Sustainable Digital Transformation for SMEs: A Comprehensive Framework for Informed Decision-Making

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Abstract: This study presents a sustainable digital transformation framework to integrate sustainable practices into digital transformation initiatives within Small and Medium Enterprises (SMEs). The methodology includes a literature review, a framework creation, and a case study with passive participation. The framework was structured to help industries implement responsible digitalization initiatives in five key stages: setting objectives, fostering stakeholder-focused engagement, defining sustainable objectives and dimensions, creating a sustainable model, and executing the project. Validating the proposal in the context of an SME allowed us to discern the tangible benefits of sustainability practices for the organization, further reinforcing the relevance and applicability of the framework. In conclusion, this research offers valuable information for SMEs considering starting a sustainable digitalization process.

Keywords: digital transformation; management; organization; SMEs; stakeholders

1. Introduction

Digital Transformation (DT) has gained significant attention worldwide in recent years. It includes the adoption of new technologies and innovation to transform processes and products in response to market competition and the evolution of consumer behaviours [1–3]. Successful DT requires several crucial components, including customer centricity, digital maturity, Information Technology (IT) infrastructure, organizational culture, and strategic orientation [4]. These components transform the business model, encourage growth, and improve production processes [5–7].

In the literature, we can find different definitions of DT [6–10]. For example, DT refers to the evolutionary transition of industrial manufacturing towards connected and intelligent cyber-physical production systems. This transition involves four stages: digitization, virtualization, connectedness, and automatization [6,9]. Moreover, DT represents a holistic effort to transform core processes and services beyond traditional digitization. It includes

a transition continuum from analogue to digital, involving a comprehensive review of policies, procedures, and user needs. The outcome is to satisfy user needs, introduce new service delivery models, and expand the user base [7]. The DT relies on strategically utilizing essential resources and capabilities to radically improve an entity and redefine the value proposition for the stakeholders [8,9].

In the context of DT and its vital connection to sustainable practices, integrating environmental and social sustainability principles at the core of DT strategies is imperative [11]. Digitization facilitates this integration, enabling data-driven decisions, optimizing processes, facilitating remote collaboration, monitoring resources, ensuring supply chain transparency, and engaging customers.

A comprehensive approach is necessary to establish a sustainable DT process, particularly in SMEs, which involves integrating environmental and social sustainability principles into the core of the DT strategy. Senior managers and stakeholders are crucial in establishing clear policies, effective communication channels, well-defined command structures, and leveraging IT systems for information flow [12–14].

Recognizing the human dimension in sustainable practices, the active engagement of employees is essential. Addressing their basic needs, fostering a sense of belonging, promoting peer collaboration, and involving employees in decision making are vital. This active involvement fosters a positive mindset and proactive behaviour and minimizes resistance to change [15,16].

Integrating sustainable practices into core processes and services through DT can support long-term economic prosperity while emphasizing the success of individuals and environmental protection [17]. Therefore, stakeholders and senior managers should adopt a change-oriented strategy during the sustainable transition [18]. This strategy involves defining new corporate governance practices and policy goals to support future actions, focusing on continuous improvement, and reducing contamination in all forms [19]. By aligning DT with sustainability, organizations can define the way for a future that balances economic success, environmental responsibility, and individual well-being.

Integrating digitalization into the SME search is also carried out for transforming business philosophies and quality management systems, considering internal and external contexts [12]. This shift fosters greater environmental, economic, human, and social responsibility [1,5]. Through IT, SMEs can innovate solutions that contribute to recycling policies, safeguard business margins, and minimize costs [20,21]. Additionally, DT empowers companies to enhance sustainability throughout operations and improve employees' quality of working life [22]. Emphasizing environmentally conscious digitalization in SMEs is crucial for process optimization, resource efficiency, and aligning with the industry's focus on sustainability and responsible business conduct [23].

However, while Sustainable Digital Transformation (SDT) has gained traction in big enterprises, there must be a significant gap in its adoption and implementation by SMEs [24]. Many SMEs face unique challenges in integrating IT [25] and sustainable practices into their operations [26–29]. These challenges include a resistance to change, a lack of digital culture, and a lack of experience in Industry 4.0 technologies within the organizational culture. In addition, creating a collaborative culture that allows the adoption of new processes and technologies is necessary. Managers must also have excellent knowledge and leadership skills to empower the workforce. Efficient planning poses significant obstacles, marked by the need for a digital strategy, vision, and direction, along with errors in project management.

The existing literature focuses on large corporations' DT strategies [2,4,30–33] and sustainability initiatives [4,34–36], leaving a need for more guidance specifically tailored to SMEs. Therefore, SMEs often need help solving the problems of adopting sustainable practices and TD, which requires a framework or roadmap tailored to their needs and resource constraints. Addressing this gap is crucial, as SMEs play a vital role in the worldwide economy and represent a significant portion of the overall business ecosystem [14]. The main contributions of this manuscript are as follows:

- Develop a theoretical SDT framework for SMEs, integrating the following key theories: Organizational and Technological Maturity, Leadership, Systems, Goal-Setting, Participative Decision-Making, and Stakeholder;
- Formalize an SDT framework for SMEs based on five stages, which provide valuable information to include sustainable goals in DT projects;
- Through a case study, the validation process facilitates a structured and practical approach to integrate sustainable digital practices, emphasizing the role of leadership, stakeholder participation, and a holistic perspective to drive tangible benefits in environmental sustainability, savings costs, efficiency, and innovation.

The paper follows this organization: Section 2 summarizes the literature on theories supporting the proposal. Section 3 presents the related works. Section 4 outlines the research methodology, while Section 5 presents the results. Section 6 covers the discussion of the findings, and, finally, Section 7 addresses the conclusions and limitations.

2. Literature Review

2.1. Sustainable Dimensions

In the design of the SDT theoretical framework, sustainable dimensions emerge as a multifaceted construct, incorporating the following dimensions [37]:

- The economic dimension is essential since it means financial viability and long-term profitability. Within the SDT framework, economic sustainability ensures that digital initiatives contribute to organizational prosperity while maintaining fiscal responsibility and resilience [7].
- Human considerations within the SDT framework prioritize the holistic well-being of people and continuous development within the organizational ecosystem. The framework strives to create an environment that fosters personal growth, skill enhancement, and overall job satisfaction [38].
- The social dimensions of sustainability within the SDT framework extend beyond organizational boundaries, emphasizing the broader community impact, cultivating ethical practices, promoting diversity and inclusion, and positively contributing to social well-being [7].
- Environmental sustainability within the SDT framework aims to minimize ecological footprints, advocating for green practices [34]. The framework seeks to align technological advances with responsible environmental management by integrating environmentally conscious strategies into digital initiatives.
- The technological dimensions in the SDT framework focus on innovation, ensuring that DT actively contributes to technological progress while aligning with broader sustainability goals [34,39].

These dimensions serve as fundamental pillars to guide and harmonize the infusion of sustainability principles into the DT process [40]. Integrating these sustainable dimensions within the SDT framework creates a harmonious and balanced approach, driving a transformative project towards the next digital evolution.

2.2. Successful Factors for SDT

Starting the transformative digitalization action is paramount for SMEs, necessitating strategic foresight and innovative planning [13,19,41–46]. Success in this SDT effort depends on creating adaptive business models and fostering a culture that embraces change, innovation and dynamic capabilities [47,48]. Overcoming challenges related to technological readiness, resource acquisition, and judicious technology investments becomes imperative for operational efficiency [46].

The pillars of governance and innovation act as the backbone and heart of SDT, creating the necessary structure for promoting creativity [44,45]. In this context, leadership is critical in shaping the transformative direction, fostering an environment conducive to collaboration and idea generation [42]. At the same time, knowledge management is necessary in order to exchange and use collective knowledge efficiently [42].

This comprehensive integration of strategic planning, cultural adaptation, technological perspective, and effective governance fortifies organizational SDT efforts and benefits SMEs, ensuring adaptation and excellence in leveraging digital technologies for enduring growth and substantial competitive advantages [49,50].

2.3. Small and Medium Enterprises

SMEs are vital contributors to the global economy, operating as dynamic entities with a significant role in various industries. Defined by financial metrics or employee numbers, SMEs lack a globally standardized classification due to variations across countries and industries [51,52].

