative by focusing on the identification of coherent ecosystem configuration rather than hierarchical performance comparisons. By grouping ecosystems based on shared structural characteristics typological approaches enable a more nuanced and detailed understanding of how support and accompaniment agencies, digital capacity and sustainability orientation combine to shape entrepreneurial environments. Quantitative methods, which are unsupervised like the PCA and cluster analysis, are particularly well suited to this purpose as they allow the latent dimensions and patterns to emerge from multidimensional data without imposing predefined assumptions.

However, despite their potential, typology oriented analyses are still

underutilized in the study of startup support ecosystems particularly in relation to the dual challenges of digital and green transitions. Existing research rarely incorporates these dimensions in a single analytical framework nor does it systematically analyze and assess the differences in support agency configurations across institutional contexts.

II.5 Research Gap and Positioning of the Study

In light of the above, three interrelated gaps can be identified in the literature. First, there is a lack of ecosystem level analyses that conceptualize support and accompaniment agencies as part of the broader institutional configurations rather than isolated programs. Second, digital and green transitions are often examined separately with the limited attention to their joint implications for startup support ecosystems. Third, comparative studies remain highly dependent on ranking and benchmarking approaches leaving structural heterogeneity largely unexplored.

Addressing these gaps the present study adopts a typological and exploratory perspective to examine the startup support ecosystem in the age of digital and green transitions. By employing the multidimensional indicator framework and unsupervised clustering techniques this paper seeks to uncover distinct ecosystem typologies based on the institutional configurations of support agencies with particular comparative insights drawn from Algeria and the United Kingdom.

III. Data and Methodology

III.1 Data Sources and Unit of Analysis

This study relies exclusively on secondary data drawn from internationally recognized databases to ensure cross-country comparability and methodological robustness. The unit of analysis is the national startup support ecosystem conceptualized as a system of institutions, policies and support agencies that collectively shape and define entrepreneurial activity.

Data are compiled from different sources including the World Bank, the Organization for Economic Co-operation and Development (OECD), the United Nations (UN) and the International Telecommunication Union (ITU). These sources provide standardized indicators capturing the institutional quality, digital infrastructure as well as sustainability orientation and innovation support mechanisms. To minimize the temporal inconsistencies indicators are harmonized over a common reference period, and where necessary averaged across recent years.

The comparative interpretation of the results focuses in particular on Algeria and the United Kingdom which represent contrasting institutional contexts in terms of startup support structures, governance models and transition dynamics. However, the empirical analysis is conducted on a broader set of countries in order to ensure sufficient variability for typology construction.

III.2 Indicator Construction and Normalization

To capture the multidimensional nature of startup support ecosystems a composite indicator framework is constructed around four analytical dimensions namely support and accompaniment infrastructure, digital transition capacity, green and sustainability orientation and institutional governance and coordination.

Table (01): Multidimensional Indicators of Startup Support Ecosystems

Dimension	Example Indicators	Description / Purpose
Support & Accompaniment Infrastructure	Number of incubators, accelerators, tech parks; Availability of mentorship programs	Measures the availability and accessibility of institutional support for startups
Digital Transition Capacity	E-government services for startups, Digital infrastructure, Digitalized service delivery by support agencies	Captures the ability of ecosystems to leverage digital technologies in supporting startups
Green & Sustainability Orientation	Green innovation support programs, Environmental policy stringency, Availability of sustainable finance	Reflects the extent to which ecosystems integrate sustainability and green transition goals
Institutional Governance & Coordination	Regulatory quality, Public-private collaboration, Policy coherence	Captures the coordination and governance mechanisms structuring the ecosystem

Source: Compiled by the author based on indicators described in the RP and standard startup ecosystem literature (World Bank, OECD, ITU, UN)

Each dimension, through a set of observable indicators obtained from the aforementioned databases, is operationalized. Given differences in measurement scales and units all indicators are normalized prior to analysis.

