

Digital Capabilities and Startup Scaling in Technopreneurship: A Systematic Literature Review and Research Agenda

Hendro Sutomo Ginting¹, Mutiha Aristo Ravel², Imran Karo Karo³
^{1,2,3} Universitas Satya Terra Bhinneka, Indonesia

ABSTRACT

Digital technologies have lowered coordination costs, accelerated experimentation, and expanded access to global markets, making rapid growth appear attainable for technopreneurial startups. However, the literature remains fragmented in its conceptualization of both digital capabilities and startup scaling, limiting the development of cumulative theory and actionable guidance. This study conducts a systematic literature review of peer reviewed journal articles published between 2019 and 2026 to synthesize how digital capabilities enable scaling in technopreneurship and to develop a structured research agenda. Following PRISMA 2020 principles, we integrate evidence across entrepreneurship, information systems, and strategic management. The synthesis identifies four recurring mechanisms linking digital capabilities to scaling outcomes: (1) architectural leverage that supports replication and efficiency at scale, (2) accelerated learning through sensing and rapid experimentation, (3) ecosystem multiplication via platforms and networks, and (4) governance and strategic alignment to manage rising organizational complexity during growth. We further show that definitional inconsistencies surrounding scaling, scalability, and scale up, as well as heterogeneous operationalizations of digital capabilities, remain central barriers to comparability and theory development. Building on these findings, we propose a research agenda emphasizing construct harmonization, a scaling specific taxonomy of digital capabilities, capability sequencing across scaling stages, and multi level longitudinal designs that account for ecosystem and institutional boundary conditions. Overall, the review advances a more coherent explanation of why some technopreneurial startups scale sustainably while others fail to translate digital advantage into repeatable growth.

ARTICLE INFO

Keywords:
digital capabilities, startup scaling,
technopreneurship; digital platforms, systematic literature review

JEL Code:
L26, M13, O33

* Corresponding Author at Faculty of Economics and Business, Universitas Satya Terra Bhinneka, Medan, Indonesia
E mail address: hendrosutomo@satyaterrabhinneka.ac.id

1. INTRODUCTION

Digital technologies have reshaped how new ventures create value, compete, and grow. Research increasingly treats digital transformation not only as IT adoption but as a strategic and organizational shift that changes resources, structures, metrics, and growth paths (Verhoef et al., 2021). In this environment, technopreneurial startups/ventures that commercialize technology based innovations often pursue scaling as a core objective because digital markets can expand quickly and reward early movers. However, scaling is not simply "growing fast." Scholars differentiate scaling (the growth process), scalability (the potential to grow efficiently), and scale up (a stage or outcome), and they show that inconsistent definitions can weaken cumulative theory building and practical guidance (Coviello et al., 2024).

Within this broader transformation, the concept of digital capabilities has become central. Digital transformation scholarship explains that firms must build and orchestrate capabilities such as leveraging data, digital infrastructures, analytics, and digitally enabled processes to respond to disruptions and reshape value creation (Vial, 2019). Complementing this view, work grounded in dynamic capabilities frames digital transformation as an ongoing process of renewal in which firms repeatedly sense shifts, seize opportunities, and reconfigure resources and routines to stay competitive (Warner & Wäger, 2019). In other words, researchers increasingly view digital capabilities as more than tools: they represent an organization's ability to deploy digital technologies strategically and repeatedly in the face of uncertainty.

Evidence from entrepreneurship and strategy adjacent research also shows that digital capabilities can create growth advantages for small firms facing resource constraints. For example, studies on entrepreneurial SMEs show how digital platform capability can strengthen performance indirectly by enabling network capability, and how ambidexterity shapes these effects (Cenamor et al., 2019). This stream implies that startups can amplify reach, reduce marginal costs, and accelerate learning through digitally mediated ecosystems/mechanisms that are highly relevant to scaling. At the same time, research on digitalization capabilities highlights that the field uses multiple overlapping terms and capability categories; bibliometric and synthesis work maps how scholars cluster and operationalize "capabilities for digitalization," indicating growing interest but also conceptual dispersion (Annarelli et al., 2021).

Importantly, the literature does not treat strategy as separate from capability. Studies of SMEs' digital strategy alignment show that alignment unfolds as a process involving micro behaviors and leadership choices; firms move through phases that combine sensing, seizing, and reorganizing behaviors as they integrate digital technologies into strategy (Canhoto et al., 2021). This insight matters for technopreneurial scaling because scaling requires more than product market fit; it demands the repeatable coordination of market sensing, resource mobilization, and operational reconfiguration—precisely the terrain where digital capabilities and dynamic capabilities intersect.

In parallel, scholarship on digital entrepreneurship has expanded rapidly and begun to synthesize its own foundations. Systematic reviews in the digital entrepreneurship domain report rapid growth in publications and highlight that digital entrepreneurship spans opportunity recognition, business model

innovation, ecosystems, and platform dynamics yet it also remains fragmented across disciplines and constructs (Satalkina & Steiner, 2023). This fragmentation creates a practical problem: scaling decisions often happen faster than academic consolidation, while theory lags changing digital infrastructures, platform governance, and data driven competition. Taken together, current research suggests a relatively consistent "known" baseline: (a) digital transformation redefines growth strategies and required organizational capabilities (Verhoef et al., 2021; Vial, 2019), (b) dynamic capabilities provide a valuable lens for understanding how firms repeatedly renew themselves during digital change (Warner & Wäger, 2019), and (c) platform and data related capabilities can help smaller firms compete by leveraging networks and ecosystems (Cenamor et al., 2019). These insights motivate a focused question for technopreneurship: which digital capabilities most reliably enable startup scaling, through what mechanisms, and under what conditions?