In a broader societal context, SMEs are crucial for economic development and stability. They constitute a substantial portion of enterprises and provide diverse goods and services. Their flexibility and dynamism make them essential contributors to employment, with a significant percentage of the workforce engaged in SMEs [10]. Moreover, these enterprises contribute significantly to the overall value added to the economy and play a crucial role in driving exports and fostering international trade [53].

Despite their importance, SMEs need more resources and access to credit, and have a lack of essential skills, hindering their productivity and growth potential. In this context, SDT is critical for SMEs to overcome these barriers and thrive in an increasingly globalized and technology-driven business environment. Moreover, SDT integrates digital technologies into various business operations, from manufacturing to management practices. Embracing SDT enhances operational efficiency, facilitates better resource management, and enables streamlined communication for SMEs. Adopting digital technologies fosters innovation, a key driver for SMEs' long-term success and sustainability [54].

In addition to enhancing internal processes, SDT allows SMEs to tap into new markets, connect with a broader customer base, and participate more actively in global supply chains. It fosters agility and adaptability, essential qualities for solving the complexities of modern businesses. Furthermore, DT empowers SMEs to incorporate sustainable practices, aligning with global initiatives for environmentally conscious business operations [51].

3. Related Works

In [55], the authors present a framework for SDT, focusing on integrating digital tools with Sustainable Development Goals (SDGs) and intelligent governance principles. It advocates for a federal regulatory framework to set macro-level goals with local adaptability, promoting inclusivity. Strategic funding ensures the alignment of digital projects with SDGs, fostering innovation and collaboration across sectors. Partnerships between public and academic sectors are crucial for knowledge transfer and interdisciplinary collaboration, facilitated by involving higher education institutions. Basic digital infrastructure enables widespread access, while the concept of anchoring institutions for innovation promotes bright governance awareness. This institutional framework catalyzes organizational change and resource mobilization, particularly in regions with diverse needs. Promoting data literacy and social-centric policies is vital for addressing societal needs and equity, facilitating data-driven decision-making aligned with sustainable development principles.

The article [56] describes a conceptual framework for SDT within Supply Chain Management (SCM), underpinned by theories such as the resource-based view, stakeholder theory, legitimacy theory, and transaction cost theory. It emphasizes the critical role of IT resources in enhancing economic, environmental, and social performance. The framework underscores the importance of aligning IT and SCM resources across the supply chain to realize sustainability capabilities and competitive advantages. However, challenges emerge in ensuring comprehensive adoption and alignment among all partners, particularly for SMEs needing more resources or technological infrastructure. Business alignment and common technological standards are crucial but may need to be improved for SMEs with limited capabilities and resources.

Integrating DT in SCM offers potential benefits such as improved operational efficiency, cost reduction, and enhanced environmental and social impact. However, realizing these benefits requires substantial investment and collaboration among partners. SMEs may need help accessing and implementing these technologies due to financial constraints and technological barriers, limiting their ability to leverage DT for sustainable transformation. While IT resources offer opportunities for efficiency gains and environmental monitoring, their effectiveness hinges on integrating sustainable strategies and practices. SMEs may need more resources and expertise to develop and implement such strategies due to limited resources and expertise, impeding their ability to harness the potential of DT for sustainability fully. Overall, while the conceptual framework presents promising avenues for SDT in SCM, implementation challenges persist, particularly for SMEs.

The article [57] explores the construction of a theoretical framework for DT, emphasizing its complex nature and the need for systematic support. It highlights the need for a clear theoretical context in the evolution of DT theories, which are hindering their development. Critical dimensions of DT include environmental synergy, structural optimization, and function realization. Environmental synergy involves connections between organizations and their internal/external environments, adapting to changes in employment methods, demand-supply dynamics, and competition-cooperation boundaries. Structural optimization enhances opportunity identification, resource integration, and business model transformation capabilities to adopt a digital environment. Function realization emphasizes creating new value propositions, leveraging digital networks for efficient manufacturing and distribution, and fostering value-creation platforms. Implementation mechanisms involve reshaping organizational capabilities through environmental symbiosis, facilitating resource integration and opportunity identification, and ultimately driving value creation. Feedback loops between capability reconstruction and value creation reinforce organizational symbiosis, strengthening the organization's resilience and legitimacy in the digital era. Companies must understand their competitive positioning and choose innovation paths to overcome the digital transition effectively.

While the framework provides valuable insights into DT, challenges persist in its practical implementation, especially for SMEs. SMEs may need help with resource constraints, limited technological infrastructure, and organizational inertia, hindering their ability to fully leverage DT for sustainable development. Addressing these challenges requires tailored strategies, collaborative efforts, and capacity-building initiatives to support SMEs in embracing SDT.

The article [58] presents descriptive and inferential results from a Lean Project Management (LPM) implementation study. It focuses on the importance of socio-technical factors, particularly in the context of DT within organizations. Descriptively, the study reveals respondents' profiles in LPM projects, highlighting their leadership positions and experience. Factor Analysis identifies two dimensions crucial for sustainable LPM implementation: Dimension 1 emphasizes process-oriented factors like change management, knowledge management, and quality management, while Dimension 2 underscores the importance of interpersonal relationships and human-centric aspects in LPM success. The study emphasizes the socio-technical nature of LPM in the digital age, suggesting that sustainable implementation requires technical expertise and interpersonal soft skills. It argues for a holistic approach integrating process optimization with people-centric practices to generate sustainable value. However, challenges may arise in implementing LPM, especially in SMEs. SMEs may need more resources and expertise for comprehensive LPM adoption. Additionally, resistance to change and organizational inertia could hinder efforts to integrate socio-technical dimensions into project management practices.

Furthermore, while the study highlights the importance of agile methodologies and interpersonal collaboration, it may need to pay more attention to potential drawbacks, such as resistance to agile adoption or difficulties in fostering a culture of continuous improvement.

The study [59] reveals that DT positively impacts operational performance through process and business improvements. However, its effects on financial and innovation performances are more nuanced. While R&D investment initially contributes to innovation performance.

The findings underscore the higher costs associated with DT for SMEs but highlight its potential to enhance operational performance and organizational resilience, implying a need for strategic, systematic, and long-term approaches to DT, contrasting with previous singular-focused transformations. Emphasizes the importance of management trust in responding quickly and effectively to the threats of DT, especially amid limited resources. Moreover, the study suggests an "overall planning and local first" strategy for SMEs, starting with sales and procurement to demonstrate tangible benefits and build confidence before expanding digital deployment across the organization. However, challenges such as perceived failure in the short term, employee scepticism, and weak sustainability of digital investments may hinder this process.

While DT significantly benefits SMEs in improving operational performance and resilience, its implementation poses challenges, especially regarding financial and innovation performance. Strategic planning, long-term commitment, and localized approaches are vital for SDT in SMEs, ensuring effective utilization of resources and mitigating potential drawbacks.

In [60], the authors highlight the alliance between digitalization capabilities and cyber resilience to address the complexities of digital projects, particularly for SMEs. Key insights include identifying digitalization capabilities such as employing resources, promoting continuous learning, and improvisational capabilities, which drive various cyber resilience practices across different phases. These capabilities enable SMEs to effectively prepare, adapt, and respond to cyber threats and challenges.

However, challenges arise due to the need for SMEs to balance digitalization efforts with limited resources and the evolving cyber threat landscape. While digitalization capabilities offer strategic advantages, their implementation requires careful planning, resource allocation, and adaptation to the dynamic digital environment. Furthermore, the text highlights the interconnected nature of digitalization capabilities and their potential synergies in enhancing cyber resilience and business strategies. Maintaining a diverse set of resources and fostering capabilities for timely reconfiguration are essential for building resilience in the face of cyber threats. The text underscores the importance of further research and empirical validation to explore the union between digitalization capabilities and cyber resilience. By understanding these capabilities effectively, SMEs will realize their DT while ensuring security and sustainable growth in the digital age.

4. Methodology

The main objective of this research is to create a theoretical SDT framework for SMEs. The purpose is to bridge the existing gap and empower SMEs to embrace digital innovation and sustainable practices. The research has the following specific objectives:

- Propose a theoretical SDT framework for SMEs. This framework provides a structured approach and guidelines for SMEs to effectively integrate sustainability practices into their DT initiatives.
- Provide evidence and insights into a real case study. The aim is to assess how the framework contributes to the organization's sustainability initiatives, operational efficiency, and overall business performance.

