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Methodological Foundations of Digital Transformation of SMEs: Applicability of an Integrated Model for the Implementation of BPMN, CRM, and ERP in the US Economy

KOVALCHUK ANDRII

Business Development and Entrepreneurial Consultant Boryslav, Ukraine

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ABSTRACT

This article looks at how a combined methodological approach — one that brings together BPMN for process mapping, CRM for managing customer relationships, and ERP for tying core operations together — can strengthen digital-transformation efforts in U.S. small and medium-sized enterprises (SMEs). The aim here is to bring together what recent studies have been saying about these methods and to get a sense of whether a combined BPMN–CRM–ERP approach can actually help with the digitalization issues SMEs keep running into. The study looks at peer-reviewed work published between 2021 and 2025 and mixes it with insights from an established consulting methodology, focusing on the barriers, enablers, and integration points that seem to matter most in practice. What comes out of this review is that several pieces need to move together. Readiness diagnostics, BPMN-based process improvements, CRM tools that support customer engagement, and ERP systems that knit operations together — when these elements are combined, SMEs tend to see better productivity, more room to scale, and a digital setup that's a lot more stable. The major result is that digitalization for SMEs is not limited to adding new software. In practical terms, meaningful digitalization requires a certain degree of internal coherence — the operational processes, the firm's leadership routines, the capabilities of the workforce, and the systems meant to coordinate these areas must be reasonably aligned. When these elements move independently of one another, the introduction of new technologies tends to produce only limited or short-lived improvements. Seen from that perspective, the discussion offered here is relevant to several groups: SME owners and managers who are planning the next stage of their digital development, consultants who build or oversee integrated transformation initiatives, and policymakers interested in designing support measures that strengthen the longer-term competitiveness of small firms.

Keywords: SMEs, digital transformation, BPMN, CRM, ERP, process optimization, enterprise integration, readiness assessment, scalability, consulting methodology.

Introduction

Digital transformation has turned into a strategic necessity for small and medium-sized enterprises (SMEs) that intend to stay competitive in today's digital economy. SMEs sustain growth and jobs, but many of them still struggle to weave newer technologies or updated work routines into what they do every day. They are usually working with tighter budgets than large firms, and the gaps in digital skills, combined with the usual internal bottlenecks, complicate settling into new systems without friction.

BPMN helps managers actually see their processes laid out in front of them, CRM systems give them a way to deal with customers based on real information rather than gut feeling, and ERP platforms pull the main parts of the business into a single structure instead of leaving everything scattered. When these three are used side by side, they can support a more complete form of digital transformation. Some SMEs are already trying these elements — running analytics through their ERP systems or setting up automated follow-ups in their CRM tools — but plenty of others are still a step or two behind.

Even with all the pressure brought on by recent disruptions, a large portion of SMEs continue to move slowly when it comes to digital adoption. Policymakers in advanced economies — the United States among them — continue to emphasize the importance of digitalization for small firms. What remains less clear, however, is the practical matter of how a combined BPMN–CRM–ERP model should be introduced and managed inside an SME. This article addresses that gap by examining the methodological foundations of such an approach and considering how it may operate in the U.S. setting, drawing on the patterns and findings that emerge across recent research.

Methods and Materials

A growing body of literature has examined SME digital transformation from diverse perspectives. Anatan and Nur investigated SMEs' readiness for digital transformation in Indonesia, finding that internal issues (financial, human resources, marketing, operations, and administration) and external barriers impede readiness, and recommending knowledge transfer partnerships to overcome these challenges [1]. Ben Slimane et al. reviewed the field and put forward a three-part framework for what makes SME digital transformation work in practice. Their model points to three areas that need attention: updating digital infrastructure and core processes, putting new organizational mechanisms in place, and having strong leadership to keep the whole effort on track [2]. Brozzi et al. looked at the issue from a different angle and developed a set of Key Readiness Indicators that manufacturing SMEs can use to judge where they stand in terms of digital maturity. They point to strategy, technological awareness, employee skills, and awareness of digital trends as the main areas firms should pay attention to when preparing for Industry 4.0 adoption [3].