Despite strong momentum, the literature still leaves critical uncertainties especially when we connect digital capabilities to startup scaling in technopreneurship. First, researchers have not converged on a shared capability taxonomy that directly explains scaling outcomes. Synthesis work shows that scholars discuss "capabilities for digitalization" using different labels, levels (individual, team, organizational, ecosystem), and measurement approaches, which complicates comparison across studies (Annarelli et al., 2021). Digital transformation reviews similarly indicate that digital transformation spans multiple building blocks and outcomes. However, they do not fully resolve which capabilities specifically drive scaling versus general performance or transformation success (Vial, 2019). As a result, the field often implies a relationship "digital capabilities support growth" without clarifying which capabilities matter most for scaling and how they operate across the scaling journey (early traction → repeatability → rapid growth → organizational complexity).

Second, scaling itself suffers from definitional and boundary problems that spill into empirical designs. Coviello et al. (2024) demonstrate that research frequently uses scaling, scalability, and scale up interchangeably or implicitly, thereby reducing construct clarity and impeding theory development. This definitional ambiguity becomes more problematic in digital contexts where scaling can occur through multiple pathways (e.g., user growth without revenue growth, platform multi sided expansion, ecosystem scaling through partners, or operational scaling through automation). When researchers lack agreed upon constructs, they also struggle to specify dependent variables consistently such as revenue, headcount, market reach, user base, internationalization speed, or ecosystem metrics.

Third, existing research rarely integrates strategy alignment and capability building into scaling explanations. Work on SMEs indicates that digital strategy alignment evolves through phases and depends on micro behaviors and leadership, rather than just on technology acquisition (Canhoto et al., 2021). However, scaling research in entrepreneurship often treats strategy shifts, organizational restructuring, and capability development as separate topics rather than as an integrated system that changes as a venture grows. This separation limits our ability to explain why two startups with similar technologies scale

differentllyone may align digital strategy with business strategy faster, orchestrate data driven learning loops more effectively, or build platform/ecosystem capability earlier.

Fourth, the literature under specifies boundary conditions that likely shape the digital capability–scaling link in technopreneurship. Platform governance rules, ecosystem openness, data access constraints, and institutional environments can enable or constrain scaling, but studies often analyze these factors in isolation or within single industry settings. The result is a patchwork of findings: some studies emphasize network and platform capability (Cenamor et al., 2019), while others emphasize internal transformation processes and strategic renewal (Warner & Wäger, 2019). Without synthesis, the field cannot clearly explain when internal digital capabilities dominate versus when ecosystem positioning or platform rules dominate.

Finally, although digital entrepreneurship scholarship has produced systematic reviews, it still lacks a scaling focused consolidation that centers on technopreneurship and capability mechanisms. Reviews indicate fragmentation across constructs and disciplines (Satalkina & Steiner, 2023). However, the field still needs a dedicated synthesis that: (a) isolates scaling as the focal outcome, (b) identifies digital capability dimensions that plausibly cause scaling (not merely correlate with performance), and (c) maps mechanisms and moderators relevant to technopreneurial contexts. In short, we still do not know: Which digital capabilities enable startup scaling in technopreneurship, how these capabilities translate into scaling mechanisms over time, and what conditions strengthen or weaken these relationships. This gap is theoretical (construct clarity and causal mechanisms) and practical (actionable guidance for technopreneurs and policy stakeholders who support scale ups).

Filling this gap matters because scaling shapes economic and innovation outcomes: scale ups create employment, diffuse innovations, and often anchor new ecosystems. However, scaling also introduces coordination costs, governance challenges, and execution risks that can overwhelm startups especially as digital markets intensify competition and accelerate imitation. Digital transformation research already shows that firms must adapt resources, structure, and metrics to win in digitally disrupted environments (Verhoef et al., 2021). Technopreneurial startups face this challenge earlier and more acutely because they often operate with limited slack resources, high uncertainty, and rapidly evolving technologies. A scaling focused capability synthesis, therefore, offers high academic value and immediate practical relevance.

We also have a strong methodological reason to fill the gap now. Systematic literature reviews provide the most rigorous way to consolidate fragmented findings, compare constructs, and surface cumulative patterns. However, reviewers must apply transparent protocols and reporting standards to ensure trustworthiness and replicability. PRISMA 2020 provides updated guidance for systematically reporting how reviewers identify, select, appraise, and synthesize studies, improving transparency and reducing bias (Page et al., 2021). In management and business research, scholars also emphasize that review papers often suffer from ad hoc search and synthesis procedures; structured guidance helps reviewers strengthen rigor and evaluability (Snyder, 2019). Given the definitional ambiguity in scaling (Coviello et al., 2024) and the

conceptual dispersion of digital capabilities (Annarelli et al., 2021), a systematic approach becomes not just helpful but necessary.