Consequently, the text intends to provide insight and answer the research question: How can a framework for integrating sustainable practices through DT be established? The answer to this question could set the stage for more informed decision-making and the development of practical implementation strategies to increase the probability of success in sustainable digitalization projects. To answer the research question, we have structured our investigation as follows:

Research Philosophy: The guiding philosophy of this study is pragmatism, which emphasizes the practical applications and real-world outcomes. This research aims to give SMEs a practical framework that can be directly used to improve their digital transformation and integrate sustainable practices. The pragmatic approach is shown in the goal to not only address theoretical gaps but also enhance the business performance and sustainability for SMEs [61].

Research Focus: The approach adopted in this study is deduction. Deductive reasoning involves creating a framework based on existing theories and testing it with real-world observations. In this research, the SDT framework for SMEs is developed from a review of the current literature. The framework is then tested and refined through a real case study. This deductive method allows researchers to validate the theoretical framework with practical evidence, ensuring it is relevant and applicable to real SME situations [61].

Type of Study: The study uses a mixed-method approach, combining qualitative and quantitative research methods for a comprehensive analysis. The development of the theoretical framework involves qualitative research based on a detailed review of existing literature and concepts. The practical application of this framework in a real case study includes collecting and analyzing quantitative data. This mixed-method approach provides a comprehensive view of the framework's effect on sustainability initiatives, operational efficiency, and business performance in SMEs, offering detailed and reliable information [61].

Figure 1 shows an overview of the methodology steps.
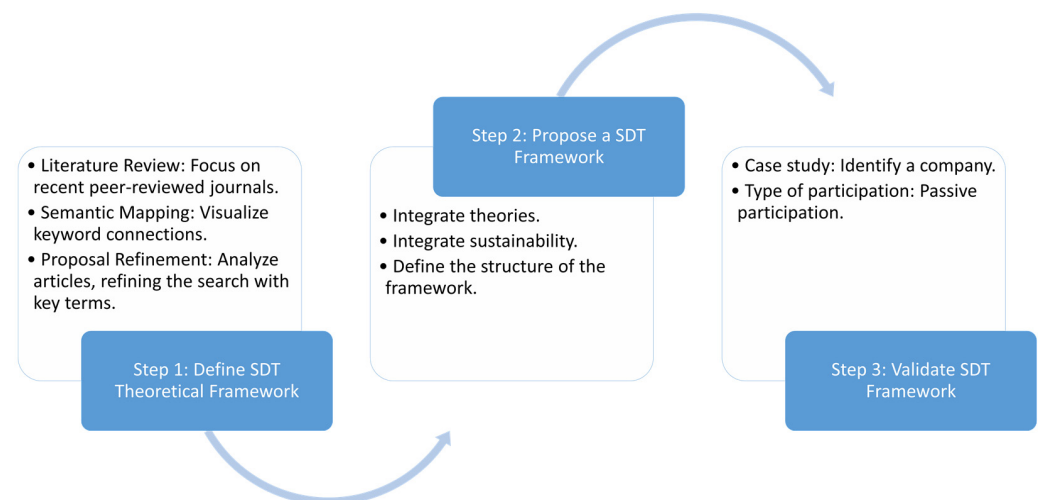
Figure 1. Sequential steps in the methodology.

4.1. Define SDT Theoretical Framework

The design of the SDT theoretical framework was inspired by [62,63]. In this step, we focused on peer-reviewed academic journals published in the Web of Science Core Collection to ensure data collection from high-quality sources. The selection of the years 2018 to 2021 for data collection was deliberate and aligned with the temporal context of our study. We chose this specific timeframe because our project unfolded between 2020 and 2021, and we aimed to focus on the most recent and pertinent literature available during this period. These years were particularly significant due to the rapid evolution of the discourse surrounding the intersection of sustainability and DT. To ensure that our study reflects the latest insights, developments, and discussions in the field, we intentionally limited our search to this specific temporal scope. Our decision to exclude editorial material, corrections, proceeding papers, book chapters, and letters was strategic, streamlining our focus on peer-reviewed publications and scholarly articles during this dynamic timeframe and ensuring a thorough examination of the most authoritative and current literature.

Our database search strategy, which utilized keywords such as "sustainable" and "digital transformation" with the search type "by topic," was designed to cover the relevant literature comprehensively. This approach included titles, abstracts, author keywords, and additional keywords to ensure a thorough exploration of the subject matter within the chosen timeframe.

The initial search resulted in 263 articles. From this point, we created a semantic map using VOSviewer (https://www.vosviewer.com/) [64,65] to visualize the connection among keywords and identify their association with an SDT framework. A total of 321 keywords were identified. We selected the minimum number of occurrences of keywords of 3, obtaining 35 keywords with the greatest total link strength. From these keywords, we deleted "0" in the verification-selected keywords phase. Figure 2 shows the result.
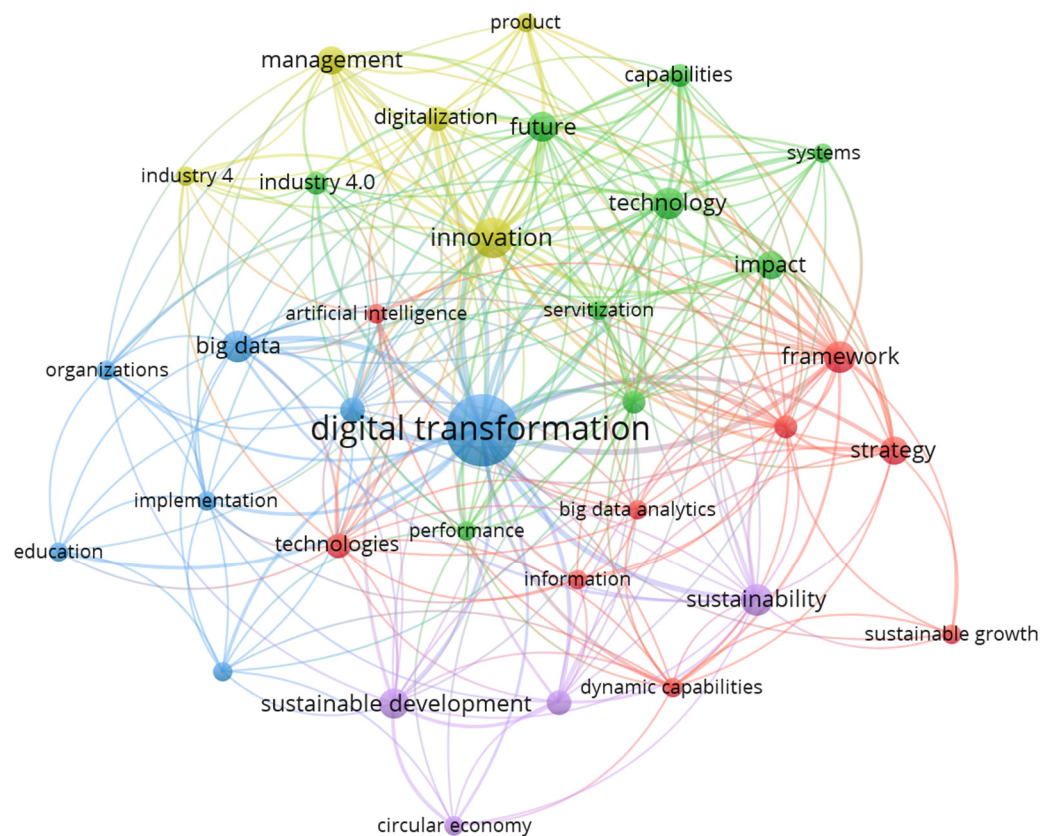
Figure 2. Keywords network based on co-occurrence.

After that, we included the following keywords to refine the final result: "framework" and "strategy". Consequently, 18 articles were analyzed to define the structure of a new proposal for SMEs.

4.2. Propose a SDT Framework

In developing the SDT framework, we were inspired by the meticulous design of the theoretical frameworks proposed in [63,66].

In the initial stage of the SDT framework, senior managers assume a critical role in aligning the digitalization efforts with the organizational culture. This stage involves a meticulous process where leaders validate the project scope, ensuring it resonates with the overarching strategic goals. Their active involvement ensures a seamless integration of digital initiatives into the organizational fabric, fostering a culture of innovation and adaptability.

