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Digital Absorptive Capacity and Barriers to Circular Transformation Among Small and Medium-Sized Enterprises: A Theoretical Review and Policy Implications for Vietnam

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Abstract

In the context where small and medium-sized enterprises (SMEs) account for as much as 95 percent of all enterprises in Vietnam, yet many firms that have gained access to digital technology through the Enterprise Digital Transformation Support Program have not translated that access into circular business practice as envisioned by the Scheme for Circular Economy Development in Vietnam, this study aims to systematize the mechanism through which digital absorptive capacity is converted into SMEs' circular transformation capacity, to construct a barrier-classification framework corresponding to each absorptive-capacity stage, and on this basis to propose policy implications suited to Vietnam's practical conditions. Using a desk-research method that synthesizes, analyzes, evaluates, and compares secondary literature grounded in three theories - absorptive

capacity theory, circular economy theory, and innovation-barrier theory for SMEs - the study constructs a barrier-classification framework organized as a four-stage absorptive-capacity matrix, comprising acquisition, assimilation, transformation, and exploitation, cross-referenced with the internal or external origin of each barrier, and shows that the transformation and exploitation stages are the two policy bottlenecks left unaddressed in Vietnam, while existing support programs concentrate mainly on the acquisition stage. On this basis, the study proposes a set of policy implications tied to each stage and implementing actor, contributing a more structured analytical framework in place of the topic-based barrier listings common in the existing literature.

Keywords: Digital Absorptive Capacity, Circular Economy, Small and Medium-Sized Enterprises, Digital Transformation

1. Introduction

Small and medium-sized enterprises, hereafter SMEs, form the backbone of Vietnam's economy, accounting for as much as 95 percent of all enterprises currently in operation, of which roughly 45 percent remain in the low-to-medium technology group according to recently cited General Statistics Office data (Tạp chí Kinh tế - Tài chính, 2024) ^[9]. At the same time, Vietnam has pursued two parallel policy tracks: one promoting circular transformation through the Scheme for Circular Economy Development in Vietnam issued under Decision No. 687 of the Prime Minister (Prime Minister of Vietnam, 2022) ^[7], and the other promoting digital transformation through the Enterprise Digital Transformation Support Program for 2021–2025 approved by the Ministry of Planning and Investment under Decision No. 12/QĐ-BKHĐT (Ministry of Planning and Investment of Vietnam, 2021) ^[4]. However, implementation in practice reveals a notable paradox: a considerable number of enterprises have gained access to digital platforms through this support program yet have not translated that level of technology access into the capacity to operate a circular business model in practice. The gap between possessing technology and generating substantive change in production and business methods is precisely the starting point of this study.

The international literature on this issue can be identified along two main strands, which have largely developed separately from one another. The first strand originates in absorptive capacity theory as systematized by Zahra and George (2002) ^[10], in which absorptive capacity is disaggregated into four stages: acquisition, assimilation, transformation, and exploitation of external technological knowledge. This theoretical framework explains why two organizations that access the same technology differ in how effectively they convert that knowledge into competitive capability, depending on internal capacity at each stage. A recent study by Lee *et al.* (2024) ^[3] extended this framework into the context of green innovation, showing that absorptive

capacity and transformative capacity mediate the relationship between digitally enabled servitization and firms' green-innovation outcomes. The second strand focuses on the barriers that SMEs face when transitioning to circular business models; the foundational study by Rizos *et al.* (2016) [8], based on a review of SME case studies across Europe, found that a lack of financial resources and a lack of technical skills were the two most common barriers, though this study, like most others in the same strand, mainly lists barriers by topical category - finance, human resources, technology - without linking each barrier to a specific stage of the technology-absorption process.

A notable observation is that these two strands of research are rarely integrated. The absorptive capacity framework has largely been tested in the context of large firms with dedicated research and development units, whereas the circular-barrier literature on SMEs has not drawn on the four-stage structure of absorptive capacity to explain why barriers manifest differently across stages. As a result, existing studies struggle to explain precisely the phenomenon noted in the opening paragraph - namely, why the same level of digital-technology availability produces different circular-transformation outcomes across SMEs. This is precisely the research gap that this study seeks to fill, by constructing an analytical framework that directly links each stage of digital absorptive capacity to the corresponding type of barrier obstructing circular transformation, situated within the specific context of SMEs' small scale and limited resources in a developing economy such as Vietnam.