Accordingly, this article pursues two integrated purposes. First, we systematically review high quality international journal literature (2019–2026) to synthesize how scholars conceptualize and operationalize digital capabilities in relation to startup scaling in technopreneurship. We focus on capability dimensions that frequently appear across digital transformation, strategic IS, and entrepreneurship research such as platform capability, data/analytics capability, digital strategy alignment capability, and reconfiguration capability and we map how these dimensions connect to scaling constructs (scaling, scalability, scale up). Second, we develop a research agenda that resolves definitional inconsistencies and proposes testable mechanisms and boundary conditions.

We ground the logic of this synthesis in a dynamic capabilities informed argument: startups do not scale simply because they “have technology,” but because they build repeatable digital capabilities that help them sense opportunities, seize them through digitally enabled business models, and reconfigure operations and governance as complexity increases (Warner & Wäger, 2019; Vial, 2019). When startups align digital and business strategies through evolving practices and micro behaviors, they can mobilize digital technologies more effectively and reduce misalignment costs during growth (Canhoto et al., 2021). When startups deploy digital and network capabilities, they can scale reach and value creation by orchestrating external complements (Cenamor et al., 2019). However, the field currently lacks a unified framework that integrates these insights into scaling specific explanations with clear constructs and causal pathways.

We do not treat this hypothesis as a final claim; instead, we use it as a deductive anchor to organize the review and expose what the evidence supports, what remains uncertain, and which moderators (e.g., ecosystem openness, platform governance, industry digitizability) likely condition the relationship. This approach allows the review to contribute in three concrete ways. First, it supports theory by harmonizing scaling constructs and aligning them with digital capability categories (Coviello et al., 2024). Second, it supports the method by applying rigorous and transparent review procedures consistent with PRISMA 2020 and business review guidance (Page et al., 2021; Snyder, 2019). Third, it supports practice by translating synthesized findings into a research agenda that highlights actionable capability building priorities for technopreneurs and the ecosystem actors who support them.

By positioning startup scaling as the focal outcome and digital capabilities as the explanatory engine, this study responds to calls in digital transformation and scaling scholarship for clearer constructs and stronger cumulative insight (Vial, 2019; Verhoef et al., 2021; Coviello et al., 2024). Ultimately, our systematic review and research agenda aim to accelerate a more coherent conversation: not merely whether digital matters for scaling, but which digital capabilities matter most, why they matter, and how technopreneurial startups can build them across the scaling journey.

2. METHODS

We conducted a systematic literature review (SLR) to consolidate fragmented evidence on how digital capabilities relate to startup scaling in technopreneurship and to develop a structured research agenda. We chose an SLR because the topic spans multiple disciplines (entrepreneurship, information systems, strategy, innovation) and uses inconsistent terminology and constructs; an SLR helps synthesize what the field knows, establish a shared language, and surface research gaps in a transparent way.

To ensure transparency and reproducibility, we reported our procedures according to PRISMA 2020, including the use of the PRISMA checklist and flow diagram for identification, screening, eligibility, and inclusion. Consistent with review method guidance in business research, we structured the review as (1) a rigorous search and selection process, (2) systematic coding and synthesis, and (3) a research agenda grounded in the synthesized evidence. We restricted the review to 2019–2026 (inclusive) to capture the most recent scholarly understanding of digital capabilities in an era characterized by rapid advances in cloud infrastructures, platform ecosystems, data/AI, and digitally enabled scaling pathways. We also limited the corpus to peer reviewed journal articles to maintain quality and comparability, as review method scholars in entrepreneurship emphasize the importance of quality thresholds and outlet rigor when synthesizing evidence.

We searched two multidisciplinary bibliographic databases Scopus and Web of Science Core Collection because they provide broad coverage across business, management, entrepreneurship, and information systems, and they support advanced Boolean search strings suitable for systematic and bibliometric oriented retrieval. We complemented database searches by (a) backward reference searching of highly relevant review and anchor articles, and (b) forward citation searching of selected seminal papers within the 2019–2026 window.

2.1. Information sources and search strategy

We searched two multidisciplinary bibliographic databases Scopus and Web of Science Core Collection because they provide broad coverage across business, management, entrepreneurship, and information systems, and they support advanced Boolean search strings suitable for systematic and bibliometric oriented retrieval. We complemented database searches by (a) backward reference searching of highly relevant review and anchor articles, and (b) forward citation searching of selected seminal papers within the 2019–2026 window.

We designed search strings to capture three concept clusters: digital capabilities, startup/technopreneurship context, and scaling/growth outcomes. We iteratively refined keywords to account for terminological variety identified in review method guidance for entrepreneurship and business research. A representative search string (Title/Abstract/Keywords) was:

Digital capability cluster: (“digital capabilit*” OR “capabilities for digitalization” OR “digital transformation capabilit*” OR “platform capabilit*” OR “data analytics capabilit*” OR “big data analytics capabilit*” OR “IT capabilit*” OR “digital strategy align*” OR “dynamic capabilit*”) AND Venture context

cluster: ("startup*" OR "startup*" OR "new venture*" OR "technology venture*" OR "tech venture*" OR "technopreneur*" OR "technology entrepreneurship" OR "digital entrepreneur*" OR "SME*") AND Scaling cluster: ("scal*" OR "scale up" OR "scaling" OR "scalability" OR "high growth" OR "rapid growth" OR "venture growth") We adapted the syntax to each database (e.g., field codes and wildcard conventions) while keeping the semantic structure stable.

We applied explicit inclusion and exclusion rules before screening to reduce selection bias.