García-Vidal et al. examined what micro and small-enterprise owners expect from data-driven BPM. They reported clear perceived advantages — better process optimization, more informed decisions, and stronger operational efficiency — but also noted recurring obstacles such as tight budgets, resistance to change, skill shortages, and problems with data quality [4]. Hafeez et al. added another layer by reviewing the role of knowledge management in SME digital transformation. Their findings underline the importance of external actors: customers and suppliers push SMEs toward innovation, intermediaries help transfer knowledge, and government support — through policy or funding — creates conditions that make digital initiatives more feasible [5].

Existing studies also provide broader frameworks and diagnostic tools. Kovalchuk presented a comprehensive consulting framework for SMEs, offering a methodological roadmap to systematically foster growth and implement digital transformation practices [6]. It also provides the methodological logic that directly underpins the integrated model examined in this article. It argues that SMEs cannot introduce digital tools before defining their internal architecture, because fragmented processes inevitably produce fragmented technologies [6]. In this framework, the reason many U.S. SMEs fall behind in digital maturity is fairly straightforward: they tend to lean on intuition instead of formal process structures, which makes it challenging for CRM and ERP systems to mirror how the business actually works. The methodology lays out a four-step path — diagnosis, planning, implementation, and monitoring — so that digital tools are not installed as separate fixes but are fitted into one coherent system. BPMN maps out the business processes, the roles involved, how data moves, and where decisions happen. That map then becomes the base that CRM can build on (digitalizing revenue-related work) and that ERP can align with (digitalizing operations and finance). This system-level view helps avoid the typical fragmentation seen in many U.S. SMEs and explains why a BPMN–CRM–ERP approach tends to work better than the piecemeal digital upgrades criticised in earlier studies.

Marino-Romero et al., for instance, used a bibliometric lens to show how research on SME digital transformation has evolved, noting the themes that keep resurfacing and the newer trends gaining ground [7]. Meier et al. take a more conceptual angle, weaving together several theoretical perspectives and proposing a framework that links digital transformation to competitiveness in established SMEs [8]. Their work outlines nine

dimensions and sets out a multi-level research agenda for studying how digital initiatives can actually drive competitive advantage [8]. Moreira et al. added a quantitative lens by introducing a way to measure SME digitalization through the Alkire–Foster multidimensional index. They found that, although many SMEs now have basic digital infrastructure, gaps remain in both digital-skills supply and everyday use; their model helps firms benchmark how well technology is being integrated and what that means for performance [9]. Nguyen (2025), meanwhile, surveyed SME managers in Vietnam to gauge digital readiness and proposed business-process models that combine traditional and digital channels. These models give firms a clearer path for reengineering processes, automating routine work, and improving customer service [10].

Even with these contributions, the literature still shows a clear gap. Much of the existing work looks at only one slice of digital transformation at a time — readiness assessment [1][3], managerial or strategic frameworks [2][8], or individual enablers like knowledge sharing [5] — without tying these pieces together into a single, unified model for implementation. Moreover, much of the evidence is drawn from specific regions or developing economies [1][4][10], leaving a gap in understanding how an integrated approach could be applied in the context of US SMEs. No study to date has explicitly examined a methodology that synergistically implements BPMN-based process optimization, CRM-driven customer engagement, and ERP integration in smaller enterprises. This gap matters, especially in the U.S., where SMEs operate in fast-moving, highly competitive markets but still deal with the familiar problems of limited resources and limited in-house expertise. This article takes up that gap by pulling together the methodological ideas found across the literature and shaping them into one integrated model, then discussing how that model can be applied to digital transformation in U.S. SMEs.

Results and Discussion

The research suggests that a successful digital-transformation effort starts with a realistic look at an SME's readiness and a clear framework for how change will unfold. A recurring issue is low e-readiness, often tied to gaps in digital skills and tight financial constraints — problems that show up strongly in studies of developing-country SMEs as well [1]. Readiness tools such as the KRI framework are useful here because they break readiness down into specific pieces — strategy, technology, human capital — instead of reducing everything to a single "digital score" [3]. By identifying issues like weak employee digital skills or limited awareness of new technologies, SMEs can focus their improvement efforts where they matter most (see Figure 1).