Similarly, the second stage of SDT emphasizes the application of stakeholder theory. It goes beyond merely identifying stakeholders to actively engaging them in the

transformation process. This stage involves soliciting input, addressing concerns, and encouraging critical questions. By incorporating diverse perspectives, this stage ensures the digitalization is inclusive and aligned with various stakeholders' expectations and needs.

In the third stage, rooted in strategic decision-making [63,66], the focus is on delineating sustainable objectives and dimensions. Informed by established frameworks, this entails a meticulous process of establishing clear, measurable, and inherently sustainable goals. Incorporating insights from previous strategic decision-making models, SDT guarantees purposeful digitalization efforts that align seamlessly with long-term sustainability, making a meaningful contribution to organizational objectives.

The fourth stage of the SDT framework emphasizes building a sustainable model. This stage implies the relevance of the careful selection of indicators that reflect the organization's commitment to sustainability. Integrating digitalization efforts with sustainable practices ensures that the model enhances operational efficiency and positively contributes to environmental, social, and economic dimensions.

Finally, the fifth stage, the execution and monitoring phase of SDT, ensures accuracy, efficiency, and tangible benefits. This structured approach combines insights from diverse stakeholders and leverages theoretical foundations to guide SMEs through the transformative process of sustainable digitalization.

4.3. Validate SDT Framework

To validate our SDT framework, a case study with passive participation within an SME will allow us to understand its impact and benefit. The study will reveal the framework's scope in integrating sustainable digital practices in projects. Tangible benefits, including increased efficiency, reduced environmental impact, and improved overall sustainability, are expected to be identified. This case study will provide insight into the effectiveness of the SDT framework.

The research team assumed an external position with a passive participation approach, involving observing and analyzing ongoing processes within the SME without direct involvement in day-to-day activities. The data collection methods were predominantly remote, utilizing document analysis to review project proposals and approval documents and facilitate the understanding of existing processes, quality management systems, and challenges. This external observation allowed the research team to track the project's progress, gather information on the phased implementation, and assess its impact on the organization.

5. Results

5.1. Keyword Co-Occurrence Network-Based Approach

The keyword co-occurrence network analysis delves into the interrelationships between critical terms relevant to sustainable digital transformation (SDT) initiatives within small- and medium-sized enterprises (SMEs). In particular, "digital transformation" appears as the central theme, with a significant incidence of 39 and a solid link strength of 123, which shows that the literature review was correct and consistent with the research topic. Moreover, this result highlights the overall focus on leveraging digital technologies to achieve transformative change in SME contexts. Additionally, "innovation" stands out with 13 occurrences and a tie strength of 71, underscoring the emphasis on fostering innovative approaches within SDT frameworks. Furthermore, the presence of terms such as "big data", "technology", and "sustainability" with notable occurrences and strong links suggests the multifaceted nature that needs to be considered in the design of the SDT framework, encompassing the aspects of data-driven decision-making, technological advancements, and sustainability principles. This analytical approach provides deeper insights into the interrelation of critical concepts that shape and support the creation of the SDT framework for SMEs.

5.2. SDT Theoretical Framework

After reviewing 18 articles, a solid theoretical framework emerges, supported by six key pillars. This framework serves as our guide, simplifying the exploration of complex concepts in research. It is a cohesive structure that incorporates knowledge from various sources and ensures a comprehensive understanding of the topic. The six pillars central to our approach were carefully selected to capture the various aspects of the theme. Figure 3 shows the design of the SDT theoretical framework.
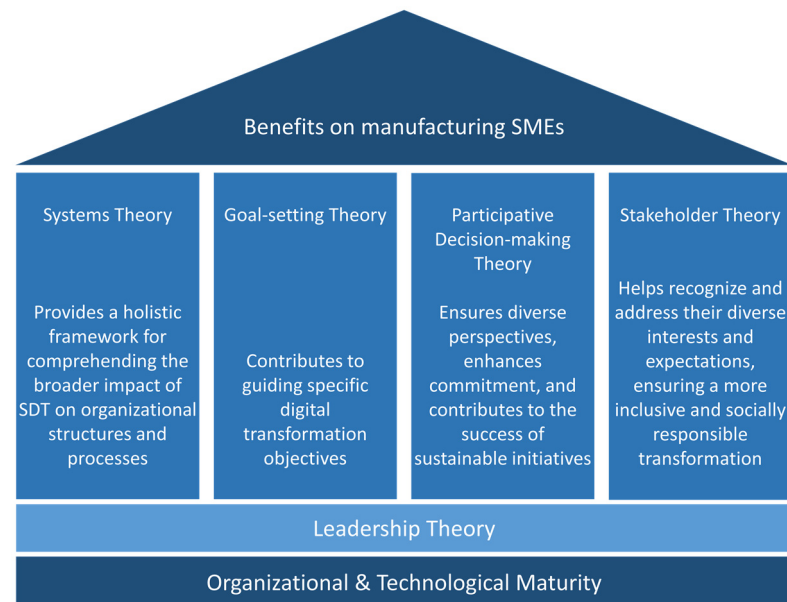
Benefits on manufacturing SMEs

Systems Theory	Goal-setting Theory	Participative Decision-making Theory	Stakeholder Theory
Provides a holistic framework for comprehending the broader impact of SDT on organizational structures and processes	Contributes to guiding specific digital transformation objectives	Ensures diverse perspectives, enhances commitment, and contributes to the success of sustainable initiatives	Helps recognize and address their diverse interests and expectations, ensuring a more inclusive and socially responsible transformation

Leadership Theory

Organizational & Technological Maturity

Figure 3. SDT theoretical framework design.

5.2.1. Organizational and Technological Maturity

Maturity models are indispensable tools with which to overcome the complexities SDT. These models offer a roadmap for organizations seeking to mature in their digital endeavours [67]. Maturity models comprise dimensions and levels, categorizing an organization's capabilities through processes essential for future scenarios, aiding internal analysis, competitor evaluations, and benchmarking [68]. The levels signify stages of maturity, propelling evolution towards advanced states through predefined processes. The term 'maturity' signifies reaching full development and readiness for specific tasks [68,69]. Maturing technical or organizational systems progressively enhances their capabilities. Various maturity models in the literature differ in scope, measuring selected functional areas or elements of organizational architecture, or carrying out the assessment of implemented digital technology solutions [70].

In the context of SDT, the transformation's intricacy demands a phased approach, acknowledging the varied pace of change across business processes. Although various maturity models exist, accommodating the varied pace of change across business processes, there is a need for more granularity, especially concerning SMEs. As a foundational pillar of SDT, maturity models empower organizations to quantify and measure activities, fostering maturity over time. They guide the consolidation of practices, ensuring a holistic approach to predefined processes and contributing to overall organizational performance enhancement.

5.2.2. Leadership Theory

In the SDT framework, leadership theory is the guiding force that influences organizational change towards more environmentally, socially, and economically responsible practices. Within this framework, leadership promotes innovation, instilling a sense of responsibility, and driving sustainable practices in the DT project [71].

Therefore, leadership is not limited to traditional notions but extends to a visionary approach to solving the complexities of innovations. Leaders within the SDT framework are crucial in steering the organization towards profound changes aligned with sustainability objectives, embracing the responsibility to achieve economic, social, and environmental outcomes as an integral part of leadership in SDT; they must exhibiting stewardship behaviours, which involves responsibility, accountability, and commitment to sustainability goals [72]. It operates within the broader organizational context, recognizing that successful SDT requires a nuanced understanding of the interconnected elements.

When integrated into the SDT framework, effective leadership catalyzes technological advancements and fosters a culture of sustainability and resilience. Through leadership theory, organizations can embrace SDT, taking significant steps towards a more responsible and innovative future [73].

Effective leadership is instrumental in identifying and understanding systemic connections within the organization, aligning digital strategies seamlessly with sustainability goals [33,40]. Leaders' guidance facilitates the identification of interdependencies, allowing organizations to respond to the complexities of SDT with precision and foresight [40].

5.2.3. Systems Theory

Systems theory is a critical pillar in SDT, offering profound insights into the interplay between digitalization and sustainability within organizations. At its core, systems theory views organizations as complex systems with interconnected components, emphasizing the significance of understanding their holistic functioning [74]. Consequently, systems theory proves invaluable in the SDT process, where the convergence of the digital and sustainable dimensions necessitates a comprehensive perspective. This approach encourages organizations to move beyond isolated initiatives and perceive the entirety of their operations as an interconnected system [75]. It underscores the idea that changes in one part of the organization have cascading effects on the entire system, emphasizing the need for a synchronized and integrated approach to SDT.