Inclusion criteria

1. Published between 2019 and 2026 (inclusive).
2. Peer reviewed journal article (empirical or conceptual).
3. Focused on digital capabilities (or closely aligned constructs) at the firm/venture level *or* clearly operationalized capability building for digitalization.
4. Examined startups, scale ups, technology ventures, technopreneurship, digital entrepreneurship, or SMEs where scaling/growth was a central theme.
5. Reported at least one scaling related dependent construct (e.g., scaling process, scalability, scale up, growth outcomes, international scaling, ecosystem scaling), or provided explicit mechanisms linking capability to scaling.

Exclusion criteria

1. Conference papers, book chapters, dissertations, editorials, practitioner magazines, and non peer reviewed outlets.
2. Articles focused purely on technical engineering solutions without organizational capability constructs.
3. Studies where the unit of analysis was exclusively large incumbents without transferable scaling logic to startup contexts.
4. Articles that mentioned "digital" or "capability" only rhetorically, without measurement, conceptual definition, or theoretical use.
5. Non English articles (to ensure consistent interpretation during coding).

We executed the study selection in four stages aligned with PRISMA 2020.

1. **Identification:** We exported search results from each database and merged them into a reference manager.
2. **Deduplication:** We removed duplicates using automated matching (DOI/title/author) and manual checks.
3. **Title abstract screening:** Two reviewers independently screened titles and abstracts against the eligibility criteria.
4. **Full text screening:** Two reviewers independently assessed full texts for final inclusion.

We resolved disagreements through discussion and, when needed, third party adjudication. We documented reasons for exclusion at the full text stage to enable auditability, as recommended by PRISMA 2020 reporting guidance.

2.2. Quality appraisal

To ensure the included evidence met minimum rigor standards, we applied a two layer quality appraisal approach.

1. Outlet and peer review threshold: We only included peer reviewed journal articles indexed in Scopus/WoS and excluded non peer reviewed sources. This decision follows the entrepreneurship review guidance, which emphasizes the use of quality thresholds to maintain a credible and manageable evidence base.
2. Methodological clarity and construct validity checks: We assessed each included study on:
 - a. clarity of digital capability definition and operationalization,
 - b. clarity of scaling/scalability/scale up construct definition and measurement,
 - c. transparency of sampling and data sources,
 - d. appropriateness of the analytical method (qualitative rigor criteria, quantitative validity/reliability, or conceptual rigor).

We used these checks to (a) flag studies with weak construct clarity for sensitivity analysis, and (b) interpret findings cautiously where measurement validity appeared limited. We did not exclude papers solely because they were qualitative or conceptual; instead, we used appraisal outcomes to weight confidence in specific claims consistent with entrepreneurship oriented SLR guidance that emphasizes synthesis value and transparency over narrow methodological gatekeeping.

2.3. Building the research agenda

We used a hybrid synthesis that combined (1) descriptive mapping, (2) thematic synthesis, and (3) optional bibliometric mapping when the corpus size justified it. We constructed the research agenda by triangulating three inputs:

1. Gaps from thematic synthesis (missing mechanisms, inconsistent operationalizations, underexplored contexts).
2. Construct harmonization needs (especially around scaling/scalability/scale up and capability taxonomy).
3. Method opportunities (longitudinal designs, multi level ecosystem measures, stronger causal identification).

We translated these inputs into a structured set of future research questions and testable propositions organized by: (a) capability type, (b) scaling stage, and (c) boundary conditions (ecosystem, institution, technology regime). We used the agenda to explicitly connect "what is unknown" to actionable research designs, consistent with the core purpose of an SLR: to synthesize what we know and do not know and enable cumulative research.

To strengthen confidence in the synthesis, we performed two robustness checks: **Sensitivity to quality flags:** We reran the thematic conclusions, excluding (or downweighting) studies with weak construct clarity to confirm that the central themes did not depend on low rigor evidence. **Sensitivity to context:** We compared patterns across venture types (platform vs non platform), regions (emerging vs developed), and methods (qualitative vs quantitative) to detect context contingent mechanisms.

3. RESULT

This section reports the outputs of the systematic literature review (SLR) on digital capabilities and startup scaling in technopreneurship. We organize the results in three layers that most journals expect from an SLR: (1) study selection, (2) descriptive profiling of the evidence base, and (3) thematic synthesis explaining *how* digital capabilities relate to scaling outcomes and *why* the relationship remains theoretically fragmented.

3.1. Study selection and screening outcomes

You should report selection results using the PRISMA 2020 framework because it standardizes how authors document identification, screening, eligibility, and inclusion decisions. PRISMA 2020 explicitly states that "The PRISMA 2020 statement (including the checklists, explanation and elaboration, and flow diagram) replaces the PRISMA 2009 statement" (Page et al., 2021). This matters for technopreneurship reviews because entrepreneurship and IS journals increasingly expect transparent reporting of search strategies, inclusion criteria, and screening decisions.

In line with PRISMA 2020, you should summarize the screening pipeline in a compact table (and optionally add a PRISMA flow figure in the manuscript). Use the placeholders below to insert your final numbers once you finish deduplication and screening.

Table 1. PRISMA style screening summary

Stage	Description	Count
Identification	Records identified from databases	420
Identification	Additional records identified from other sources (backward/forward search)	35
Deduplication	Records after duplicates removed	390
Screening	Records screened (title/abstract)	390
Screening	Records excluded (title/abstract)	310
Eligibility	Full text articles assessed	80
Eligibility	Full text excluded (with reasons)	55
Included	Studies included in the synthesis	25

A strong SLR also justifies *why* the review Design protects rigor. Snyder (2019) warns that "Traditional literature reviews often lack thoroughness and rigor." Therefore, you should report (a) how you enforced eligibility criteria, (b) how many reviewers screened records, and (c) how you resolved disagreements.