Figure 1. Readiness Indicators and Common Barriers Affecting SME Digital Transformation

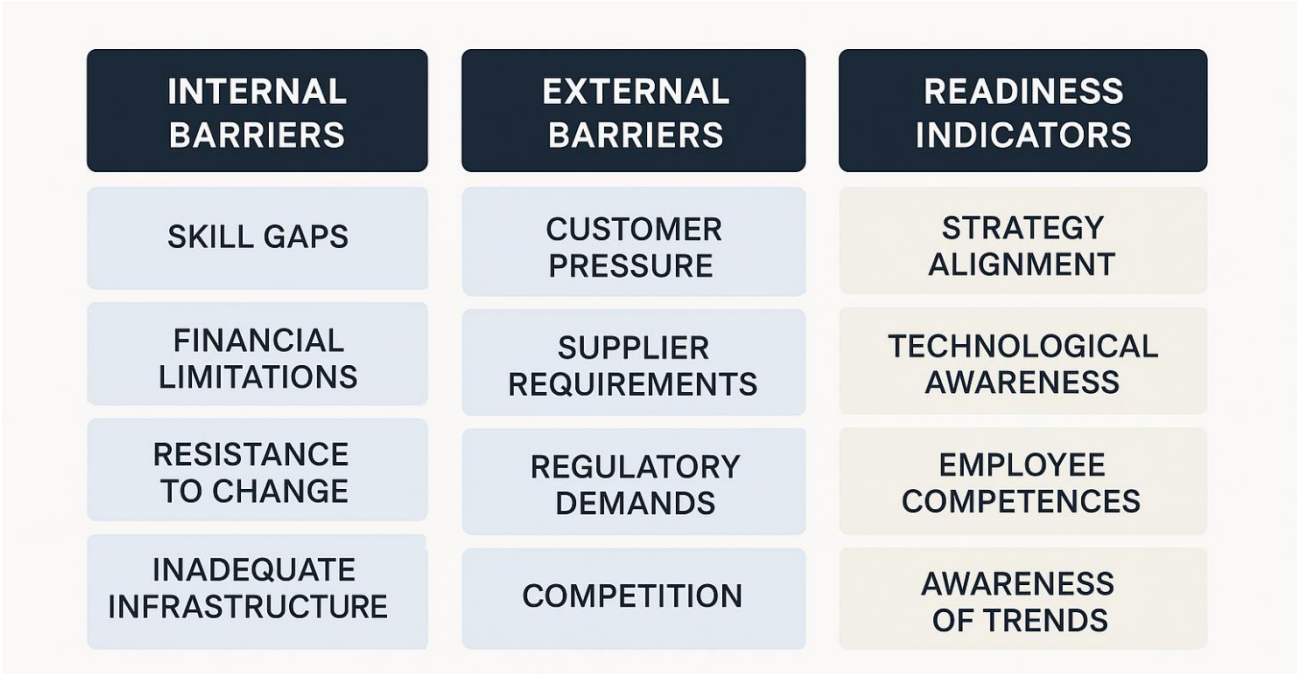

Figure 1 illustrates how internal barriers, external pressures, and readiness indicators jointly shape an SME's capacity to undertake digital transformation. The left column summarizes the internal constraints most frequently cited in the literature—skill gaps, financial limitations, resistance to change, and inadequate infrastructure—which collectively reduce e-readiness and slow the adoption of BPMN, CRM, and ERP. The middle column points to the external forces at play — customer and supplier expectations, regulatory requirements, and competitive pressure. These factors often speed up the push toward transformation, but they do not, on their own, create the internal capability needed to carry it out. The right-hand column shows the readiness indicators that recent studies keep coming back to, such as strategic alignment, technological awareness, employee skills, and general awareness of digital trends. The overall message is that external pressure can spark change, but real transformation depends on having a solid internal base, supported by planning, leadership buy-in, and tools like readiness assessments and KRIs.