From a management and practice standpoint, filling this gap carries urgent significance. If digital-transformation support programs and circular-economy support programs continue to be designed and implemented separately as they currently are, public resources invested in technology diffusion risk failing to generate a commensurate circular impact, because the barrier actually obstructing firms may lie at the transformation or exploitation stage rather than at the initial technology-access stage that current support programs focus on.

Building on this context and gap, the study aims to systematize the mechanism through which digital absorptive capacity is converted into SMEs' circular transformation capacity, to construct a barrier-classification framework corresponding to each absorption stage, and on this basis to propose policy implications suited to Vietnam's practical conditions. Two central research questions are posed: which barriers obstruct SMEs at each specific stage of digital absorptive capacity, and which stage do Vietnam's current support policies concentrate on while leaving others unaddressed? The study's contribution lies in proposing a distinctive barrier-classification framework that replaces the topic-based barrier listing common in the existing literature. The remainder of the paper is structured as follows: Section 2 presents the theoretical framework and research methodology; Section 3 presents the results of the analysis and discussion; Section 4 proposes policy implications; and Section 5 concludes.

2. Theoretical Framework and Research Methodology

2.1 Core Concepts

Four core concepts underlying the study need to be clarified before proceeding to the analysis. Digital absorptive capacity, following the foundational framework of Zahra

and George (2002) [10], is an organization's ability to acquire, assimilate, transform, and exploit external technological knowledge in order to generate commercial value. These four stages are grouped into two broader capacities: potential absorptive capacity, comprising the acquisition and assimilation stages, reflecting the ability to access and understand new knowledge; and realized absorptive capacity, comprising the transformation and exploitation stages, reflecting the ability to combine new knowledge with existing knowledge and apply it in actual operations. The circular economy, the second concept, is defined under Article 142 of the Law on Environmental Protection No. 72/2020/QH14 as an economic model in which design, production, consumption, and service activities aim to reduce the extraction of raw materials, extend product life cycles, and limit waste generation (National Assembly of Vietnam, 2020) [5], consistent with the common understanding in the international literature as synthesized by Kirchherr *et al.* (2017) [2] from 114 definitions. Small and medium-sized enterprises, the third concept, are defined under Article 5 of Decree No. 80/2021/NĐ-CP based on three criteria - the average number of employees registered for social insurance during the year, total annual revenue, and total capital - classified across three sectors: agriculture, forestry and fisheries; industry and construction; and trade and services (Government of Vietnam, 2021) [1]. Circular transformation, the fourth concept, is understood in this study as the process by which an enterprise shifts from a linear mode of production and business toward operating according to the above principles of reduction, reuse, and recycling, in which digital technology serves as one of the key enabling inputs. The relationship among these four concepts - specifically, digital absorptive capacity acting as the mediating mechanism between the availability of technology and SMEs' circular-transformation outcomes - is the central analytical focus of this study.

2.2 Theoretical Framework

The study integrates three theories to explain this mechanism, rather than relying on a single theoretical lens. First, absorptive capacity theory by Zahra and George (2002) [10] serves as the central theoretical framework, providing the four-stage structure that runs throughout the analysis. Each of these four stages requires different organizational conditions, thereby creating different bottlenecks as a firm engages with digital technology, and this variation explains why the same level of technology availability does not translate into uniform outcomes across firms. Second, circular economy theory, drawing on the systematization by Kirchherr *et al.* (2017) [2], defines the specific destination toward which digital absorptive capacity must be directed - that is, not every form of digital-technology application automatically produces a circular outcome; only applications that are transformed and exploited toward reduction, reuse, or recycling genuinely contribute to this goal. Third, innovation-barrier theory for SMEs, synthesized from the findings of Rizos *et al.* (2016) [8] and Ormazabal *et al.* (2018) [6], emphasizes that limited resources and the vulnerability inherent in small scale cause SMEs to encounter barriers of a different magnitude and nature than large firms, while also providing a classification of barriers by internal origin - such as a lack of technical skills or financial resources - and external origin - such as a

lack of supporting policy or a lack of market demand for circular products.