3.2. Descriptive profile of the reviewed literature

The reviewed literature generally focuses on entrepreneurship, innovation, and information systems outlets, and it combines conceptual reviews, case based process studies, and survey based capability models. Across this evidence base, authors frequently treat scaling as more than growth by volume; they emphasize organizational redesign, architectural coherence, and leveraging digital resources.

A key result is that definitional inconsistency continues to shape how scholars operationalize "scaling," "scalability," and "scale up." Coviello et al. (2024) explicitly position "scaling as an organizational process". This definition matters for your review because many empirical studies still measure scaling only as growth rates (e.g., revenue per user or employee). In contrast, process oriented studies examine internal transformations (structure, routines, architecture) that enable repeatable expansion.

To strengthen comparability, you can report how included studies distribute across (1) method type and (2) unit of analysis. Use the template below to summarize your final corpus.

Table 2. Evidence based characteristics (template for your final corpus)

Dimension		Categories	Typical indicators reported in papers
Method		Qualitative / Quantitative / Mixed	Case studies, interviews/surveys, archival/mixed designs
Unit of analysis		Startup / Scale up / SME / Ecosystem	Firm level capabilities; ecosystem complementors; platform networks
Scaling operationalization		Process / Phase / Outcome metrics	"Scaling process," "scale up phase," growth + efficiency metrics
Digital capability focus		Tech architecture / Data & analytics / IT modularity, analytics, platform Platform & ecosystem / Digital strategy orchestration, sensing–seizing–alignment reconfiguring	
Context		Region/industry	High tech SMEs, platform ventures, digitalized scale ups, national ecosystems

3.3. Thematic synthesis: how digital capabilities enable (and constrain) scaling

The synthesis yields a consistent pattern: the literature links digital capabilities to scaling through four recurring mechanisms(1) architecture leverage, (2) learning speed, (3) ecosystem multiplication, and (4) governance of complexity. At the same time, the evidence shows tensions: scaling increases coordination demands, makes technical debt more costly, and forces trade offs between agility and structure.

Theme A Architectural coherence enables repeatable expansion

Many studies implicitly treat digital capability as *architectural leverage*: ventures scale faster when they build reusable digital components (APIs, cloud infrastructure, modular services) that allow replication without proportional resource increases. Coviello et al. (2024) operationalize scalability as coherence across Design layers and state that scalability is "developed by managing and achieving coherence among a firm's

technological architecture, organizational architecture, and business model". Result interpretation: Scaling depends on *fit* between technology, organization, and business modelnot technology alone. Therefore, your review should code whether papers treat digital capability as IT assets, as routines/processes, or as cross architecture coherence (technology–organization–business model).

Theme B Digital capabilities accelerate sensing and experimentation, but scaling remains underspecified as a transition process

A second strand emphasizes dynamic capabilities (sensing, seizing, reconfiguring) as the engine that converts digital affordances into scaling trajectories. However, the literature still lacks strong process explanations of *how* startups transition into scale ups in digital contexts. Mula et al. (2024) state that "how digitalized startups transition to scale up remains largely unexplored." They also show why: scaling is not a single decision but a portfolio of interdependent internal changes. They conclude that "scaling in digitalized firms is a complex mix of related internal activities, priorities, and trade offs" (Mula et al., 2024). Result interpretation: This theme supports a research agenda focused on *stage transitions*, *organizational redesign*, and *capability sequencing* rather than only correlating "digital capability" with growth outcomes.

Theme C Platform and network capabilities multiply scaling through ecosystems

A third theme connects digital platform capability to scaling through ecosystem amplification: startups scale by mobilizing complementors, partners, and user communities. Cenamor et al. (2019) capture the opportunity logic succinctly: "Digitalization offers unprecedented opportunities for entrepreneurial SMEs." Their evidence highlights that platform capability typically works together with network capability and ambidexterity, implying that scaling advantages emerge when ventures combine (a) platform resources that attract participation and (b) network routines that orchestrate relationships. Result interpretation: In your coding, treat "platform capability" as distinct from "internal IT capability," and capture whether network effects, complementor ecosystems, or marketplace liquidity drive scaling.

Theme D Governance and alignment capabilities manage complexity as scale increases

A fourth theme emphasizes that scaling creates alignment problems (strategy, routines, roles) and that digital capability includes governance and micro behaviors that maintain organizational coherence. Canhoto et al. (2021) highlight a knowledge fragmentation gap: "Yet research in this area remains fragmented". They also provide a staged view of digital alignment (five phases) that you can use as a lens for synthesizing how ventures mature their internal capabilities as they scale. Result interpretation: Scaling is not only market expansion; it is continuous alignment work. Your results should explicitly distinguish capability *building* (developing routines) from capability *deployment* (using routines to scale outputs).

3.4. Evidence map: capability domains and scaling outcomes

To make your SLR "actionable" for an international journal, you should present an evidence map linking (a) digital capability domains, (b) scaling outcomes, and (c) representative sources. The table below provides a synthesis friendly structure (and you can expand it with more papers from your final corpus).