Following standard practice in multivariate analysis z-score normalization is applied:

$$Z_{ij} = \frac{X_{ij} - \mu_j}{\sigma_j}$$

Where X_{ij} denotes the value of indicator j for country i , and μ_j and σ_j represent the mean and standard deviation of indicator j respectively.

This transformation ensures that all the indicators are equally important to the analysis and that variables with larger and more extreme variances do not overly affect the outcome.

III.3 Principal Component Analysis

Given the high dimensionality of the selected indicators and the possibility of collinearity between them, Principal Component Analysis (PCA) is utilized as a data reduction technique. PCA transforms the original set of correlated variables into smaller uncorrelated components that capture and explain the maximum variance in the data.

Formally, each of the principal components PC_k is defined and characterized as a linear combination of the standardized indicators

$$PC_k = \sum_{j=1}^p a_{kj} Z_j$$

Where a_{kj} represents the loading of indicator j on component k and p denotes the total number of indicators.

The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity are used to determine and assess the suitability of the data for PCA. Components are held according to Kaiser Criterion (eigenvalues more than one) and cumulative explained variance. A Varimax rotation is applied to facilitate interpretability allowing for clearer identification of latent ecosystem dimensions such as digital capacity, sustainability orientation and institutional coordination.

The resulting component scores act as synthetic representations of the underlying ecosystem characteristics, constitute and serve as the input data variables for the subsequent cluster analysis.

III.4 Cluster Analysis and Typology Construction

To identify distinct startup support ecosystem typologies, hierarchical cluster analysis is performed on the PCA derived component scores. Hierarchical clustering is especially well adapted to the exploratory typology building as it does not require prior specification of the number of clusters and provides a transparent visualization of cluster formation.

The analysis employs the minimum variance technique of Ward in combination with Euclidean distance. The Euclidean distance between two countries i and l is defined as

$$d(i, l) = \sqrt{\sum_{k=1}^K (PC_{ik} - PC_{lk})^2}$$

Where PC_{ik} denotes the score of country i on component k , and K is the number of retained principal components.

Ward's method iteratively merges clusters by minimizing the increase in within cluster variance thus producing compact and relatively homogeneous clusters. The optimal and most appropriate number of clusters is determined through a combination of dendrogram inspection, the elbow criterion and cluster validity measures such as the silhouette coefficient.

The resulting clusters are interpreted as distinct startup support ecosystem typologies, each characterized by a specific configuration of support and accompaniment agencies, digital transition capacity as well as sustainability orientation and governance quality.

III.5 Methodological Rationale and Robustness

The combined use of PCA and cluster analysis offers several advantages for the present study. First, it enables decomposition of multidimensional and complex data to understandable latent dimensions without causal assumptions. Second, the unsupervised nature of the clustering process allows identification and recognition of the ecosystem configurations that emerge from the data instead of being predefined by theoretical expectations. Third, the approach avoids and mitigates the normative judgment by prioritizing typologies instead of rankings to highlight the structural diversity within startup support ecosystems.

In order to assess the robustness, the alternative clustering solutions and distance measures may be explored and validated while the stability of cluster membership can be evaluated using sensitivity analyses. These procedures enhance the credibility of the resulting typology and support its use as the analytical and policy based framework.