The study's intended theoretical contribution lies in integrating these three theories into a single classification framework, in which each type of barrier is linked to a specific stage among the four absorptive-capacity stages and simultaneously classified by internal or external origin. This approach differs from most existing research, which merely lists barriers by topical category - finance, human resources, technology - without an underlying theoretical axis, and therefore often struggles to pinpoint precisely which barrier must be removed first to enable the next absorption stage to proceed.

2.3 Research methodology

The study uses a desk-research method comprising the steps of synthesizing, analyzing, evaluating, and comparing secondary literature, consistent with the objective of building a theoretical classification framework without requiring primary data collection. Literature was selected according to three criteria: direct relevance to digital absorptive capacity or to circular-transformation barriers among SMEs; publication in peer-reviewed, reputable journals; and representativeness across different research contexts, to avoid bias toward a single industry or geographic region. The secondary data sources used comprise three categories: peer-reviewed academic publications retrieved from the Scopus and Web of Science databases on absorptive capacity and circular barriers; domestic SME survey reports concerning digital readiness; and current Vietnamese legal documents and policies supporting digital transformation and the circular economy. The analytical framework is constructed as a two-dimensional matrix, with one dimension being the four stages of digital absorptive capacity and the other being the internal or external origin of each barrier, so that each barrier is assigned a specific position within the matrix rather than merely being listed in isolation. The study's scope is limited to the analysis of publicly available published literature and does not include field surveys or enterprise interviews; the resulting classification is therefore a theoretical synthesis that requires empirical validation in future research, a limitation discussed further in the study's conclusion.

3. Results and Discussion

3.1 The mechanism through which digital absorptive capacity is converted into circular transformation capacity

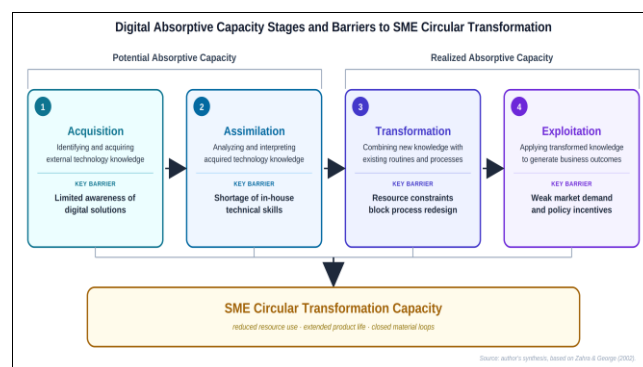
Building on the four-stage framework of Zahra and George (2002) [10] presented in Section 2, the mechanism converting the availability of digital technology into SMEs' circular-transformation capacity can be described as a chain of four successive stages, each imposing a different organizational-capability requirement, as illustrated in Fig 1.

At the acquisition stage, a firm must identify and access external technological knowledge - for example, information about enterprise-management platforms, monitoring sensors, or data-analysis tools used for material traceability. This stage depends primarily on how proactively the firm's owner searches for information, a capacity that is typically constrained by small scale and the absence of a dedicated unit tracking technology trends. At the assimilation stage, the acquired knowledge must be analyzed and interpreted so

that staff understand the nature and operation of the technology, a requirement that Rizos *et al.* (2016) [8] identify as particularly difficult for SMEs owing to a lack of specialized technical skills. Together, these two stages form what Zahra and George (2002) [10] term potential absorptive capacity, reflecting the capacity to open the door to new knowledge without yet guaranteeing that the knowledge is put to use.

A critical difference emerges at the next two stages, which together form realized absorptive capacity. At the transformation stage, a firm must combine the new technological knowledge with its existing operating processes, requiring investment to redesign production processes or supply chains toward reduction and reuse of materials - a step that Lee *et al.* (2024) [3], in the context of digitally enabled servitization, show to depend considerably on what the authors term transformative capacity, which moderates the extent to which digital technology is converted into green-innovation outcomes. At the exploitation stage, the transformed output must be commercialized or put into sustained operation to generate concrete business value - for example, a recycled product sold on the market, or a material-saving process maintained over the long term rather than only piloted.

The key point illustrated in Fig 1 is that each of these four stages carries a distinct characteristic barrier; a firm may therefore pass through the acquisition and assimilation stages smoothly - that is, it already possesses and understands the technology - yet still fail to generate circular-transformation capacity if it is blocked at the transformation or exploitation stage. This is precisely the mechanism that explains the practical paradox noted in the introduction, whereby the same level of digital-technology availability yields different circular-transformation outcomes across SMEs.



