

How industrial clusters can foster frugal digital innovation: A theoretical perspective

Comment les clusters industriels favorisent-ils l'innovation numérique frugale : Une perspective théorique

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Abstract

This article presents a theoretical exploration of the role industrial clusters can play in fostering frugal digital innovation particularly, in the Moroccan context. This theoretical analysis incorporates porter cluster theory (Porter, M.E. 1990) with the principles of frugal innovation as introduced by (Radjou and Prabhu 2015), along with institutional and Resource Based perspectives (Dimaggio & Powell, 1983; North, 1990). This study demonstrates how spatial and relational interactions present in clusters, such as proximity, trust, and shared learning, can help alleviate challenges in creating affordable and sustainable digital solutions. A conceptual framework is outlined, highlighting three primary mechanisms: Shared infrastructure, collective capacity building, and market orientation. Frugal innovation is described here as the creation or modification of simple, efficient, and accessible technologies that engage with local needs while minimizing resource utilization. Although this work seeks to further the theoretical understanding of accessible and cost-effective digital transitions in environments with limited resources, this review also considers how clusters may serve to support firms in preserving competitiveness while handling digital challenges, especially in relation to those with traditional resource based advantages. This contribution is exploratory in nature and attempts to encourage further academic interest in the potential of clusters as a foundation for frugal, collaborative, and sustainable innovation strategies.

Keywords : Frugal innovation, Industrial clusters, Digital transformation, Collective learning, Competitiveness.

Classification JEL: O32, O33

Paper type : Theoretical research

Résumé

Cet article propose une exploration théorique du rôle que les clusters industriels peuvent jouer dans la promotion de l'innovation numérique frugale, en mettant particulièrement l'accent sur le contexte marocain. Cette analyse théorique combine la théorie porterie des clusters (1990) avec les principes de l'innovation frugale tels qu'introduits par Radjou et Prabhu (2015), ainsi que les perspectives institutionnelle et basée sur les ressources (Dimaggio & Powell, 1983 ; north, 1990). L'étude montre que les interactions spatiales et relationnelles présentes au sein des clusters, telles que la proximité, la confiance et l'apprentissage partagé, peuvent contribuer à réduire les obstacles à la création de solutions numériques abordables et durables. Un cadre conceptuel est proposé, mettant en évidence trois mécanismes principaux : Les infrastructures partagées, le renforcement collectif des capacités et l'orientation marché. L'innovation frugale est ici définie comme la création ou la modification de technologies simples, efficaces et accessibles, répondant aux besoins locaux tout en minimisant l'utilisation des ressources. Ce travail vise à approfondir la compréhension théorique des transitions numériques accessibles et économiques dans des environnements à ressources limitées. La revue examine également comment les clusters peuvent soutenir les entreprises dans le maintien de leur compétitivité tout en relevant les défis numériques. Cette contribution a un caractère exploratoire et cherche à susciter un intérêt académique sur le potentiel des clusters en tant que propulseur pour les stratégies d'innovation frugale, collaborative et durable.

Mots clés : Innovation frugale, cluster industriels, transformation numérique, apprentissage collectif, compétitivité.

JEL classification : O32, O33

Type du papier : Recherche théorique

1. Introduction

In many emerging economies, digital transformation is becoming increasingly more important, however, progress remains uneven and often limited due to a lack of resources, infrastructure, and institutional support. In such contexts, firms are often required to innovate in ways that are not only creative but also cost-effective and adapted to local conditions. This approach is commonly referred to as frugal innovation, defined by Radjou and Prabhu (2015) as the development of simple, affordable, and useful technologies that work in difficult environments without relying on expensive or complex systems.

Furthermore, industrial clusters, which are groups of companies, institutions, and support structures located in the same region, are often viewed as ideal places where innovation can happen due to how its close arrangement of the aforementioned structures naturally facilitates and encourages cooperation in a day-to-day operation.

According to Porter (1990), these clusters naturally encourage cooperation, trust, and learning between different individuals and organizations which are ordinarily operated independently of one another, making it easier to share knowledge, build partnerships, and adapt quickly to change. While clusters are traditionally known for helping firms become more productive and competitive, especially in exports, they are now also being studied as tools for supporting digital and sustainable innovation.