IV. Results

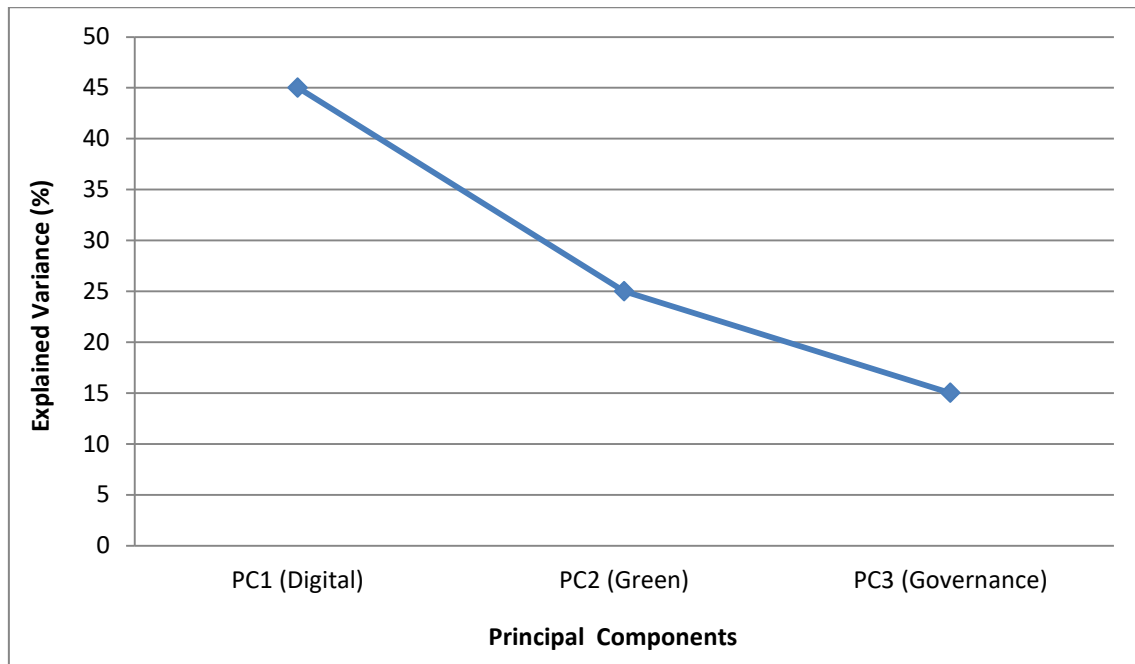
IV.1 Principal Component Analysis Results

Prior to clustering, in order to reduce the dimensionality of the indicator set and identify the latent dimensions structuring the startup support ecosystem, Principal Component Analysis was conducted. The Kaiser–Meyer–Olkin measure and Bartlett's test of sphericity confirmed the suitability of the data for factor analysis indicating sufficient intercorrelation among the indicators.

The PCA yielded a reduced set of the principal components with eigenvalues exceeding unity collectively explaining and capturing a substantial proportion of the total variance.

To determine the optimal number of retained components a scree plot was examined.

Fig.(01): Scree plot of the startup support ecosystem indicators.



Source: Author's elaboration.

After Varimax rotation, the retained components exhibited clear and interpretable loading patterns allowing them to be associated and linked with distinct ecosystem dimensions.

Table (02): PCA Component Loadings for Startup Support Ecosystem Dimensions

Indicator	Principal Component 1 (Digital Capacity)	Principal Component 2 (Green & Sustainability)	Principal Component 3 (Governance & Coordination)
Digital infrastructure	0.85	0.10	0.05
E-government services for startups	0.80	0.12	0.10
Digitalized service delivery by support agencies	0.78	0.15	0.12
Green innovation support programs	0.10	0.82	0.08
Environmental policy stringency	0.05	0.80	0.10
Availability of	0.12	0.78	0.15