Source: Author's synthesis, based on Zahra and George (2002) [10]

Fig 1: Digital absorptive capacity stages and characteristic barriers to SME circular transformation

3.2 Classifying and analyzing barriers using the four-stage absorptive-capacity framework

Building on the mechanism presented above, the study constructs a barrier-classification framework as a two-dimensional matrix, with one dimension being the four stages of digital absorptive capacity and the other being the internal or external origin of each barrier, drawing on the internal/external classification that Ormazabal *et al.* (2018) [6] applied when studying circular-economy barriers among Spanish SMEs. Table 1 presents the results of this classification, together with illustrative sources for each cell.

Table 1: Classification of Circular-Transformation Barriers by the Four-Stage Digital Absorptive Capacity Framework Among SMEs

Absorption stage	Internal barrier	External barrier	Illustrative source
Acquisition	Limited awareness among owners of available digital solutions	Information on digital solutions is fragmented; lack of a reliable initial advisory channel	Rizos <i>et al.</i> (2016) ^[8] ; Ormazabal <i>et al.</i> (2018) ^[6]
Assimilation	Shortage of staff with the digital-technical skills needed to interpret and operate new technology	Limited access to external training or specialized technical advisory services	Rizos <i>et al.</i> (2016) ^[8]
Transformation	Limited financial resources to redesign production and business processes	Lack of dedicated financial instruments; difficulty accessing credit for circular-transformation investment	Rizos <i>et al.</i> (2016) ^[8] ; Ormazabal <i>et al.</i> (2018) ^[6]
Exploitation	Short-term managerial orientation; risk aversion toward commercializing transformation outcomes	Weak market demand for circular products and services; lack of policy mechanisms incentivizing circular output	Ormazabal <i>et al.</i> (2018) ^[6] ; Rizos <i>et al.</i> (2016) ^[8]

Source: Compiled by the author from Zahra and George (2002) ^[10], Rizos *et al.* (2016) ^[8], and Ormazabal *et al.* (2018) ^[6].

The classification results in Table 1 reveal two notable patterns. First, barriers at the first two stages - acquisition and assimilation - are largely universal, appearing in most studies of innovation barriers among SMEs regardless of sector, because they are tied to the general characteristics of small scale, such as a lack of dedicated staff and limited access to information, rather than being specific to circular transformation. Second, barriers at the latter two stages - transformation and exploitation - are more specific to the circular context, as they relate directly to characteristics of the market for circular products, which typically carry a higher short-term price than conventional products and are not yet prioritized by consumers, consistent with the policy recommendation of Rizos *et al.* (2016) ^[8] regarding the need to influence consumer preferences in order to support firms' market outlets.

Another important finding is that internal and external barriers at the same stage tend to reinforce one another unfavorably. At the transformation stage, SMEs' limited internal financial resources become more severe when the external credit market lacks financial instruments specifically designed for circular-transformation investment, making it difficult for firms to offset internal constraints with externally mobilized resources. A similar unfavorable reinforcing mechanism appears at the exploitation stage, where owners' short-term managerial orientation coincides with an immature circular market, further weakening the incentive to commercialize. This finding suggests that support policy addressing only one side - internal or external - at these two stages is unlikely to be effective unless the other side is addressed simultaneously.

3.3 Assessment of current conditions and gaps among Vietnamese SMEs

Comparing the classification framework in Table 1 with Vietnam's current support-policy landscape reveals a notable mismatch between where support is concentrated and where the real barriers lie. The Enterprise Digital Transformation Support Program for 2021–2025 under Decision No. 12/QĐ-BKHĐT focuses mainly on raising digital-transformation awareness and connecting firms with technology platforms (Ministry of Planning and Investment of Vietnam, 2021) ^[4] - that is, it primarily targets the acquisition stage within the four-stage framework presented above. Meanwhile, given that Vietnam's SME structure includes as much as 45 percent of firms in the low-to-medium technology group (Tập chí Kinh tế - Tài chính, 2024) ^[9], the real bottleneck more likely lies at the transformation stage - that is, the financial and organizational capacity to redesign processes - and at the

exploitation stage - that is, the ability to access markets for circular products.