Within this framework, senior managers assume a strategic role as orchestrators of organizational harmony. Their leadership is instrumental in identifying and understanding systemic connections, ensuring that digital strategies align seamlessly with sustainability goals [71,76]. Systems theory, guided by senior leaders, facilitates the identification of interdependencies, enabling organizations to address the complexities of SDT with precision and foresight [75].

Moreover, systems theory fosters adaptability and resilience, which are essential for organizations engaged in sustainable digital endeavours. By recognizing the holistic nature of SDT, senior managers can guide their teams towards innovative solutions that meet immediate challenges and position the organization for long-term success.

Organizations with a holistic perspective ensure organic integration, fostering efficiency, reduced environmental impact, and enhanced stakeholder value. The interconnected approach addresses immediate challenges and positions the organization for sustained success in the ever-evolving SDT [77].

Within this framework, senior managers assume a strategic role as orchestrators of organizational harmony. They leverage their leadership to identify and understand systemic connections. Their guidance facilitates the recognition of interdependencies, allowing organizations to address the complexities of SDT with precision and foresight.

5.2.4. Goal-Setting Theory

In SDT, goal-setting theory emerges as a potent force, providing a structured guide for organizations to front the complexities of transformative endeavours. At the core of this theory lies the principle that setting clear and well-defined goals contributes significantly to the success of SDT initiatives [78].

Organizations beginning their SDT transformation benefit from the clarity and focus of goal-setting theory. By establishing specific, measurable, achievable, relevant, and time-

bound goals, they create a roadmap aligning the workforce towards shared objectives [79]. This precision enables organizations to channel their efforts strategically, fostering a cohesive approach to sustainability in the digital era.

The active participation of employees in goal-setting becomes a crucial aspect of goal-setting theory. In the context of SDT, involving employees in the goal-setting process empowers them, instils a sense of purpose, and aligns individual efforts with overarching sustainability objectives [71]. This participatory approach enhances motivation and leverages the collective intelligence of the workforce, driving innovation and adaptability [80].

Furthermore, goal-setting theory contributes to the success of SDT by providing a mechanism for ongoing evaluation and adjustment. Regularly assessing the progress towards established goals allows organizations to adapt to evolving challenges and opportunities in the digital era, ensuring the sustainability transformation remains dynamic and responsive to changing circumstances. Goal-setting theory acts as a guiding beacon, steering organizations towards SDT by fostering clarity, employee engagement, and adaptability [78].

The goal-setting theory discussed here provides a mechanism for ongoing evaluation and adjustment, aligning with the adaptability and resilience fostered by systems theory. Regularly assessing the progress towards established goals allows organizations to adapt to evolving challenges and opportunities in the digital world, ensuring the sustainability transformation remains dynamic and responsive to changing circumstances.

5.2.5. Participative Decision-Making Theory

Participative decision-making theory emerges as a catalyst in SDT, fostering a culture of active involvement and reducing the resistance to change within organizations. This theory underscores the significance of involving employees in the decision-making process, amplifying their role in shaping the trajectory of DT initiatives [81].

In the context of SDT, employees' active participation becomes a cornerstone of success. Participative decision-making theory encourages organizations to engage employees, particularly those with hands-on experience and domain expertise, in decision making [82]. By including diverse perspectives, organizations can tap into a wealth of knowledge, identify opportunities, and address potential challenges in the SDT projects.

Moreover, this theory is critical in mitigating the resistance to change, a common obstacle in transformative initiatives. When employees are actively involved in decision making, they are more likely to embrace the changes associated with SDT. Their inclusion empowers them to become champions of the transformation, fostering a sense of ownership and commitment to the shared sustainability goals [71].

Participative decision-making theory, therefore, contributes to the success of SDT by cultivating an environment where decisions are collaborative, transparent, and inclusive [76]. This approach enhances the quality of decision making through the active participation of employees, aligning with the active participation of employees. The participatory approach enhances motivation, leverages collective intelligence, and fosters innovation and adaptability.

5.2.6. Stakeholder Theory

An essential step in any SDT project is accentuating the critical role of internal and external stakeholders. The careful selection and engagement of stakeholders form a linchpin in the success of SDT, underscoring the need for a strategic approach to involve those who can profoundly impact and be impacted by the transformation [83].

Stakeholder theory emphasizes recognizing and prioritizing the diverse interests of individuals or groups associated with the organization [84]. In SDT, this theory advocates for identifying stakeholders whose collaboration is critical for success. Internally, this might include employees and management, while, externally, it could involve customers, suppliers, and regulatory bodies. Engaging the right stakeholders ensures a holistic understanding of sustainability goals, aligning digital initiatives with broader organizational

objectives [66,84]. Internal stakeholders contribute their domain expertise, while external stakeholders bring valuable perspectives on market dynamics and societal impacts. This collaboration, rooted in stakeholder theory, facilitates the development of an SDT framework that resonates with the broader ecosystem.

Furthermore, stakeholder theory can promote a culture of inclusivity and shared responsibility. When stakeholders are actively involved in the SDT process, they can help organizations to obtain support and advice regarding complexities that may arise [85]. This theory suggests involving diverse perspectives, aligning with the participatory approach encouraged by participative decision-making theory. This inclusive approach ensures a holistic understanding of sustainability goals and fosters a culture of inclusivity and shared responsibility.

5.3. SDT Framework

After describing the theories linked to the SDT framework, we developed a novel proposal that includes five meticulously designed stages. Each stage strategically facilitates the practical implementation of the SDT framework, ensuring a structured and practical approach to integrating sustainable digital practices in a successful digitalization project. Figure 4 shows the SDT framework for SMEs.
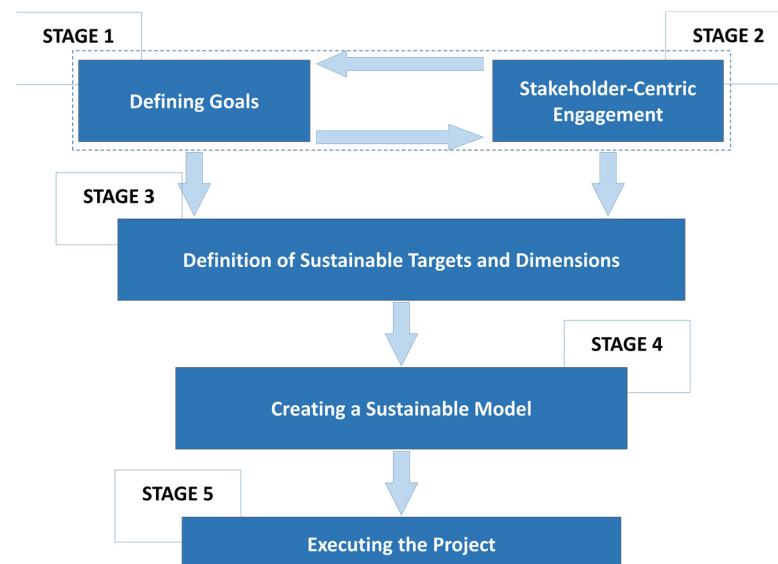

Figure 4. SDT framework for SMEs.

5.3.1. First Stage: Defining Goals

In the initial phase of SDT, the influence of decision-making theory is fundamental. The leadership of senior managers is paramount as they actively align with the organizational culture, validate the project scope, and provide robust support during transitions [42]. Their strategic vision and decision-making process guide initiatives towards sustainability, fostering an innovative culture that encourages experimentation and adaptability. By empowering teams to overcome challenges and thrive amidst sustainable digital advancements, this proactive leadership is critical for enduring success in the sustainable, transformative action towards a digitized future [76].

The project's primary purpose is clarified during this crucial stage, which involves senior managers, stakeholders, project managers, and team members. Specifically, the project goals is to integrate IT with sustainable design, necessitating modifications to traditional processes [78]. The project manager and team members must also consider the organizational culture when defining SDT goals. Consequently, the backing of senior managers and stakeholders becomes indispensable in facilitating a seamless SDT for all project participants.

The first stage, centred on defining goals, is tightly linked to leadership theory and participative decision-making theory. As highlighted in leadership theory, senior managers' influence ensures that the decision-making process aligns with the organizational culture and validates the project scope. This stage sets the foundation for a participatory approach, embracing insights from team members and stakeholders.