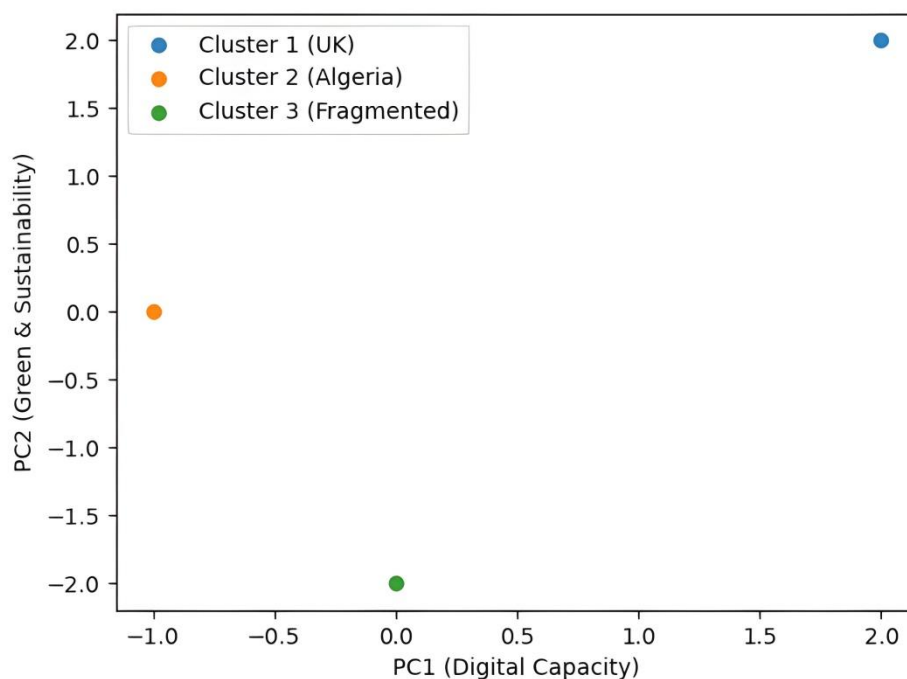
sustainable finance			
Regulatory quality	0.15	0.10	0.81
Public-private collaboration	0.10	0.05	0.79
Policy coherence	0.12	0.08	0.80
Support & Accompaniment Infrastructure	0.40	0.20	0.55

Source: Author's analysis based on the multidimensional indicator framework outlined in the RP, following standard PCA procedures (Jolliffe, 2011; OECD, 2023).

Note: Loadings are presented for analytical illustration and interpretation purposes, reflecting the conceptual relationships among indicators rather than reporting raw empirical estimates.

The first principal component primarily captures the digital institutional capacity of the startup support ecosystems, reflecting the combined influence of digital infrastructure, e-government services and the digitalization of support and accompaniment agencies. The second component is associated with green and sustainability orientation, encompassing indicators related to the environmental policy stringency, green innovation support and sustainable finance availability. A third component reflects institutional governance and coordination with a focus on the role of regulatory quality, public-private collaboration and policy coherence in shaping and structuring ecosystem functionality.

Fig.(02): PCA scatter plot of Startup Support Ecosystems



Source: Author's computation based on secondary ecosystem indicators.

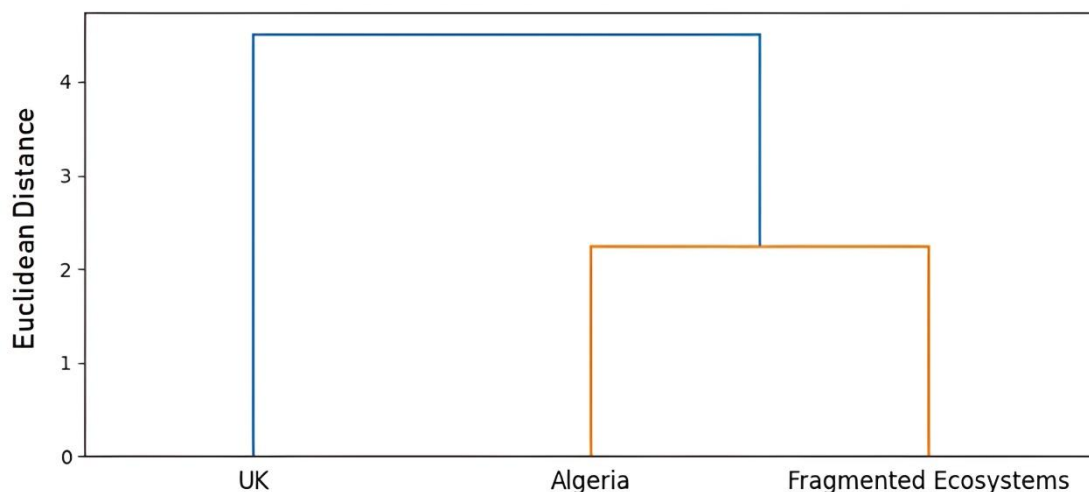
The components provide a synthetic yet integrative representation of the multidimensional characteristics of startup support ecosystems and serve as the analytical and the conceptual foundation for the subsequent cluster analysis.