Business-process optimization sits at the center of digital transformation. Using data to guide BPM work lets SMEs rethink their operations based on how processes actually perform, which can lead to sharper efficiency and better decision-making. However, SMEs often face obstacles in this domain, including resistance to changing established workflows, inadequate IT infrastructure, and technical complexity aversion [4]. The introduction of BPMN (a standardized process modeling notation) provides SMEs with a tool to visualize and streamline their operations. By mapping out processes in BPMN, organizations can identify inefficiencies and apply automation where feasible. Nguyen's study offers empirical support for the benefits of process reengineering: SMEs that redesigned their business processes through automation saw cost reductions and improved customer responsiveness, using models that integrated traditional operations with new digital channels [10]. This suggests that adopting BPMN to guide process redesign can help SMEs systematically implement changes such as workflow automation or the introduction of process mining analytics (Figure 2).

Figure 2. BPMN-Driven Workflow Redesign Cycle for SME Process Optimization

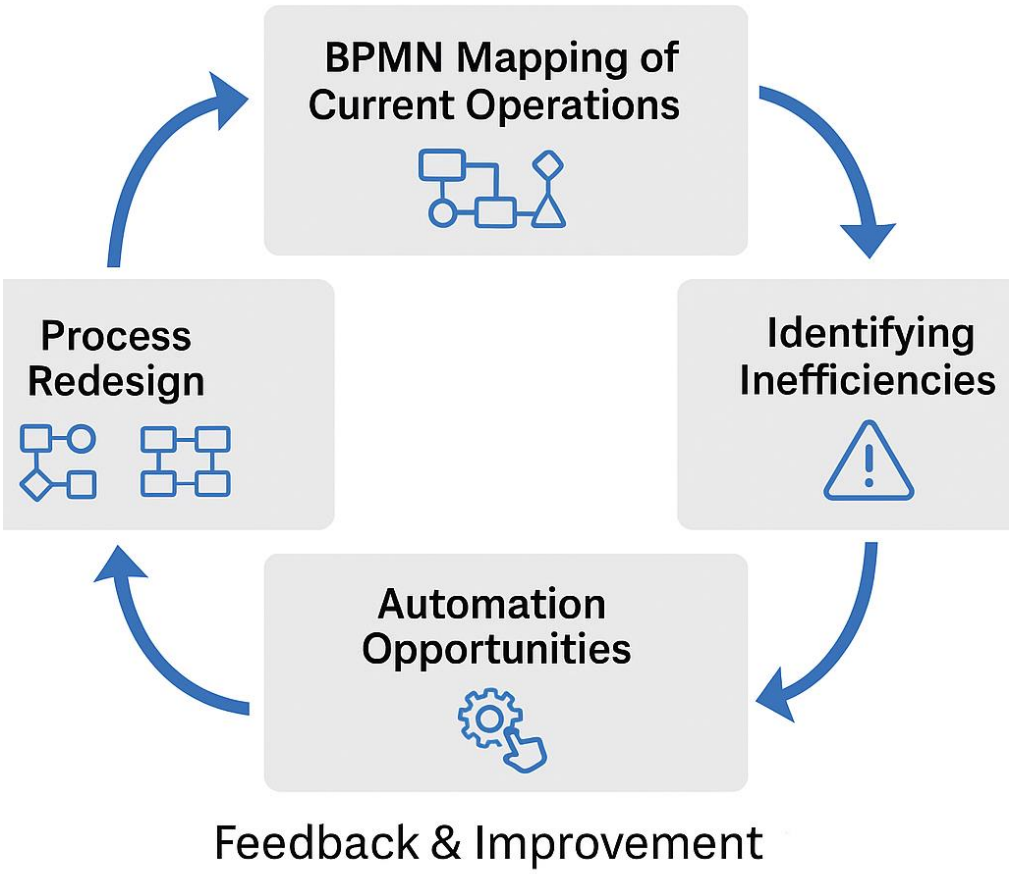

Figure 2 illustrates the iterative cycle through which BPMN supports systematic process optimization in SMEs. The diagram begins with BPMN mapping of current operations, where existing workflows are documented in a standardized visual notation. This step reveals how tasks, decisions, data flows, and role assignments are currently executed. From mapping, the process naturally moves into identifying inefficiencies—such as bottlenecks, redundant manual activities, long waiting times, or poorly defined responsibilities. The next stage, automation opportunities, shows how the identified steps can be linked to digital tools. In this phase, SMEs determine which BPMN elements can be connected to CRM touchpoints (e.g., automated follow-ups, customer data flow), ERP modules (inventory updates, financial processes), or analytics tools (process mining, KPI dashboards). This prepares the workflow for digital execution rather than manual intervention.