Although frugal innovation and industrial clusters are both well-established research domains, their intersection remains insufficiently explored in the academic literature. In particular, limited attention has been paid to how clusters can support firms in developing digital solutions that are both effective and adapted to local needs, especially in countries like Morocco. Clusters already provide some key advantages in this regard. Shared infrastructure, trust between actors, and collaboration between different individuals and sectors that seem useful for naturally facilitating and encouraging frugal digital innovation. This could be critically important for small and medium-sized enterprises (SMES), which often struggle to keep up with digital changes due to limited resources.

The Moroccan context provides a unique setting to examine frugal digital innovation within clusters. Unlike informal innovation systems observed in countries such as India or Brazil, Moroccan clusters often operate under strong institutional coordination and public policies. Moreover, while the benefits of clusters for productivity and competitiveness are widely recognized, few studies have explicitly examined their role in fostering digital solutions under resource constraints. SMEs face challenges not only in financial and technological resources, but also in navigating institutional frameworks, which may limit the adoption of the innovation. By focusing on these combined constraints, the study addresses a clear gap on these in the academic literature and set the stage for exploring mechanisms through which clusters can facilitate frugal digital innovation.

This paper aims to address this gap by proposing a theoretical framework that explains how industrial clusters can support frugal digital innovation. To build this framework, we will use a combination of several different theories.

First, Porter's cluster theory (Porter, m.e. 1990), which details how being close together and specialized helps firms innovate. Second, the idea of frugal innovation (Radjou & Prabhu, 2015), which describes how companies can create value despite economic constraints. Third, institutional theory (Dimaggio & Powell, 1983; North, 1990), which assists us in understanding how firms react to formal and informal rules and expectations.

Lastly, in Barney's resource-based view hypothesis (1991), he gives us insights into how firms use both material and non-material resources to innovate, even when they are under-resourced. Based on these ideas, this study identifies three key methods clusters can support frugal digital innovation:

- Shared digital infrastructure that helps reduce costs and improve access to technology.
- Collective capacity building through training, knowledge exchange, and collaboration between sectors.
- Market orientation, which encourages firms to be more aware of their environment.

These mechanisms can make an impactful change in environments where firms need to innovate with limited funding, technical knowledge, or few skilled workers.

To guide this reflection, we ask the following research question: How can industrial clusters support frugal digital innovation, and through which mechanisms?

The next parts of the paper will review the main theories behind this work and then present the proposed conceptual framework.

2. Theoretical Framework

Understanding how industrial clusters can organically facilitate frugal digital innovation in emerging economies requires combining the many different theoretical perspectives we discussed earlier. This section mobilizes four complementary but conceptually distinct approaches: Cluster theory, frugal innovation, institutional theory, and the resource-based view. Which has rarely been articulated together in the context of digital innovation under constraint. When combined, these perspectives offer an insightful way to understand how innovation can take place in an environment with limited resources while remaining inclusive, cost-effective, and adapted to local needs.

2.1 Cluster theory and innovation ecosystems

Cluster theory, as introduced by Porter (1990), describes industrial clusters as groups of related companies, suppliers, service providers, and supporting institutions geographically concentrated within the same region. These clusters create benefits for firms through local cooperation, shared knowledge, and trust.

The geographic concentration present in clusters allows firms to benefit from localized externalities, including access to skilled labor, specialized suppliers and faster circulation of information, which collectively improve their innovative and competitive potential.

However, while cluster theory emphasizes proximity and cooperation as drivers of innovation, it tends to under-explore how firms innovate under severe resource constraints.

Recent research views clusters not only as geographic groupings, but also as active innovation ecosystems. In this view, clusters help firms adapt to change, learn from each other, and use shared resources and infrastructure. This is especially relevant in emerging economies, where small and medium-sized enterprises (SMES) may not have access to innovation support on their own due to their inherent lack of adequate resources when compared to larger, established economies.