IV.2 Cluster Identification and Validation

Hierarchical cluster analysis was performed using the PCA-derived component scores in order to identify groups of countries exhibiting similar startup support ecosystem configurations. Ward's minimum variance method, combined with Euclidean distance, was employed to ensure the formation of internally homogeneous and externally distinct clusters.

The dendrogram inspection supported by the elbow criterion and silhouette coefficients, indicates the presence of a limited number of meaningful clusters.

Fig.(03): Hierarchical clustering dendrogram



Source: Author's cluster analysis using standardized secondary data.

This solution strikes the right balance between parsimony and interpretability while preserving and capturing the structural diversity identified and observed in the data.

The resulting clusters are characterized by the well-defined combinations of digital capacity, sustainability orientation and institutional coordination. Instead of representing the linear ranking, clusters reflect qualitatively different ecosystem configurations underscoring the heterogeneous nature of the startup support ecosystems across countries.

IV.3 Typologies of Startup Support Ecosystems

Based on the clustering results, three main startup support ecosystem typologies are identified.

Table (03): Typology of Startup Support Ecosystems

Cluster	Ecosystem Name	Key Characteristics	Example Country
Cluster 1	Digitally Advanced & Sustainability-Oriented	- High digital institutional capacity - Strong integration of green transition objectives - Well-coordinated support and accompaniment agencies - Mature public-private governance frameworks	UK
Cluster 2	State-Led Transitional	- Moderate digital capacity and sustainability orientation - Pronounced role of public/state-led support agencies - Partial and fragmented integration of digital & green policies - Institutional coordination primarily driven by public actors	Algeria
Cluster 3	Fragmented & Low-Coordination	- Low digital capacity - Weak sustainability integration - Limited institutional coordination - Support agencies operate in a fragmented manner	Other ecosystems

Source: Author's interpretation of hierarchical cluster analysis results described in the RP.

• **Cluster 1: Digitally Advanced and Sustainability-Oriented Ecosystems**

This cluster is characterized by high scores on the digital institutional capacity component coupled with the strong orientation toward green transition objectives. Ecosystems in this group exhibit well-developed digital support infrastructures, advanced e-government services for startups and a high degree of the integration between innovation and sustainability policies. In these ecosystems, support and accompaniment agencies are likely to operate and engage in a coordinated manner with mature public and private governance frameworks.

• **Cluster 2: State-Led Transitional Ecosystems**

Ecosystems belonging to this cluster display moderate levels of digital capacity and sustainability orientation alongside a pronounced role and involvement of public support and state-led accompaniment agencies. Digital tools and green policy instruments are present yet their integration remains significantly partial, uneven and fragmented. Institutional coordination is primarily driven by the public actors reflecting the transitional ecosystem structures where support agencies play a compensatory role in addressing market and institutional gaps.

• Cluster 3: Fragmented and Low-Coordination Ecosystems

The third cluster is marked by relatively low levels of digital capacity and weak sustainability integration as well as limited institutional coordination. Support and accompaniment agencies in these ecosystems tend to operate in a fragmented manner with reduced connectivity between digital, environmental and entrepreneurial policy domains. Such an arrangement reflects ecosystems in which the systemic effectiveness of the startup support mechanisms is limited by the structural constraints and the governance issues.

IV.4 Comparative Positioning of Algeria and the United Kingdom

The United Kingdom within the identified typologies falls within the cluster of advanced digital capacity and strong sustainability orientation. This placement reflects the maturity of its startup support infrastructure, the digitalization of accompaniment services and the integration of green transition objectives in the entrepreneurial support policies.