The cycle then moves into process redesign, where the "future-state" workflow is developed. Here, the redesigned process is simplified, standardized, and partially or fully automated. This redesign ensures that new digital systems (CRM/ERP) align with the optimized process structure rather than being added on top of dysfunctional workflows. Finally, the bottom of the diagram highlights feedback and continuous improvement, indicating that redesigned and automated processes must be monitored over time. Using process-mining analytics or KPI tracking, SMEs can further refine their processes, creating a loop where BPMN continuously supports improvement rather than being a one-off exercise.

For US SMEs, which often have to scale operations quickly, using BPMN-driven BPM ensures that digital transformation is not just about ad-hoc technology adoption but about fundamentally improving how the business runs. The results from various contexts imply that when SMEs carefully align process changes with technology (for instance, implementing standard operating procedures and then automating them), they reap significant performance gains [10][4]. Thus, embedding BPMN into the transformation roadmap fortifies the methodological foundation—every new CRM or ERP system should be accompanied by clearly modeled and optimized business processes.

A substantial part of digital transformation for SMEs is learning how to engage customers more effectively through online channels. Many studies point out that smaller firms often overlook the value of structured customer-relationship management or digital marketing, and that gap ends up hurting their competitiveness. Bringing in a CRM system helps fill that gap by giving SMEs a way to organize customer information, tailor their communication, and streamline sales processes. Moreira et al., for example, show how even small service businesses can use a CRM platform to automate follow-ups and group customers into meaningful segments with simple analytics — something that used to be realistic only for larger companies [9]. In practice, CRM adoption helps SMEs turn digital data into actionable market insight—leading to better customer service and targeted marketing campaigns. Furthermore, external pressures make CRM increasingly indispensable: customers in the digital age expect seamless service and personalization. Hafeez et al. found that customers (and suppliers) actively push SMEs toward digital tools, effectively encouraging the uptake of CRM and related innovations as a means to improve collaboration and service [5]. Therefore, integrating a CRM system as part of an SME's transformation not only improves internal handling of customer interactions but also aligns the business with market expectations. In the U.S. economy—where consumer expectations for quick, customized service are high—SMEs implementing CRM can enhance their competitiveness by fostering loyalty and accessing richer customer insights. An integrated model positions CRM as the customer-facing facet of digital transformation, ensuring that process improvements (via BPMN) and backend integration (via ERP) ultimately translate into better customer value delivery.

ERP systems form the backbone of digital integration by consolidating information across functional areas (finance, inventory, sales, etc.) into one coherent system. Research suggests that most SMEs undergoing digital transformation do manage to establish basic digital infrastructure – often an indication that some form of an ERP or similar system is in place [9]. However, merely having infrastructure is not enough; the transformative benefit comes from fully utilizing integration capabilities. Meier et al. observe that in more digitally advanced SMEs, emerging technologies (like AI-driven analytics) are not deployed in isolation but are linked into core systems such as ERP to become "strategic assets" [8]. This highlights that true digital transformation involves weaving new tools into the enterprise's central information framework. For SMEs, implementing an ERP system can be challenging due to cost and complexity, but the payoff is significant operational visibility and data-driven decision-making across the organization. The Alkire–Foster assessment results

indicate SMEs often have room to improve in leveraging such systems fully—particularly in using data from ERP for strategic decisions and in developing the digital skills to exploit system features [9]. In an integrated model, ERP provides the platform where improvements from BPMN and insights from CRM converge: process changes are codified into the ERP's workflows, and customer data flows into production, inventory, or service planning modules (Figure 3).