Beyond proximity and corporations, clusters in resource-constrained environments function as collective innovation platforms. They allow SMEs to share digital tools, develop processes and access institutional support that would be hard individually. In this way, clusters serve as enablers of frugal digital innovation, where structural, relational and knowledge-sharing mechanisms converge to reduce costs, mitigate risks and accelerate learning. This perspective emphasizes that clusters are not only sites of economic concentration, but also active ecosystems for resource-efficient innovation.

Clusters, which naturally encourage active innovation ecosystem, create an environment where cooperation and specialization lead to faster innovation and better performance.

They also support innovation through social and relational factors. When firms share common goals, values, and a sense of trust, they are more willing to collaborate and take risks with one another. Cluster governance, like management teams or coordination bodies, can help align different actors, build partnerships, and organize access to public or private resources

(Lazzeretti et al., 2014). These social and structural aspects make clusters of a promising setting for developing efficient, affordable, and sustainable innovation strategies within emerging economies.

In Morocco, several public policies and regulations such as the National Pact Of Industrial Emergence have aimed to support cluster development, by promoting the creation of industrial ecosystems. One such method of encouragement has been to provide small and medium sized enterprises (SMES) with financial and institutional support to join the cluster ecosystems. Sector-specific clusters have been formed in areas like Tangier and Casablanca supporting a variety of industries ranging from automotive, agribusiness, and smart technologies to support digital and industrial growth.

However, the impact of these initiatives varies across regions and sectors. These clusters are generally characterized by strong public involvement in governance, a high concentration of SMEs and a policy driven logic focused on industrial upgrading rather than radical technological innovation.

Within these cluster ecosystems, SMES have primarily benefited from collective support mechanisms rather than direct firm level subsidies. These include access to shared industrial and digital infrastructure, participation in joint training and skills development programs, which facilitated links with public agencies, universities and export support institutions. Despite these collective mechanisms, many Moroccan SMEs continue to face persistent constraints related to limit digital maturity, restricted access to innovation finance and uneven integration into global value chains.

From a theoretical perspective, these Moroccan cluster initiatives illustrate how public policy can reinforce the structural and relational mechanisms identified in the proposed framework. Compared to other emerging economies where frugal innovation often emerges through informal or large scale, market dynamics. The Moroccan case highlights of more institutionally coordinated cluster mediated pathway to frugal digital innovation.

2.2 Frugal innovation: From constraint to capability

Frugal innovation is the process of designing simple, affordable, and impactful solutions that solve problems using very limited resources (Radjou & Prabhu, 2015). Unlike traditional innovation that often depends on sizable investments and advanced technologies, frugal innovation focuses on doing more with less. It prioritizes essential functionalities, alignment with local contexts and avoiding unnecessary technological complexity, thereby reframing constraints as a source of innovative capability rather than limitations.

While frugal innovation capability is often examined at firm level, emerging research suggests that it can also be supported at the ecosystem level, particularly within industrial clusters that provide shared resources, collective learning and market feedback mechanisms. In addition, frugal innovation can evolve into a repeatable organizational capability, especially when supported by cluster ecosystems. SMEs can develop digital solutions that are affordable easy to implement, and responsive to local needs. This capability includes not only technological adaptation, but also a knowledge sharing, joint problem solving and strategic experimentation, enabling firms to leverage scarcity as a resource of competitive advantage. Recognizing frugal digital innovation as a cluster supported capability connects the gap between firm level strategies and ecosystem level outcomes.

More recent research studies have introduced the idea of “Frugal Innovation capability”, which is the ability of firms or ecosystems to create such solutions repeatedly (Rossetto et al., 2023). This is typically accomplished using three main strategies : Cutting costs while maintaining quality, focusing on essential functions that match local needs, and using resources in a sustainable way. These are especially important in digital innovation, where affordability and ease of use are key.