This gap becomes even clearer when set against the circular-economy policy framework. The Scheme for Circular Economy Development in Vietnam under Decision No. 687 sets out a general direction for developing circular business models but does not yet include a dedicated financial mechanism supporting SMEs' transformation stage, nor a policy instrument that directly addresses market demand to support the exploitation stage (Prime Minister of Vietnam, 2022) ^[7]. In other words, the two largest policy programs related to this topic in Vietnam - one on digital transformation and one on the circular economy - have yet to design support instruments that align precisely with the barrier locations identified by this study's analytical framework, reinforcing the case for redesigning support mechanisms around each specific absorption stage, as detailed in Section 4.

4. Policy Implications for Vietnam

Based on the gap identified in Section 3.3, policy implications are presented for three groups of actors. Each recommendation is tied to the specific absorption stage it addresses, a prerequisite condition, and an order of priority, in order to avoid repeating the current scattershot approach to support.

For state management agencies, four recommendations corresponding to the four stages are proposed. At the acquisition stage, the Enterprise Digital Transformation Support Program already has a suitable operating foundation, so it is only necessary to adjust the criteria for selecting the platforms introduced to firms, prioritizing platforms with life-cycle monitoring or material-traceability functions rather than generic management platforms. This is a fast, low-cost adjustment that can be implemented immediately in the short term. At the assimilation stage, the Ministry of Planning and Investment needs to add a technical-training component alongside the granting of platform-usage rights, rather than stopping at subsidizing subscription costs, because possessing technology without understanding how to operate it does not generate transformation. At the transformation stage, the most serious bottleneck according to the analysis in Section 3.3, a dedicated financial component should be established within the SME Development Fund, earmarked for process-redesign investment aimed at circularity, with approval criteria kept separate from ordinary digital-transformation loans. The prerequisite is issuing a list of process-redesign activities eligible for such loans. This is a medium-term step requiring coordination between the Ministry of Planning and

Investment and the policy-banking system. At the exploitation stage, a demand-side instrument is needed, specifically prioritizing SMEs' circular products in public procurement, combined with tax incentives for products meeting a verified circularity standard. This is a long-term step requiring interagency coordination among the Ministry of Finance, the Ministry of Industry and Trade, and the Ministry of Planning and Investment.

For enterprises, the recommendation focuses on action that does not depend on the pace of policy development, likewise tied to each stage. At the acquisition stage, firms should assign a dedicated focal point to track digital solutions relevant to circularity, rather than leaving this entirely to chance encounters. At the assimilation stage, firms should proactively partner with local vocational training institutions or universities to send staff to short-term training courses on operating the technology, taking advantage of lower costs than in-house training. At the transformation stage, firms should start with a pilot scale limited to a single production line or product line, in order to control financial risk before scaling the process across the whole operation. At the exploitation stage, firms should proactively seek value-chain partners with guaranteed demand for circular products before investing in scale expansion, rather than producing first and seeking a market afterward.

For industry associations, the intermediary role should focus on two areas. One is periodically consolidating members' support needs according to the four absorption stages, serving as the basis for proposing a specific priority list to the Ministry of Planning and Investment, rather than submitting generic complaints about digital-transformation difficulties. The other is developing sector-specific technical handbooks guiding process redesign toward circularity, focused on the transformation stage, thereby reducing the individual consulting costs that small firms would otherwise have to bear on their own.

5. Conclusion

This study has constructed an integrated analytical framework combining three theories - absorptive capacity theory, circular economy theory, and innovation-barrier theory for SMEs - to explain the mechanism through which digital absorptive capacity is converted into circular-transformation capacity. The study's theoretical contribution lies in proposing a barrier-classification framework structured as a four-stage absorptive-capacity matrix combined with the internal or external origin of each barrier, replacing the topic-based barrier listing common in the existing literature. Its practical contribution is reflected in a set of policy implications tied directly to each specific absorption stage, identifying the transformation and exploitation stages as the two policy bottlenecks left unaddressed in Vietnam, in contrast to the current scattershot support approach.

The study's main limitation stems from the nature of the desk-research method. Because no primary data were collected, the barrier-classification framework is drawn from a synthesis of secondary literature and has not been directly verified through surveys or interviews with Vietnamese SMEs; the suitability of each barrier to specific sectors may therefore require adjustment in practical application. On this basis, future research should conduct empirical surveys to quantify the severity of barriers at each absorption stage

across different sectors, as well as evaluate the impact of the proposed policy instruments once piloted.

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