Figure 3. The author's illustration of the integrated BPMN–CRM–ERP Architecture Supporting SME Digital Transformation

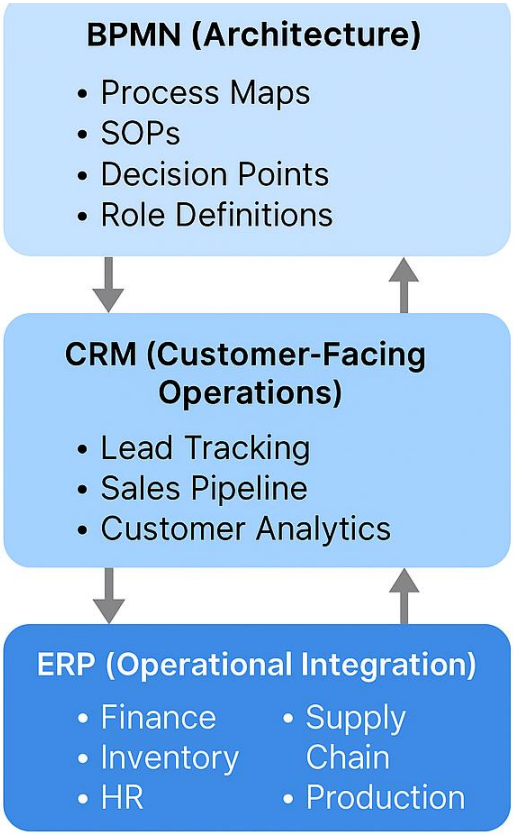

Figure 3 illustrates how BPMN, CRM, and ERP function as an integrated system that supports end-to-end digital transformation in SMEs. The top layer, BPMN, defines the architectural foundation by specifying process maps, standard operating procedures, decision points, and role assignments. These models flow downward into CRM and ERP, ensuring that customer-facing activities and operational processes are structured consistently. The middle layer, CRM, manages lead tracking, the sales pipeline, and customer analytics, sending demand and market signals into ERP while also receiving updates about inventory and delivery status from it. The bottom layer, ERP, integrates core operational functions—finance, inventory, HR, supply chain, and production—codifying the standardized processes designed in BPMN and feeding operational data back into CRM and managerial decision-making. Taken together, the arrows between the layers show how the pieces feed into one another. BPMN keeps both systems pointed in the same direction, CRM shapes what the ERP needs to deliver, and the ERP, in turn, strengthens the work done on the CRM side — the end result is a digital setup that feels unified rather than stitched together.

This integration is important for U.S. SMEs in sectors that have to scale quickly or juggle complicated supply chains. When CRM data and day-to-day operations are tied together through an ERP system, smaller firms can reach a level of coordination and efficiency that used to be typical only for much larger companies. The literature's integrative frameworks implicitly support this synergy; for instance, one dimension of Ben Slimane et al.'s framework is "rethinking digital infrastructures and processes," which in practice entails upgrading IT infrastructure (like ERP systems) alongside process

redesign [2]. Thus, ERP implementation in SMEs serves as the technological backbone that, when combined with BPMN-driven processes and CRM systems, completes a triad of transformation tools.

Beyond technology and process, effective digital transformation relies on human and organizational factors. SME studies repeatedly emphasize limitations in employee skills and organizational culture as major hindrances to transformation [1][4][9]. Addressing these issues is a methodological necessity. The integrated model must include strategies for knowledge management and skill development—such as training programs, partnerships with universities or consultants, and fostering a culture open to innovation. Anatan and Nur's work demonstrated that knowledge transfer from universities significantly helped Indonesian MSMEs overcome internal knowledge deficits and improve readiness for digitalization [1]. Likewise, Hafeez et al. highlighted that intermediaries and ecosystem collaborations (e.g., innovation hubs, industry platforms) can provide SMEs access to expertise and technologies they lack in-house, effectively augmenting their capabilities [5]. For US SMEs, tapping into local tech incubators, Small Business Development Centers, or consultant networks can similarly provide the know-how to implement complex systems like ERP or to execute BPMN modeling. Change management is another critical methodological component. Introducing BPMN, CRM, and ERP will likely reconfigure workflows and job roles, which often meets employee resistance. García-Vidal et al. noted that resistance to organizational change and lack of data literacy among staff are significant barriers to adopting data-driven BPM in smaller firms [4]. Therefore, SMEs should incorporate change management practices: clear communication of transformation benefits, involvement of employees in process redesign, and stepwise implementation to build confidence. Top management plays an essential role here—strong leadership and vision are needed to champion the transformation and align it with the company's strategy (as stressed by Ben Slimane et al.'s identification of senior management responsibility in driving change) [2]. In summary, the "people" aspect underpins the BPMN-CRM-ERP model: without building the requisite digital skills and an adaptive culture, the technical tools will not yield their full potential.