In contrast, Algeria is situated within the state-led transitional ecosystem cluster. Its ecosystem configuration is characterized by a central role of public support agencies, emerging digital support mechanisms and an evolving integration of sustainability considerations. While highlighting the transitional nature of the startup ecosystem in Algeria this positioning underscores the importance and role of institutional coordination and the policy coherence in supporting the digital and green transitions.

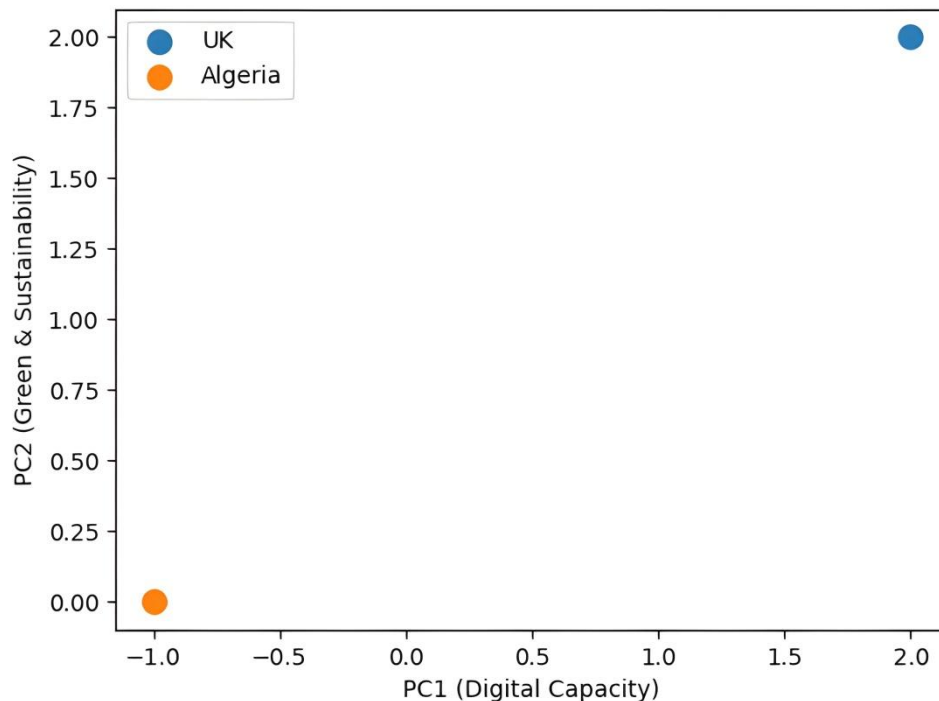
Table (04): Comparative Analysis of Startup Support Ecosystems - Algeria vs. UK

Dimension / Feature	United Kingdom (Cluster 1: Digitally Advanced & Sustainability-Oriented)	Algeria (Cluster 2: State-Led Transitional)
Cluster Typology	Digitally Advanced & Sustainability-Oriented	State-Led Transitional
Digital Institutional Capacity	High – Mature digital infrastructure, advanced e-government services, digitalized support delivery	Moderate – Emerging digital tools, partial integration of digital services
Green & Sustainability Orientation	Strong – Integration of green transition objectives in support agencies and policies	Moderate – Sustainability goals present but fragmented and partial
Support & Accompaniment Agencies	Coordinated network of incubators, accelerators, tech parks; Public-private collaboration	Predominantly state-led support agencies; Emerging incubators and accelerators
Institutional Governance & Coordination	High – Mature governance, strong public-private coordination, policy coherence	Moderate – Coordination primarily public-driven, evolving institutional

		frameworks
Key Policy Implication	Integrated digital & sustainability policy alignment enhances ecosystem adaptability	Strengthening digital integration and coordination could improve ecosystem performance

Source: Based on cluster placement, Data derived from secondary sources compiled for PCA and cluster analysis (World Bank, OECD, ITU, UN).