Defining goals is critical in SDT as it establishes the project's primary purpose and outlines its scope. This phase's proactive leadership guides sustainability initiatives, fostering an innovative culture. Senior managers empower teams to overcome challenges, ensuring enduring success in the SDT actions.

5.3.2. Second Stage: Stakeholder-Centric Engagement

Applying stakeholder theory in this critical stage becomes integral to the SDT framework. Stakeholders, both end-users and critical decision-makers, play a central role in addressing crucial questions that guide the transformative process; for that reason, they need to answer "what" and "why" questions to obtain additional information on SDT projects [85].

Q1. Purposeful Transformation: Why carry out a sustainable digital transformation journey?

Q2. Sustainable Dimensions: What constitutes the primary sustainable dimension of the project?

Q3. Organizational Gains: What sustainable benefits can organizations derive from digital transformation?

Recognizing the significance of stakeholder theory, the engagement of employees, particularly those serving as domain experts and end-users, is indispensable. They actively participate in the process and offer valuable insights from hands-on experience, enhancing the identification of existing opportunities.

Simultaneously, adhering to participative decision-making theory, stakeholders involved in the digital transition are not merely observers; they actively participate as end-users [85]. Establishing direct communication channels with process leaders is encouraged, aiming to gather comprehensive information and solicit their perspectives on improvement proposals. The essence lies in transforming the person in charge into an active participant in the transformation process, strategically diminishing the likelihood of resistance to change. This dual-theory approach underscores the collaborative and inclusive nature of the framework, aligning it with principles essential for the success of SDT endeavours.

Stakeholder-centric engagement builds upon the defined goals by actively involving stakeholders in the transformative project. This stage answers questions raised during goal definition and leverages insights from domain experts and end-users. The participative decision-making theory's influence continues as stakeholders actively participate in the decision-making process.

The transition to defining sustainable targets and dimensions involves the same stakeholders who play a crucial role in shaping the project's trajectory. Their engagement and insights from this stage contribute significantly to crafting sustainable targets aligned with organizational goals.

Stakeholder-centric engagement is critical as it ensures that the perspectives of end-users and decision-makers are incorporated into the SDT framework. This stage lays the groundwork for the subsequent definition of sustainable targets and dimensions by addressing crucial questions.

5.3.3. Third Stage: Definition of Sustainable Targets and Dimensions

In this phase, the meticulous definition of sustainability targets integrates the organizational culture, systemic boundaries, and the anticipated impact of SDT. Considering sustainability policies, actors must strategically select the leading sustainable dimension linked to the process, as this decision becomes the project's nucleus, guiding all subse-

quent actions [1]. As a result, senior managers and stakeholders need to answer the following questions:

Q4. Targeted Improvement: How can the SDT process enhance the identified sustainable dimension[s]?

Q5. Comprehensive Impact: How does the targeted improvement in sustainable dimensions contribute to the organization?

Q6. Organizational Alignment: How can the proposed enhancements align with and strengthen the interconnected elements within the existing organizational culture and policies?

The answer to this question embraces a systems theory perspective that underscores the interconnected nature of these decisions, emphasizing the holistic integration of technological and administrative considerations. This approach fortifies the DT project and accentuates the benefits of enhancing sustainable dimensions within the organization.

The meticulous definition of sustainability targets integrates insights gathered from stakeholders in the second stage. The answers to the questions about targeted improvement, comprehensive impact, and organizational alignment draw from stakeholder engagement and participative decision-making.

The systematic definition of sustainable targets provides the foundation for creating a sustainable model in the next stage. The interconnected decisions in this phase, guided by systems theory, underscore the holistic integration of technological and administrative considerations.

This phase is fundamental in aligning the organizational culture, systemic boundaries, and the anticipated impact of SDT. The decisions here strategically select the leading sustainable dimension linked to the process, guiding all subsequent actions. By embracing a systems theory perspective, the decisions emphasize the interconnected nature of SDT, fortifying the project and accentuating the benefits of enhancing sustainable dimensions within the organization.

5.3.4. Fourth Stage: Creating a Sustainable Model

This strategic phase involves crafting a sustainability model that articulates the connections among its five dimensions through shared values. Including all five dimensions is crucial for fostering a holistic understanding of their relationships [74].

While not all projects may directly influence each dimension, indirect connections can be identified, contributing to the recognition of relevant indicators. Establishing these connections enables the identification of quantitative or qualitative metrics for each indicator. The final step involves defining activities associated with each value. This step serves to address the following questions:

The following question emphasizes the collaborative exploration of relationships, drawing on insights from diverse stakeholders.

Q7: What are the direct and indirect relationships among the sustainable dimensions?

Participative decision-making extends to selecting indicators, ensuring a comprehensive and inclusive approach to metric determination.

Q8: Which indicators do we need to use?

The following question underscores the collective identification of actions required to attain the defined indicators.

Q9: What actions should we take to achieve the defined indicators?

The responses to these questions define the association between the sustainable dimensions and the DT project. This comprehensive approach considers the indicators for improvement and delineates the collaborative actions needed. The outcome demonstrates an understanding of how and what to measure to assess the project's impact.

The sustainability model crafted in this stage directly builds upon the defined sustainable targets and dimensions. The direct and indirect associations among sustainable dimensions, indicators, and actions are explored collaboratively, drawing insights from diverse stakeholders.

The connections established in this stage lay the groundwork for project deployment. The sustainability model, illustrating the interconnection of dimensions through shared values, aligns with the organizational culture, fostering successful execution.

Creating a sustainable model is a strategic phase articulating the connections among its five dimensions through shared values. This phase ensures a holistic understanding of their associations, even if not all projects directly influence each dimension. The comprehensive approach considers improvement indicators and delineates the necessary collaborative actions, demonstrating an understanding of how and what to measure to assess the project's impact.

5.3.5. Fifth Stage: Deployment

Having developed a comprehensive sustainability model, the transition to project implementation is a critical juncture that requires precision and efficiency. The sustainability model must illustrate the interconnection of dimensions through values and align perfectly with the organizational culture to foster a successful execution. The indicators must strongly support the defined set of values as markers of progress to ensure tangible organizational benefits [67,82,86]. In this sense, specific actions must be meticulously mapped to support each indicator, underscoring the importance of a well-structured execution strategy.

The execution stage unfolds in six phases, each designed for efficiency and success.

Phase 1—Scope Definition: The implementation team rigorously defines the project's technical scope, meticulously incorporating sustainable requirements. Clear objectives are outlined and aligned with sustainability goals, forming the basis for subsequent phases.

Phase 2—Process Understanding: Development teams deepen their understanding of project complexities, actively identifying potential challenges and comprehensively understanding project needs. This understanding becomes a pivot, which mitigates risks and reduces failures in later stages.

Phase 3—Customization and Planning: Customization takes centre stage as the team adapts the solution to meet the technical, operational, and sustainability requirements. End-user participation is encouraged for validation, ensuring alignment with their needs. The detailed design, development, testing, and evaluation are meticulously planned, and the project budget is finalized.

Phase 4—Efficient Communication: Transparent communication is prioritized as the team presents the project progress and budget details to senior management and key stakeholders. This phase facilitates feedback and adjustments based on strategic objectives and organizational priorities.

Phase 5—Execution: The team executes the project plan based on the established foundation, collaborating closely with end-users. Regular validation, feedback collection, and extensive testing ensure that the solution achieves the desired results.

Phase 6—Implementation and Monitoring: Moving from planning to execution, the team implements the finalized solution and closely monitors its performance. A sustained monitoring period, ideally of at least one year, provides real-world insights, allowing informed adjustments to be made for continued success.

The sustainability model, developed in the fourth stage, directly informs the deployment phase. The interconnected dimensions through shared values align with the organizational culture, ensuring a successful execution.

Deployment is the culmination of the SDT framework, translating the project vision into practical reality. This stage ensures a clearly defined and sustainable method by mapping specific actions to indicators, supporting the defined set of values. The structured implementation, unfolding in six phases, fosters tangible organizational benefits, marking the success of SDT.

This structured implementation ensures a clearly defined and sustainable method, transforming the project vision into a practical reality. In the following section, we reveal the tangible benefits of this framework through a real-world scenario, offering valuable insights for project managers and policymakers in the field of SDT.