The integrated BPMN–CRM–ERP model seems broadly usable for SMEs in many settings, and the same logic can carry over to the U.S. market with a few adjustments. The U.S. has a strong digital infrastructure and a competitive business landscape, so many small firms already have access to advanced software tools. At the same time, American SMEs operate under fast-shifting market pressures, which makes a coordinated digital transformation not just useful but often necessary. Findings from international studies can still point U.S. firms and policymakers in the right direction. For example, research showing that many SMEs have the hardware and systems they need but still lack digital skills [9] likely applies in the U.S. as well, suggesting that targeted training and upskilling should be a priority. Hafeez et al.'s work also highlights how government and industry support can make a difference: U.S. policy could expand SME-focused digital training programs, build out grant or tax-incentive schemes for adopting ERP/CRM tools, and strengthen knowledge-sharing networks that help small firms learn from one another [5].

The integrated model's success factors seem universal: clarity of vision, a stepwise plan linking process improvement with technology adoption, and a supportive ecosystem. US SMEs implementing this model should start with a thorough readiness assessment (possibly adapting tools like KRI [3]), then proceed to redesign key processes with BPMN diagrams, concurrently deploy CRM to enhance customer-facing operations, and finally invest in ERP modules to integrate those processes company-wide. The way these steps loop back into one another mirrors the managerial themes that come up repeatedly in the literature [2][8]. Early evidence from different countries shows that even firms with tight budgets can make real progress when they work on these pieces together instead of treating them as separate projects. And while the cultural and regulatory details will vary from place to place, the methodological groundwork laid out in prior studies still offers a solid starting point for U.S. SMEs that want to take on digital transformation using a combined BPMN–CRM–ERP approach.

Conclusion

Digital transformation in SMEs is a result of process improvements, stronger customer engagement, and better management of information across the whole firm. Based on the studies reviewed, this article lays out an integrated model in which BPMN offers a clear map for tightening and redesigning processes, CRM systems keep the business focused on customer needs and market signals, and ERP systems tie the different parts of the organization together. The research shows that each piece

plays a different role: BPMN-driven process changes boost operational efficiency [10], CRM tools help SMEs stay connected to clients and shifting markets [9], and ERP integration provides the digital backbone needed for scaling and for making decisions based on data rather than guesswork [8][9].

When these elements are put in place together, SMEs tend to become more agile and productive, and they often compete more effectively — narrowing the digital gap between themselves and larger firms. It is also clear that real success doesn't come from technology alone. It depends on doing the groundwork: checking readiness, planning carefully, and managing change in a structured way. With that kind of approach, SMEs in the U.S. can navigate digital transformation more confidently and use it as a platform for long-term growth.

Building on the findings and limitations of existing work, future research should test and refine the integrated BPMN-CRM-ERP model in diverse SME contexts. Future empirical work in the United States — and in other advanced economies — is needed to see whether the frameworks and indicators developed in earlier studies actually hold up under different economic and cultural conditions [1;3;9]. One useful direction would be longitudinal case studies that follow SMEs through an entire transformation cycle and show how process modeling, CRM adoption, and ERP integration interact over time to shape performance. As technology evolves, the integrated framework will have to develop with it. New tools — AI applications, cloud-based BPM services, and whatever comes next — will need to be worked into the model once they become part of everyday practice for SMEs. What is really needed is a deeper, context-aware picture of how small and mid-sized firms can manage a full digital transformation in real conditions. This understanding would not only push the academic discussion forward but also give SME managers and other stakeholders clearer guidance as they try to drive innovation and keep their businesses competitive.

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