Case studies from countries like India, Brazil, and Tanzania show that companies with strong strategic goals, such as being market-oriented or entrepreneurial driven, are more effective at creating frugal innovations (Niroumand et al., 2021). In the Moroccan context, frugal innovation has also been identified as a viable approach for both normal crisis situations, illustrating how domestic actors adapt resource constraints to generate impactful solutions. For example, research on the use of frugal innovation during COVID-19 pandemic in Morocco shows that local enterprises leveraged lean and adaptive strategies to create value for society across health, employment, and local market needs, showing resilience and responsiveness in challenging environments. This suggests that while frugal innovation in other emerging economies often proceeds in informal contexts, Moroccan firms and clusters may combine institutional support with adaptive strategies to foster frugal digital and social innovation in ways that are adapted to the national development priorities .

Some firms also show “organizational ambidexterity”, which means that they can explore new ideas without sacrificing their existing resources or compromising on their quality, affordability, and efficiency in their primary area of focus. In Morocco, even if the concept is not widely studied, some cluster-based projects in sectors like automotive and smart automation already apply principles of frugal innovation by offering cost-saving and practical digital solutions.

2.3 Institutional theory in innovation contexts

Institutional theory, originally developed by DiMaggio and Powell (1983) and North (1990), has evolved significantly in recent years. Today, it emphasizes that organizations are not just passive followers of rules and norms but can actively shape, negotiate, and even transform their institutional environments to support innovation (Scott, 2021; Greenwood et al., 2022).

This perspective shifts away from seeing institutions as external constraints and instead recognizes firms and clusters as agents, often called institutional entrepreneurs who influence regulations and social expectations to foster innovative activities. This does not imply the absence of institutional constraints but rather highlights that companies and clusters may face institutional gaps while actively developing adaptive strategies.

However, in many emerging economies, institutional environments remain complex, fragmented, and difficult to navigate. These institutional environments can be identified by inconsistent regulations, weak enforcement mechanisms, and limited access to formal financial and legal systems (Zahra & Nambisan, 2021; Li et al., 2023).

Institutional gaps create significant barriers for startups and small firms to innovate through conventional means due to the overwhelming challenges they inherently present relative to their resources and capability. These challenges not only encourage such firms to pursue alternative innovation approaches, like frugal innovation, which prioritizes resourcefulness, cost effectiveness, and adaptation to local contexts (Radjou & Prabhu, 2020; Tiwari et al., 2021).

Inter-collaborating organizations within clusters can help ease the operational burden created by complex and fragmented institutional environments. Through shared governance and collective action, clusters can support individual firms in accessing public programs, working with public authorities and navigating government sectors and regulations, or even influencing policy. They also help firms better understand what kinds of innovation are expected and accepted in their sector or region.

Firms within industrial clusters, who share a strategic goal, can typically create a shared mindset amongst themselves, which is a common understanding of how innovation should be done and which goals are most important.

This shared vision helps firms' synergies with one another, thereby allowing them to work together more easily, especially when traditional market or government support is missing. This

is particularly helpful for promoting frugal innovation, which often needs flexible thinking and experimentation in order to overcome strict or outdated regulations.

2.4 Resource-based view under constraint

The resource-based view (RBV), introduced by Barney (1991), argues that a firm's competitive advantage comes from the unique resources it controls. According to Barney, these resources must be valuable, rare, and hard to copy.

However, in many emerging economies, SMES do not have an abundance of resources such as intense capital, technology, or skilled labor to invest in digital transformation or innovation.

Traditionally, RBV has focused on internal firm-level assets, such as technology, capital, or proprietary knowledge. Although, this perspective has been expanded in recent years to consider how firms in resource-constrained environments such as those in emerging economies can access, combine, and leverage external resources through networks and partnerships (Morris et al., 2020).

Clusters address this limitation by enabling collective access to strategic resources that individual SMES could mobilize independently. They allow firms to share resources like technical knowledge, infrastructure, or training opportunities. Instead of working alone, firms can develop new skills and solutions together. This kind of resource sharing helps lower individual costs and encourages innovation in a more inclusive way, ultimately leveraging their shared abilities, resources, and efficiency for a competitive market advantage, despite frugal, small and medium-sized enterprises (SMES) lacking the traditionally-viewed RBV's abilities and resources.