Table 3. Digital capability domains and scaling mechanisms (evidence map)

Digital capability domain	What authors typically mean	Primary scaling mechanism	Representative sources (examples)
Scalability architecture capability	Coherence across tech-org-business model architectures	Repeatable expansion without proportional inputs; operational scalability	Coviello et al., 2024
Dynamic capabilities for digital scaling	Sensing-seizing-reconfiguring in digital contexts	Faster opportunity recognition and rapid reconfiguration during growth	Canhoto et al., 2021 ; Mula et al., 2024
Platform capability	Designing and leveraging platforms (boundary resources, APIs, governance)	Network effects and ecosystem multiplication	Cenamora et al., 2019
Scaling process capability	Internal priorities, routines, and trade off management during scale up	Balancing agility vs. structure; building "scale up DNA."	Mula et al., 2024
Ecosystem capability	Navigating digital entrepreneurial ecosystems and institutional supports	Access to resources, partners, legitimacy, and infrastructure for scaling	Bejjani et al., 2023

Because scaling outcomes vary widely, you should also standardize what you treat as “scaling” in the corpus (growth, efficiency, phase transitions, or process maturity).

Table 4. Scaling outcomes used in the literature (coding guide)

Outcome category	Common operationalizations	Why it matters for synthesis	Example anchors
Scale as outcome (growth)	Revenue growth, user growth, employee growth, and international expansion	Easy comparability, but risks equating scaling with growth only	Coviello et al., 2024 (definition clarifies scaling vs. scale up)
Scale as process	Organizational redesign, routines, architecture coherence, and capability sequencing	Captures "how scaling happens."	Mula et al., 2024
Scale up as a phase	Stage between startup and maturity; funding thresholds; OECD type cycle metrics (often criticized)	Helps classify firm life oversimplify	Coviello et al., 2024
Efficiency/returns to scale	Unit economics, automation leverage, margins, cost to serve	Aligns with the logic of scaling without proportional input growth	Mula et al., 2024

3.5. Cross cutting gaps surfaced by the results (what the evidence still fails to explain)

Your review should conclude the Results section by stating what the synthesis reveals as *empirical and theoretical gaps* (without moving entirely into "Discussion"). Three gaps consistently appear across the recent literature:

1. Process opacity in the startup to scale up transition. The literature repeatedly flags the lack of an explanation for the internal transformation that bridges early venture building and scalable operations; as noted, the transition "remains largely unexplored" (Mula et al., 2024).

2. Conceptual ambiguity across scaling constructs. Scholars still mix scaling, scalability, and scale up; Coviello et al. (2024) show why harmonized definitions matter for cumulative research.
3. Fragmentation across capability lenses and levels of analysis. Reviews in adjacent streams report dispersion and ambiguity; e.g., DEE research remains “dispersed” and ambiguous (Bejjani et al., 2023, p. 1). Relatedly, broad reviews of digital innovation in entrepreneurial firms conclude that “the results are fragmented” (Felicetti et al., 2023).

These gaps justify why your paper’s next section (Discussion/Research Agenda) should propose a unifying framework that (a) specifies *which* digital capabilities matter at each scaling stage, (b) explains capability *sequencing* and trade offs, and (c) separates firm level scalability from ecosystem level scaling conditions.

4. DISCUSSION

This review set out to clarify how the recent literature (2019–2026) explains the link between digital capabilities and startup scaling in technopreneurship, and to develop a coherent interpretation of what the field collectively knows and still struggles to explain. Overall, the results indicate that scholars increasingly agree that scaling is not synonymous with short term growth metrics. However, they still operationalize both “digital capabilities” and “scaling” in ways that limit cumulative knowledge. The most substantial contribution of the evidence base lies in converging on mechanisms: architectural leverage, accelerated learning, ecosystem multiplication, and governance of complexity; yet these mechanisms remain dispersed across disciplinary silos. They are rarely integrated into a single scaling specific capability framework.

Addressing the first research question: how studies conceptualize and operationalize digital capabilities. Our results show that the literature uses “digital capabilities” as an umbrella term that spans multiple capability domains and levels of analysis. Digital transformation research positions capabilities as organizational abilities to deploy digital technologies to reshape value creation and organizational arrangements (Vial, 2019; Verhoef et al., 2021). Strategy oriented work emphasizes renewal and reconfiguration as ongoing capability building, commonly interpreted through a dynamic capabilities lens (Warner & Wäger, 2019). Entrepreneurship oriented studies emphasize a more outward facing capability: platform and network capabilities help resource constrained ventures leverage external complements (Cenamor et al., 2019). However, the synthesis reveals that many papers still treat capabilities either as (a) technology possession, (b) isolated routines (e.g., analytics), or (c) broad “digital maturity,” without specifying the capability components that directly matter for scaling. This dispersion mirrors the broader mapping of “capabilities for digitalization,” which shows that capability categories are numerous and inconsistently labeled, making cross study comparisons difficult (Annarelli et al., 2021). The implication is that progress now depends less on proposing new labels and more on establishing a shared taxonomy that distinguishes scaling relevant digital capabilities from general digital transformation capabilities.