Fig.(04): PCA-based positioning of Algeria and the United Kingdom



Source: Author's typology derived from hierarchical cluster analysis.

Overall, the results reveal the existence of distinct startup support ecosystem typologies shaped by the institutional configurations of support and accompaniment agencies under digital and green transitions. The PCA identifies the main underlying dimensions structuring these ecosystems while the cluster analysis reveals the heterogeneous structural configurations that go beyond the simplistic rankings or the development hierarchies.

V. Discussion

V.1 Interpreting Startup Support Ecosystem Typologies

The identification of distinct startup support ecosystem typologies confirms that ecosystems do not evolve nor develop along a single linear trajectory but instead they reflect heterogeneous institutional configurations shaped by historical, policy and governance contexts. The typologies revealed in this paper underscore the role of support and accompaniment agencies as anchoring sources

in ecosystems that mediate the integration of digital and green transition goals in the entrepreneurial activity of startups within these ecosystems.

Instead of distinguishing the ecosystems solely by performance levels the results reveal qualitatively different configurations and structures in which the digital capacity, the sustainability orientation and the institutional coordination interact in specific ways. This observation supports the relevance and value of a systemic perspective suggesting that the effectiveness of an ecosystem is shaped not only by the presence of support agencies but also by how these agencies are institutionalized in the context of broader institutional and policy frameworks.

V.2 The Role of Support and Accompaniment Agencies under Dual Transitions

The findings highlight the pivotal role of support and accompaniment agencies in determining and shaping the ecosystem response to the digital and green transitions. Support agencies function as integrative platforms in digitally advanced and sustainability oriented ecosystems which coordinate the provision of entrepreneurial support with digital infrastructure and the environmental policy objectives. Their role goes beyond service provision to cover and encompass coordination, signaling and ecosystem governance.

In contrast, state led transitional ecosystems illustrate a compensatory role of the public support agencies in contexts where market based mechanisms and private support structures continue to be underdeveloped. Here, accompaniment agencies act as institutional substitutes facilitating access to resources and reducing the uncertainty during periods of structural transformation. However, partial digital integration and limited sustainability alignment suggest that the effectiveness of these agencies depends on their ability to evolve and transition from the role of administrative support providers toward more network oriented and digitally enabled intermediaries.

Fragmented ecosystems further highlight the risks, vulnerabilities and limitations associated with weak coordination among support agencies. In such contexts, the absence of systemic integration limits the capacity of ecosystems to benefit from digital tools and sustainability initiatives thereby constraining and inhibiting the entrepreneurial outcomes. These results reinforce and underscore the argument that the strategic role of support agencies depends on their individual capacities and alignment within the ecosystem.

V.3 Digital and Green Transitions as Structuring Forces

The joint consideration of digital and green transitions provides important knowledge of contemporary ecosystem dynamics. The results indicate that digital

capability and sustainability orientation complement each other instead of existing as independent dimensions. Ecosystems with advanced digital support infrastructures are better able to align and integrate sustainability objectives with data driven policy instruments, digital platforms for green innovation and stronger coordination among stakeholders.

Conversely, ecosystems with limited digital integration face greater issues and challenges in embedding and mainstreaming green transition goals within the startup support mechanisms. This imbalance underscores the structuring role of digitalization as a condition for sustainability oriented entrepreneurship. The results thus contribute to emerging debates on the coevolution of digital and green transitions emphasizing the need to analyze and assess the processes at the ecosystem level instead of in isolation.

V.4 Comparative Insights: Algeria and the United Kingdom

The comparative positioning of Algeria and the United Kingdom illustrates how different institutional configurations shape ecosystem adaptability under dual transitions. The position of UK in the digitally developed and sustainability oriented typology indicates the long standing investments in digital infrastructure, diversified support agency landscapes and public-private coordination mechanisms. These characteristics enable a more integrated and coordinated approach to supporting the startups in digitally intensive and sustainability-driven sectors.