In frugal innovation contexts, RBV also includes intangible resources like trust, networks, and social connections. These elements lay the essential foundation required in order for firms to cooperate, learn from each other, and reduce the risks of trying something new. In well-connected clusters, firms can better share information, overcome market uncertainty, and develop low-cost digital solutions suited to their environment.

Unlike traditional RBV, which focuses on firm level ownership of resources, this extended perspective converges with cluster and institutional theories by focusing on shared, relational and context-dependent resources as foundations for innovation under constraint.

2.5 Comparative discussion of theoretical perspectives

Although each of the four theoretical perspectives mobilized in this study offers valuable insights into the innovation process, none of them alone is sufficient to fully explain how frugal digital innovation appears in resource-constrained environments. Comparative discussion highlights both their complementarities and their limitations.

The cluster theory emphasizes the role of geographic proximity, specialization and inter-firm interactions in encouraging innovation. It explains how local networks, trust and shared infrastructure reduce coordination costs and facilitate knowledge exchange. However, this approach tends to focus on productivity and competitiveness but pays a limited attention to how firms innovate under financial, technological, or institutional constraints.

The frugal innovation theory directly addresses this limitation by focusing on constraint driven innovation. The research is often concentrated on the firm level strategies and provides a limited explanation of the ecosystem level conditions that enable such innovation to be sustained over time.

The institutional theory contributes by focusing on the influence of formal regulations, norms and governance structures on innovation behavior. Some recent institutional perspectives recognize firms and clusters as active agents, capable of reshaping and navigating for institutional constraints. However, institutional theory alone does not specify the real organizational or technological mechanism through which innovation is produced.

Finally, the resource-based view explains how access to valuable resources a competitive advantage is. While traditional RBV is limited in contexts where firms lack internal assets, its extended interpretations emphasize relational and network-based resources. This extension aligns closely with cluster dynamics and frugal innovation logic.

These theories join the idea of innovation being increasingly collective, context dependent, and relational. Their combination helps with a better understanding of frugal innovation as a process shaped by structural conditions, strategic response to scarcity, institutional environments, and shared resources. These theories together provide the foundation for the conceptual framework they loved in the next session.

While each theoretical perspective provides valuable insights, integrating them reveals important complementarities and tensions. Cluster theory highlights inter-firm networks and shared infrastructure, frugal innovation emphasizes adaptation to scarcity, institutional theory focuses on formal and informal constraints, and the resource-based view on the role of strategic resources.

Applied individually, each has limitations: Clusters may underplay institutional barriers, frugal innovation often ignores ecosystem dynamics, institutional theory lacks mechanisms for innovation and RBV assumes resource-rich environments.

A combined perspective clarifies that frugal innovation is a collective context dependent, and mediated process, relying on structural, relational and strategic dimensions simultaneously.

3. Conceptual Framework: Enabling Frugal digital innovation through industrial clusters

Building on the theoretical foundations presented earlier, this section introduces a conceptual framework that explains how industrial clusters can foster frugal digital innovation. The framework integrates structural, relational, institutional, and resource-based dimensions, and highlights the key mechanisms through which clusters support innovation in contexts where resources and capabilities are limited.

At the center of the framework is the industrial cluster, conceptualized as a collaborative ecosystem in which firms, universities, public institutions and support organizations interact on a regular basis to support innovation. These interactions create a favorable environment for knowledge exchange, cooperation, and learning naturally and logically take place. The framework identifies three interrelated mechanisms through which clusters contribute to frugal digital innovation: Shared infrastructure, collective capacity building, and market orientation.

3.1 Shared digital infrastructures

Clusters help small and medium-sized enterprises (SMES) overcome obstacles to digital transformation by facilitating access to shared technological resources, including cloud platforms, digital labs, training centers, and open-source software which would otherwise be far too expensive for firms of their size and capability to access. These firms, which often lack the resources to invest in these tools independently, benefit from significant economies of scale. Practically, shared digital infrastructure allows cluster members to unit financial and technical resources, thereby reducing individual investment requirements and lowering the risks associated with digital experimentation. Proceeds are then allocated for digital transformation advancements which are in turn utilized by all of the firms within the cluster. This access allows firms to experiment with affordable yet still advanced and capable technologies, adopt essential digital tools such as enterprise resource planning (ERP) systems or basic automation, and connect more easily with partners and institutions.