5.4. Validate SDT Framework through a Case Study

The procedure was performed initially to validate the proposal in the scope of a project in an SME. The company holds the ISO/TS 16949:2009 certification [87], evidence of senior managers' and stakeholders' active promotion of a Quality Management System [QMS] [88]. Additionally, they have successfully implemented the Kaizen methodology [89].

5.4.1. Defining Goals

The initiation of the SDT project was guided by a dual commitment—applying digitalization principles to tackle operational challenges and seamlessly incorporating sustainable design. This approach aligns with systems theory and leadership theory, emphasizing the interrelation of organizational elements and the critical role of proactive leadership. The overarching goals were to: (a) enhance the quality of work processes through digitalization and (b) reduce resource consumption. This strategic convergence of digital innovation and sustainable practices reflects a systems-thinking approach, recognizing the interdependence of various facets within the organization. Leadership, steering this transformative strategy, becomes instrumental in fostering a synergy between the technology-driven efficiencies and environmentally conscious practices.

5.4.2. Stakeholder-Centric Engagement

The project's rationale, centred on restructuring traditional processes, elevating human sustainability, and cultivating sustainable advantages, underscores the significance of stakeholder theory. The strategic incorporation of digital technologies plays a critical role in streamlining operations and aligning with sustainability objectives, generating positive outcomes across the environmental, economic, and social dimensions. In this context, stakeholder theory is crucial as it emphasizes engaging and satisfying the diverse needs of stakeholders.

The project's goals are to optimize processes by adopting innovative technology, positively impacting productivity, and fostering a conducive work environment—all of which are outcomes highly valued by stakeholders. The strategic integration of digital technologies streamlines operations and aligns with sustainability goals, contributing to an improved environmental performance. This shift enhances resource efficiency, reducing the environmental impact of paper production and electronic waste.

Notably, the reduction in electronic waste achieved through equipment repurposing aligns with sustainable practices, reflecting a stakeholder-oriented approach. By considering the interests and concerns of stakeholders, the project not only achieves its sustainability goals but also ensures broader societal and organizational benefits, reinforcing the importance of stakeholder theory in guiding and validating such initiatives. The sustainable benefits reflecting a stakeholder-oriented approach are as follows:

Enhanced environmental performance: The improved tracking, analysis, and reporting of environmental data enable stakeholders to identify inefficiencies and implement targeted actions, fostering sustainable practices.

Improved resource efficiency: Adopting a digital system enhances operational efficiency and optimizes resource utilization, leading to cost savings, reduced energy consumption, and more sustainable resource management.

Improved work quality and well-being: Simplifying tasks, reducing manual paperwork, and adopting a user-friendly system enhances work quality, reducing stress and increasing employee job satisfaction.

Promotion of innovation and adaptability: Embracing digital technologies instils a culture of innovation and adaptability, positioning the organization at the forefront of technological advancements for long-term resilience and competitiveness.

Reduced resource consumption: Minimizing or eliminating paper sheets through DT reduces paper waste, conserves natural resources, and decreases the environmental footprint associated with paper production and disposal. These sustainable benefits, deeply

rooted in stakeholder engagement, align the project with environmental sustainability goals, enhancing operational efficiency and employee well-being.

Guided by goal-setting theory, the criteria covering system boundaries, responsible IT usage, continuous improvements, and contamination elimination were meticulously considered. The project intends to fortify environmental sustainability by curbing resource consumption, elevate social sustainability by enriching work quality and human health, and bolster economic sustainability through judicious resource utilization. This deliberate goal-setting approach ensures a strategic alignment of project objectives with overarching sustainability principles, fostering a holistic and purpose-driven transformation.

5.4.3. Definition of Sustainable Targets and Dimensions

The project staff meticulously considered several criteria to ensure alignment with sustainability principles and foster positive impacts, reflecting a collaborative approach. These criteria consider defining the system boundaries and flow, setting goals for the responsible use of IT, establishing continuous improvements, and striving to eliminate contamination. Engaging stakeholders through participatory decision-making ensures that diverse perspectives and concerns are considered when defining sustainable objectives and dimensions.

The project directions are to improve environmental sustainability by strategically reducing resource consumption, eliminating sheets of paper, and promoting overall resource efficiency. Social sustainability takes centre stage, focusing on improving the quality of work life and human health. The participatory decision-making process involves optimizing the project, reducing workload, and addressing workplace issues to create a positive work environment for all stakeholders, aligned with their needs and expectations.

Economic sustainability is pursued through the project's responsible and sustainable use of IT. Participatory decision-making theory prioritizes efficiency and responsible resource consumption, leading to potential cost savings and economic benefits. This collaborative and inclusive approach to defining sustainable objectives and dimensions reflects the importance of stakeholder-focused engagement to ensure the success and effectiveness of sustainability initiatives within the project.

5.4.4. Creating the Sustainable Model

The project staff meticulously considered several criteria, integrating goal-setting and leadership theories to ensure alignment with sustainability principles and foster positive impacts. This approach reflected a collaborative approach. These criteria consider defining the system boundaries and flow, setting goals for the responsible use of IT, establishing continuous improvements, and striving to eliminate contamination.

Engaging stakeholders through participatory decision-making ensures that diverse perspectives and concerns, influenced by goal-setting theory, are considered when defining sustainable objectives and dimensions. Leadership theory guides the strategic direction, emphasizing the importance of senior managers in aligning the project with the organizational culture and validating the project scope.

The project purposes are to improve environmental sustainability by strategically reducing resource consumption, eliminating sheets of paper, promoting overall resource efficiency, and setting tangible goals influenced by goal-setting theory. Social sustainability focuses on improving the quality of work life and human health. It aligns with leadership theory, emphasizing the role of senior managers in fostering an innovative culture and providing robust support during transitions.

The participatory decision-making process involves optimizing the project, reducing workload, and addressing workplace issues to create a positive work environment for all stakeholders. The goals are influenced by goal-setting and leadership theory. Economic sustainability is pursued through the project's responsible and sustainable use of IT, setting objectives that reflect efficiency and responsible resource consumption, leading to potential cost savings and economic benefits.

This collaborative and inclusive approach to defining sustainable objectives and dimensions, shaped by goal-setting theory and leadership theory, reflects the importance of stakeholder-focused engagement and strategic leadership to ensure the success and effectiveness of sustainability initiatives within the project.

5.4.5. Deployment

The final stage of the project was driven by a holistic approach that seamlessly integrated participatory decision-making, systems theory, and leadership principles. This transformative project unfolded across six strategically designed phases, each contributing to tangible and sustainable results. Table 1 summarizes the project's benefits.

Table 1. Results.

Aspect	Results
Environmental Sustainability	100% reduction in paper consumption Successful repurposing and reuse of electronic devices
Cost Savings	100% cost savings in paper usage Reduced direct costs from USD16,296 to USD1660
Issue Resolution	Efficiency rate increased from 75% to 98.6% Significant decrease in unresolved issues
Resource Efficiency	Improved workplace conditions Reduced occupational risks Increased production efficiency
Time-Saving Achievements	Expedited issue resolution Opportunities for employee development

In the initial phase, the project team meticulously defined the scope, aligning the objectives with the demands of the five dimensions of sustainability. This preliminary work set the stage for an in-depth exploration of the project where all the participants identified opportunities where digital technologies, harmonized with sustainability objectives, could usher in substantial improvements.

In the third phase, the project team collaboratively gathered the team and employee requirements for explicitly integrating sustainability elements, resulting in a customized solution perfectly aligned with unique needs. Presenting the proposal to senior management in the fourth phase involved a meticulous consideration of costs, time, and resources. The goal was to obtain the crucial approval to determine senior management's support and commitment to the transformational effort. The subsequent development phase, based on participatory decision-making theory, generated a customized solution aligned with sustainability objectives and achieved cost savings.

6. Discussion

6.1. Strategic Framework Integration

The proposed framework emphasizes the crucial role of critical stakeholders, especially senior management, throughout the project lifecycle. Actively involving them aligns projects with the organizational culture, validates their scope, outlines the benefits and impacts, and ensures a smooth transition for all participants [7,40]. Additionally, the proposal reveals the complex relationships between sustainability dimensions, highlighting the far-reaching consequences of improvements in one dimension affecting others. The proposal aligns with theoretical frameworks advocating a comprehensive approach to sustainability, emphasizing the complexity of sustainable digitalization initiatives and the need for a deep understanding [23].