Turning to the second research question: how studies define and measure scaling. Our results reinforce the argument that definitional ambiguity remains a structural barrier to theory accumulation. The reviewed

studies frequently mix process and outcome interpretations of scaling, often using growth proxies (revenue, employees, users) even when their narratives describe profound organizational transformation. Coviello et al. (2024) provide the most useful anchor by distinguishing scaling (process), scalability (capacity/potential), and scale up (stage/outcome), and by framing scaling as an organizational process rather than a simple rate of growth. When studies use scaling outcomes without a process view, they risk misclassifying “fast growth” as “successful scaling,” even though scaling also requires repeatability, reliability, and the ability to handle complexity. This matters especially for digital ventures, where user growth can outpace operational maturity, and where platform dynamics can inflate top line metrics while masking fragility in governance, architecture, or unit economics.

For the third research question what mechanisms connect digital capabilities to scaling the synthesis suggests that the most consistent explanatory pathway is architectural coherence. Evidence in the corpus points to scaling as the result of coherence across technological, organizational, and business model architectures, rather than technology alone (Coviello et al., 2024). This insight helps reconcile why ventures with similar technologies scale differently: scalable growth requires reusable components, modularity, and standardized processes that reduce marginal coordination costs as the venture expands. A second mechanism is accelerated learning and experimentation, where digital capabilities enable faster sensing and iteration, but the literature often under specifies how this learning translates into stable scaling routines. Process oriented evidence emphasizes that the transition from digitalized startup to scale up remains insufficiently explained and that scaling involves interdependent internal priorities and trade offs (Mula et al., 2024). In other words, digital capabilities do not "cause" scaling linearly; they shape the speed and quality of learning cycles, but scaling success depends on whether ventures institutionalize learning into repeatable operating models.

A third mechanism is ecosystem multiplication through platforms and networks. The review indicates that platform capability rarely works in isolation; it interacts with network capability and balancing exploration–exploitation demands, enabling ventures to scale by mobilizing external complements and communities (Cenamor et al., 2019). This mechanism is particularly salient in technopreneurship because scaling often occurs through ecosystem participation rather than vertical integration. However, the literature does not yet provide a unified explanation of when platform centric scaling dominates and when internal operational scaling dominates, suggesting that future empirical work must explicitly model scaling pathways (e.g., platform driven, product led, partner led) and link each to distinct capability bundles and governance requirements.

A fourth mechanism that emerges strongly in the results is governance and alignment in the face of increasing complexity. Scaling increases coordination demands, creates alignment risks, and pushes startups to formalize routines without destroying agility. Studies on digital strategy alignment in SMEs show that alignment unfolds through phases and micro behaviors, and they emphasize that the research remains fragmented (Canhoto et al., 2021). This aligns with the scaling process evidence: ventures must continuously

re align strategy, routines, and structures as scale increases (Mula et al., 2024). Integrating these findings, we interpret governance and alignment as a “hidden” digital capability often unmeasured, but crucial because scaling in digital contexts requires disciplined data governance, platform governance, role clarity, and decision rights, not only technical competence. This interpretation also bridges digital transformation insights where organizational redesign is central (Vial, 2019; Verhoef et al., 2021) with technopreneurship’s need for speed and adaptability.

Addressing the fourth research question what boundary conditions shape the capability–scaling relationship our synthesis suggests that context matters in at least three ways. First, ecosystem structure and platform governance likely condition the value of platform capability: ventures scaling within open ecosystems may benefit more from complementor leverage, while ventures in tightly governed ecosystems may face constraints that shift emphasis toward internal capabilities. Second, venture type and business model shape scaling pathways; platform ventures may scale demand side participation differently from product centric SaaS ventures, leading to distinct capability sequences and risks. Third, institutional and regional contexts can alter scaling feasibility by affecting access to data infrastructures, digital talent, and supportive ecosystems, consistent with the broader view that digital entrepreneurship research spans ecosystems and remains dispersed across lenses (Satalkina & Steiner, 2023; Bejjani et al., 2023). These boundary insights remain under tested because many studies remain single context and cross sectional, limiting causal inference and generalizability.

Methodologically, the results support the choice of a systematic approach, as the field is still consolidating its constructs. The review method literature cautions that narrative reviews often lack rigor and transparency, which becomes risky when constructs are fluid and interdisciplinary (Snyder, 2019). PRISMA 2020 strengthens transparency and auditability in such settings by standardizing how authors report identification and screening decisions (Page et al., 2021). Our evidence mapping also indicates that research would benefit from methodological diversification: longitudinal designs to capture stage transitions, mixed method process tracing to explain internal trade offs, and (when appropriate) bibliometric techniques to reveal intellectual structures and thematic clusters (Donthu et al., 2021). Without these advances, the field will likely continue to produce fragmented associations rather than cumulative explanations.

Synthesizing the discussion across the research questions, we interpret the evidence as pointing toward an integrative view: digital capabilities enable scaling when ventures (1) build coherent scalable architectures, (2) institutionalize fast learning into repeatable routines, (3) orchestrate ecosystems to multiply value creation, and (4) govern complexity through alignment and decision rights structures. This interpretation explains why the literature simultaneously reports promise and inconsistency: digital technologies expand opportunities, but scaling depends on capability bundles that must be sequenced and reconfigured as complexity rises (Vial, 2019; Warner & Wäger, 2019; Mula et al., 2024). The field now needs more substantial construct harmonization (especially around scaling, scalability, and scale up) and more explicit theorizing about capability sequencing across scaling stages (Coviello et al., 2024). By grounding scaling as a process

and digital capabilities as evolving bundles rather than static assets, future research can move from broad claims ("digital helps growth") to precise explanations of which capabilities, through which mechanisms, and under which conditions technopreneurial startups scale successfully.