In addition, shared digital infrastructures can generate observable innovation outcomes for cluster SMEs. These include the adoption of low-cost digital tools, improvements in process efficiency, and the creation of contextually adapted digital services. Indicators such as the

frequency of platform use, collaborative project outputs, or the speed of digital adoption within member firms can help assess the effectiveness of cluster supports infrastructures. Which strengthens the link between theoretical mechanisms and tangible firm level results.

These dispositions interpret the collective advantages of clusters into tangible firm level innovation outcomes. By providing collective access to critical resources, shared infrastructures enable firms to overcome financial hurdles and technical constraints by allowing each firm to allocate remaining resources efficiently across other needs within the organization.

3.2 Collective capacity building

Innovation under resource constraints requires talent, knowledge, and strategic awareness, not solely access to a large sum of expendable capital. Collective capacity building within clusters operates as a dynamic learning mechanism through which firms develop digital skills, absorptive capacity and innovation under constrained conditions. These activities strengthen internal capabilities, promote the adoption of new practices, and allow firms to learn from each other.

Collective capacity building is further developed when clusters foster formal and informal knowledge ecosystems. Peer mentoring, workshops, and problem-solving sessions create a shared understanding of digital technologies, best practices, and innovation management approaches.

Collaboration with universities, research centers and technology providers allows SMEs to reduce the gap between theoretical knowledge and applied innovation, generating sustained frugal digital innovation capability across the cluster.

Through collaborative training initiatives and workshops, clusters can develop a regular language around digital technologies, innovation management and sustainability, thereby helping firms recognizing strategies and capabilities.

Practice of peer mentoring helps enabling better practices, process expertise and adaptive strategies thereby enriching the learning ecosystem. What creates an environment of trust where firms are encouraged to share both their achievements, failures, and the knowledge exchange platforms like seminars, cluster councils or digital communities generating collective intelligence and collaborative problem-solving dynamics.

Cooperation with universities and research laboratories further amplifies this dynamic, enabling cluster firms to effectively adapt to the gap between theoretical frameworks and applied innovation.

3.3 Market orientation

Market orientation refers to the ability of firms to identify opportunities, understand market needs, and respond strategically which reinforces the effect of collective learning. Within clusters, this orientation is strengthened through proximity to competitors, shared information, and institutional feedback, enabling a more adaptive strategic response.

Together, these mechanisms show that industrial clusters are not only sites of production and competition but also collaborative environments where innovation can grow despite constraints. They show how clusters combine structural, relational, and strategic dimensions to enable firms to innovate in ways that are affordable, locally adapted, and resource-efficient, representing the essence of frugal innovation.

At the structural level, clusters provide shared digital infrastructure, promote in collective capacity-building initiatives, and facilitate market-oriented behaviors among member firms. These actions can help an individual firm mitigate the costs and risks associated with developing such capital-intensive infrastructure on their own while enhancing access to essential resources.

Consequently, firms connected to clusters tend to develop stronger entrepreneurial awareness and marketplace responsiveness, which are crucial for identifying opportunities and adapting to resource constraints in innovative ways.