Furthermore, the proposed framework supports the involvement of end-users with domain expertise, serving a dual purpose by improving decision making, identifying areas of improvement, and reducing resistance to change [88]. It also aids in defining

sustainability targets, considering the organization's unique culture and policy. These targets strategically align with the entire organization, underlining the crucial role of senior managers and stakeholders [86,89].

At the core of our SDT framework is goal-setting theory, a powerful driver for organizational success [90]. The project establishes a robust foundation by defining system boundaries, responsible IT usage, continuous improvements, and contamination elimination [91]. Tangible objectives influenced by this theory strengthen environmental, social, and economic sustainability, creating a roadmap for success [92]. For example, a straightforward goal-setting approach led to a 100% reduction in paper consumption, demonstrating the practical impact of this theory.

Participative decision-making permeates every phase of our SDT proposal, ensuring a nuanced understanding of areas for improvement. This theory enables a collaborative approach, reducing the resistance to change and fostering a positive work environment [82,93]. The participatory decision-making process infuses vitality into our SDT framework, guiding decisions with collective wisdom. An example is the 98.6% increase in efficiency rate in resolved issues, a direct outcome of involving end-users in decision making.

Stakeholder theory guides the SDT strategy, ensuring diverse needs are considered when defining goals [83]. The strategic incorporation of digital technologies, resulting from stakeholder-centric engagement, aligns with sustainability goals, generating positive outcomes across dimensions. By considering stakeholder interests, SDT achieves sustainability goals and ensures broader societal and organizational benefits. An example is the successful alignment of digital initiatives with stakeholder expectations, resulting in the successful repurposing and reusing of electronic devices.

Systems theory forms the foundation of our SDT framework, recognizing the interdependence of organizational elements [74]. The initiation phase, guided by systems theory, acknowledges the interconnectedness within the organization. The framework transforms where technology-driven efficiencies and environmentally conscious practices synergize, ensuring SDT is a seamlessly integrated system. Production efficiency has increased resource efficiency, improved workplace conditions, reduced occupational risks, and increased productivity efficiency.

The proposal considers sustainable dimensions comprehensively, defining targets across the human, social, environmental, economic, and technical dimensions [94]. The SDT project aligns with overarching sustainability principles, showcasing the ripple effects that improvements in one dimension can have on others. The sustainability model, influenced by the sustainable dimensions theory, aids in identifying and measuring indicators, resulting in a 100% improvement in cost savings in paper usage.

The success factors for SDT include an enhanced environmental performance, improved resource efficiency, elevated work quality and well-being, promotion of innovation and adaptability, and reduced resource consumption. These factors, influenced by various theories, ensure that SDT exceeds goals, fostering a lasting impact. An example is the increase in organizational efficiency, showcasing the cumulative effect of addressing multiple success factors.

6.2. Benefits of the SDT Framework for SMEs

The SDT framework, validated through this case study, proves especially advantageous for SMEs. This discussion focuses on the SDT framework's primary benefit for SMEs, emphasizing its distinct approach to stakeholder engagement. Comparisons with existing works in digitalization and sustainability, particularly tailored for SMEs, further underscore its unique advantages [71].

The standout advantage of the SDT framework for SMEs lies in its stakeholder-centric engagement. Unlike conventional digitalization efforts that may overlook the impact on people and the environment, the SDT framework prioritizes restructuring processes, enhancing human sustainability, and cultivating sustainable practices [51]. The proposal

aligns seamlessly with stakeholder theory, ensuring active engagement and the satisfaction of diverse stakeholder needs [95].

Incorporating digital technologies strategically streamlines operations for SMEs, aligning with sustainability goals. This contrasts traditional approaches focusing on operational efficiency without considering broader impacts. By actively involving stakeholders and addressing their diverse needs, the SDT framework achieves sustainability goals and generates broader societal and organizational benefits.

Comparing the SDT framework with existing works tailored for SMEs reveals its distinction through embracing systems theory and leadership theory. This comprehensive perspective extends beyond operational improvements, addressing SMEs' unique challenges in their sustainable development process.

The sustainable benefits of the SDT framework, deeply rooted in stakeholder engagement, offer SMEs a clear advantage. The improved environmental performance, resource efficiency, enhanced work quality, and well-being highlight its unique selling points for SMEs. Additionally, reducing resource consumption aligns with SMEs' operational scale, making it a practical and feasible choice.

Furthermore, the participatory decision-making process and goal-setting theory employed in the SDT framework create a collaborative and inclusive approach that resonates well with SMEs' organizational structure and culture. This ensures that SMEs' sustainability objectives are strategic and align with the overarching business goals.

6.3. Contribution of the Proposed SDT Framework to the Literature

The proposed framework for SDT offers a structured approach grounded in critical theoretical pillars: organizational and technological maturity, leadership theory, systems theory, goal-setting theory, participatory decision-making theory, and stakeholder theory. Each pillar thoroughly explains both the theoretical foundations and practical implementation stages, providing a comprehensive roadmap for SDT initiatives.

Phased approaches, participative decision-making, and goal-setting are particularly relevant, especially for SMEs facing resource constraints. The seamless integration of theoretical insights with practical strategies effectively addresses challenges inherent in SDT endeavours.

At the heart of this framework lies the recognition of the critical roles played by leadership, stakeholder engagement, goal-setting, and systems thinking in addressing the complexities of SDT and ensuring lasting sustainability outcomes. This emphasis on leadership aligns with previous research, highlighting its indispensable contribution to driving SDT.

Furthermore, the framework emphasizes the seamless integration of five dimensions of sustainability—human, social, economic, environmental, and technological—throughout the SDT process. This integration ensures that digital initiatives align with broader organizational and societal objectives, fostering a culture of sustainability and resilience.

Previous research has consistently emphasized the necessity of a structured approach to SDT, whether through maturity models, to ensure alignment with sustainability goals. In this study, particular attention is given to the organizational and technological maturity pillar, underscoring the significance of maturity models in supporting the complexities of SDT and facilitating organizational maturity in digital efforts. Similarly, integrating digital tools with SDGs and innovating governance principles necessitate a phased approach, acknowledging the varying pace of change across business processes.

Emphasizing the critical role of stakeholder theory in guiding SDT initiatives, the proposed SDT framework advocates for the systematic involvement of internal and external stakeholders. This collaborative effort, rooted in stakeholder theory, facilitates the development of a robust SDT framework that resonates with the broader ecosystem.

Moreover, stakeholder theory fosters a culture of inclusion and shared responsibility within organizations starting their SDT. Actively involving stakeholders empowers them to become advocates for change, accelerating the implementation of digital initiatives and

enhancing the likelihood of sustained success. This inclusive approach ensures a holistic understanding of sustainability goals, nurturing a sense of collective ownership crucial for driving innovation and ensuring the enduring benefits of SDT efforts.

7. Conclusions and Limitations

The primary benefit of the SDT framework for SMEs lies in its stakeholder-centric engagement approach. Unlike conventional digitalization efforts, the framework prioritizes restructuring processes to enhance human sustainability and cultivate sustainable practices, aligning seamlessly with stakeholder needs and goals. Strategically incorporating digital technologies streamlines operations while actively involving stakeholders, improving environmental performance, resource efficiency, work quality, and well-being. Moreover, its participatory decision-making process and goal-setting theory create a collaborative and inclusive approach that resonates well with SMEs' organizational structure and culture, ensuring a strategic alignment with the overarching business goals.

Moreover, the proposed SDT framework offers SME managers and policymakers a structured approach to SDT, addressing critical theoretical pillars such as organizational and technological maturity, leadership, and stakeholder engagement. By integrating phased approaches, participative decision-making, and goal-setting, the framework effectively tackles challenges SMEs face with resource constraints. Moreover, the emphasis on leadership underscores its indispensable role in driving SDT, aligning digital initiatives with broader organizational and societal objectives. Through systematic stakeholder involvement, the framework fosters a culture of inclusion and shared responsibility, empowering stakeholders to advocate for change and accelerate the implementation of digital initiatives, ultimately ensuring the enduring benefits of SDT efforts.

While the empirical evidence and insights gained from this case study can provide valuable data into the benefits of the proposed SDT framework, it may only apply to some SMEs in different industries or geographic locations. Therefore, the investigation may need to be expanded to other economic sectors in Mexico or Latin America.

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