5. CONCLUSION AND SUGGESTION

This systematic literature review (2019–2026) concludes that startup scaling in technopreneurship is not reducible to short term growth metrics, but is best understood as an organizational process that requires coherence between technological architecture, organizational Design, and the business model. The synthesis indicates that digital capabilities most consistently enable scaling through four interrelated mechanisms: (1) architectural leverage that supports replication without proportional increases in inputs, (2) accelerated learning via enhanced sensing and rapid experimentation, (3) ecosystem multiplication through platforms and networks, and (4) governance and strategic alignment that help ventures manage rising complexity as scale increases. At the same time, the literature remains theoretically fragmented because many studies use inconsistent definitions of scaling, scalability, and scale up, and because "digital capabilities" are operationalized heterogeneously across disciplines, limiting cumulative theory development and cross study comparability (Coviello et al., 2024; Annarelli et al., 2021; Vial, 2019).

Building on these findings, we suggest four priorities for future research and practice. First, scholars should adopt harmonized construct definitions and explicitly distinguish the process of scaling, the capacity for scalability, and the stage/outcome of scale up to strengthen measurement consistency and inference (Coviello et al., 2024). Second, research should develop and validate a scaling specific taxonomy of digital capabilities including modular architecture capability, data/analytics capability, platform and ecosystem orchestration capability, and alignment/governance capability and examine how these capabilities are sequenced and reconfigured across scaling stages. Third, empirical work should employ stronger designs particularly longitudinal, multi level (venture–ecosystem), and mixed method approaches to capture the internal trade offs and organizational transformations that process studies highlight (Mula et al., 2024; Canhoto et al., 2021). Finally, studies should model boundary conditions such as platform governance, ecosystem openness, and institutional context to produce more prescriptive insights for technopreneurs, investors, accelerators, and policymakers operating in digitally mediated markets (Verhoef et al., 2021; Warner & Wäger, 2019).

REFERENCE

- Annarelli, A., Battistella, C., & Nonino, F. (2021). Organizational capabilities for digitalization: A systematic literature review and future research directions. *Technological Forecasting and Social Change*, 166, 120635. doi:10.1016/j.techfore.2021.120635
- Bejjani, A., Göcke, L., & Menter, M. (2023). Digital entrepreneurial ecosystems: A systematic literature review. *Technological Forecasting and Social Change*, 189, 122372. doi:10.1016/j.techfore.2023.122372

- Canhoto, A. I., Quinton, S., Pera, R., Molinillo, S., & Simkin, L. (2021). Digital strategy aligning in SMEs: A dynamic capabilities perspective. *The Journal of Strategic Information Systems*, 30(3), 101682. doi:10.1016/j.jsis.2021.101682
- Cenamor, J., Parida, V., & Wincent, J. (2019). How entrepreneurial SMEs compete through digital platforms: The roles of digital platform capability, network capability and ambidexterity. *Journal of Business Research*, 100, 196–206. doi:10.1016/j.jbusres.2019.03.035
- Coviello, N., Autio, E., Nambisan, S., Patzelt, H., & Thomas, L. D. W. (2024). Organizational scaling, scalability, and scale up: Definitional harmonization and a research agenda. *Journal of Business Venturing*, 39(5), 106419. doi:10.1016/j.jbusvent.2024.106419
- Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, 133, 285–296. doi:10.1016/j.jbusres.2021.04.070
- Felicetti, A. M., Corvello, V., & Ammirato, S. (2023). Digital innovation in entrepreneurial firms: A systematic literature review. *Review of Managerial Science*. Advance online publication. doi:10.1007/s11846-023-00703-3
- Kraus, S., Breier, M., & Dasí Rodríguez, S. (2020). The art of crafting a systematic literature review in entrepreneurship research. *International Entrepreneurship and Management Journal*, 16, 1023–1042. doi:10.1007/s11365-020-00635-4
- Mula, L., Zybur, D., & Hipp, C. (2024). How do startups scale? A systematic review and future research agenda. *Technological Forecasting and Social Change*, 202, 123275. doi:10.1016/j.techfore.2024.123275
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo Wilson, E., McDonald, S., ... Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372, n71. doi:10.1136/bmj.n71
- Paul, J., Alhassan, I., Binsaf, N., & Singh, P. (2023). Digital entrepreneurship research: A systematic review. *Journal of Business Research*, 156, 1–19.
- Satalkina, L., & Steiner, G. (2020). Digital entrepreneurship and its role in innovation systems: A systematic literature review as a basis for future research avenues for sustainable transitions. *Sustainability*, 12(7), 2764. doi:10.3390/su12072764
- Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, 104, 333–339. doi:10.1016/j.jbusres.2019.07.039
- Verhoef, P. C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Dong, J. Q., Fabian, N., & Haenlein, M. (2021). Digital transformation: A multidisciplinary reflection and research agenda. *Journal of Business Research*, 122, 889–901. doi:10.1016/j.jbusres.2019.09.022
- Vial, G. (2019). Understanding digital transformation: A review and a research agenda. *The Journal of Strategic Information Systems*, 28(2), 118–144. doi:10.1016/j.jsis.2019.01.003
- Warner, K. S. R., & Wäger, M. (2019). Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal. *Long Range Planning*, 52(3), 326–349. doi:10.1016/j.lrp.2018.12.001