3.4 The mediating role of cluster-based mechanisms

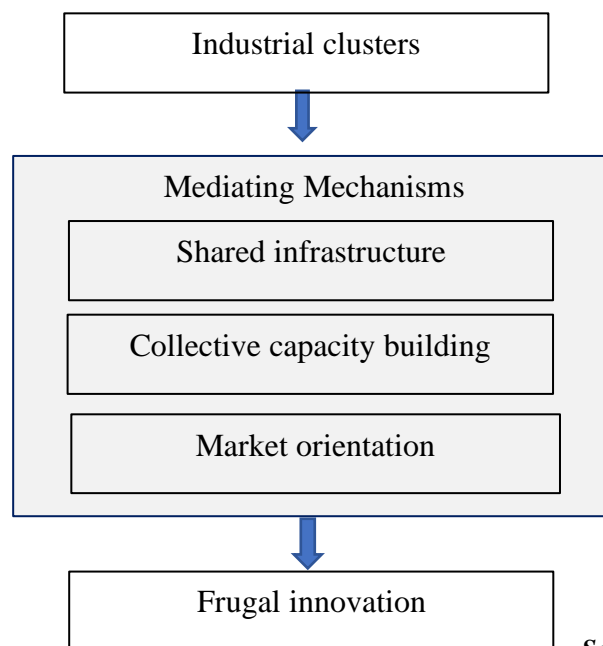
This framework argues that the relationship between industrial clusters and frugal digital innovation isn't direct. It operates through specific cluster-based mechanisms, shared digital infrastructure, collective capacity building and market orientation does not constitute innovation outcomes in themselves, but function as mediating mechanisms through which cluster interpret their structural and relational advantages into firm level frugal digital innovation.

The effectiveness of cluster-based mechanisms may be influenced by moderating factors, such as the level of digital maturity of member SMEs, institutional support and technological intensity.

From this perspective, the industrial cluster acts as an enabling environment that facilitates access to resources, learning opportunities and market signals, while the second block of the framework represents the processes through which firms absorb, mobilize, and recombine these inputs under resource constraints. These mechanisms reduce uncertainty, lower innovation costs, and enhance firms' ability to identify and exploit locally relevant digital solutions.

By conceptualizing shared infrastructure, collective capacity building and market orientation as mediating mechanisms, this framework contributes to the literature by clarifying how cluster participation leads to frugal digital innovation, particularly in emerging economies where institutional and financial constraint limit direct innovation pathways.

Figure 1: A conceptual framework cluster-based mechanisms enabling frugal digital innovation



Source: developed by the author

Based on this conceptual reasoning, the following theoretical propositions are derived:

- Proposition 1: Industrial clusters create favorable conditions for frugal digital innovation in emerging economies.
- Proposition 2: Shared digital infrastructure mediates the relationship between clusters participation and frugal digital innovation.
- Proposition 3: Collective capacity building mediates the relationship between cluster participation and frugal digital innovation.

- Proposition 4: Market orientation mediates the relationship between cluster participation and frugal digital innovation by guiding firms' collective learning processes toward locally relevant and resource efficient digital solutions.

4. Conclusion

This paper has developed a theoretical framework to explain how industrial clusters can support frugal innovation, by utilizing four different and key perspectives, cluster theory, frugal innovation, institutional theory, and the resource-based view.

The study has identified three main mechanisms, namely shared infrastructures, collective capacity building, and market orientation which enable innovation under the financial, institutional, and resource constraints typically faced by small and medium-sized enterprises (SMES) in emerging economies.

By shifting the focus from clusters as static groupings to clusters as enabling ecosystems, this framework offers an alternative, modern, and more efficient perspective on innovation. It highlights the importance of inter-collaboration within the cluster via shared infrastructure, collective capacity, and market orientation. This institutional alignment fosters affordable and context-driven digital solutions.

Industrial clusters offer more than just practical benefits. They create a space where knowledge, ideas, and experiences flow more freely. In emerging economies, these interactions can help firms discover creative solutions that are both affordable and relevant to local needs. Clusters can therefore be seen as small innovation ecosystems that encourage experimentation, learning from failure and gradual improvement with essential ingredients for frugal digital innovation. These mechanisms are particularly relevant in countries such as Morocco, where national strategies are increasingly focused on digital inclusion, industrial modernization, and support for SMES. While this study remains theoretical, it aims to offer a starting point for future empirical research that may further explore the role of clusters in fostering frugal innovation and contribute to more inclusive approaches to digital transformation.

In conclusion, the study shows that digital innovation can be achieved even with limited resources. Within industrial clusters, firms can share knowledge, collaborate, and use available resources to develop solutions that are practical and suited to local needs. This highlights an adaptable view of innovation, especially for SMEs in emerging economies.

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