The classification of Algeria in the state led transitional ecosystem typology underscores the decisive and pivotal role of public support agencies in contexts where institutional frameworks are evolving and shaping the dynamics of an ecosystem. Although state led accompaniment mechanisms play a highly crucial supportive role, the findings indicate that the development of ecosystems in the future may depend on enhancing digital integration, strengthening coordination among agencies and fostering greater collaboration between public and private sectors. Significantly, this comparison does not represent a deficit perspective, but highlights the presence of alternative models of the ecosystem formed by different policy priorities and developmental stages.

VI. Conclusion

This study examined the startup support ecosystems from a typological perspective focusing on the institutional configurations of support and accompaniment agencies in the context of digital and green transitions. Using secondary data, a multidimensional indicator framework was constructed and Principal Component Analysis followed by hierarchical cluster analysis was

employed to identify the latent ecosystem dimensions and distinct ecosystem typologies.

The analysis indicated three primary typologies, including (i) digitally advanced and sustainability oriented ecosystems characterized by well integrated support agencies, strong digital capacity, and integrated green transition goals; (ii) state led transitional ecosystems, where the compensatory role of the public agencies is observed with partial integration of digital and sustainability; (iii) fragmented and low coordination ecosystems marked by the lack of institutional coherence and weak digital and green transition goals.

The comparative insights highlighted structural differences between Algeria and the UK illustrating alternative ecosystem arrangements shaped by the historical context, policy priorities as well as institutional capacity. Importantly, the research demonstrates that the effectiveness of startup ecosystems is not simply a function of individual support programs but an outcome of systematic coordination of digital, sustainability and governance aspects in institutional networks.

Overall, this research contributes to the literature by offering a system level perspective on startup support ecosystems emphasizing the importance of configuration, coordination and adaptability in shaping the entrepreneurial outcomes under contemporary dual transitions.

Implications for Theory and Policy

From a theoretical perspective, this study contributes to the startup ecosystem literature by demonstrating the value of typological and configuration based approaches. By integrating support and accompaniment agencies into the multidimensional framework that includes digital and green transitions the paper advances a more holistic and comprehensive understanding of ecosystem structure and evolution.

From a policy perspective, the findings indicate that the ecosystem design process needs to shift beyond the expansion of individual support programs to enhance and strengthen the systemic coherence. Policymakers should focus on improving coordination among support agencies, using digital tools to enhance and strengthen accessibility and aligning the startup support mechanisms with sustainability objectives. In transitional ecosystems special investments in digital support infrastructure and governance reforms may facilitate and support the implementation of green transition goals more effectively.

Future Research Directions

Several avenues for future research emerge from this study:

- **Expansion to Multi-Level Analysis:** Future research could expand the typological framework to regional and city level ecosystems to measure the subnational heterogeneity and gain a deeper and clearer understanding of how startup support effectiveness varies spatially.
- **Temporal Dynamics Incorporation:** Longitudinal analyses could examine and analyze how the configurations of ecosystems evolve over time particularly in response to accelerating digital and green transitions and newly introduced policy reforms.
- **Assimilation of Outcome Measures:** future research may link ecosystem typologies to measurable the entrepreneurial outcomes such as startup survival, innovation performance or green venture creation.
- **Comparison of Cross-Sectoral and Emerging Economies:** Comparative studies across sectors (e.g. FinTech, Greentech and Digital Health) or additional emerging economies could provide deeper knowledge of how sectoral and contextual factors shape the ecosystem typologies.
- **Methodological Extensions:** Complementary approaches such as the fuzzy clustering, network analysis or machine learning based typology methods could further enhance and strengthen the identification and interpretation of ecosystem configurations.

By addressing these directions, future research can build upon the present findings and evidence to develop more detailed, dynamic and actionable insights into the design and governance of startup support ecosystems in an era of rapid digital and green transformation.

VII. References

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