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Review

Small- and Medium-Sized Enterprises: Trends and Future Perspectives for Sustainability and Digitalization in Germany

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Abstract: The objective of this research was to provide a review of the state-of-the-art literature related to sustainability and digitalization in SMEs to identify current trends and future perspectives within this vital sector. The focus is on German SMEs, which are considered benchmarks, given these firms' critical role in the country's economy and job market. A total of 55 peer-reviewed articles were analyzed with the support of the Atlas TI 24.1 software package, focusing on definitions, frameworks, research questions, hypotheses, primary findings, and direct reports from interviewees. Major current trends were identified, clustered in two groups: (1) digitalization, digital transformation, Industry 4.0, and performance; and (2) sustainability, innovation, entrepreneurship, and risk management. Three future perspectives were identified: disseminating digitalization in the market; incorporating sustainability into business models; and increasing investments in government support programs. While the study is focused on German SMEs, its findings are applicable to similar economies within the European Union and can serve as a reference for developing countries' sustainable development goals (SDGs). This research advances knowledge on how SMEs play a critical role in the context of sustainability and digitalization, both now and in the future.

Keywords: SME; digitalization; innovation; digital transformation; Europe

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1. Introduction

Small and medium-sized enterprises (SMEs) perform an essential role in driving sustainability efforts, and governments, businesses, and researchers must address the gap between micro-level actions and macro-level outcomes. Although much attention is given to sustainability initiatives for large enterprises, SMEs are collectively the most common company type in Europe [1].

SMEs tend to have low expectations regarding Industry 4.0's potential benefits, initially influenced by their low investment capacity and preference for customer-focused applications due to their excellent perceived cost–benefit ratio. Due to their low investment

power, smaller enterprises are less likely to invest in innovation, but when they do, they invest proportionally more than large companies. SMEs tend to invest in process innovation, while large companies invest in processes and products [2].

Germany is the largest economy in Europe and is known for its advanced technology. The country has a well-established innovation ecosystem, which the government supports by promoting digitalization among SMEs. Mittelstand 4.0 Centres of Excellence initiatives benefited more than 65,000 SMEs in 2020, while the Digital Jetzt program encourages SMEs to invest in digitization and information technology (IT) security and training employees in digital skills [3].

The Mittelstand 4.0 initiative was launched in 2015 to address most German SMEs' slow adoption of digital technologies. A 2016 survey by ZEW showed that over 30% of German SMEs had implemented basic digitization elements, while only 20% had advanced digital maturity in their operational processes. The policy promotes greater digital transformation among SMEs [4]. Although SMEs have uncomplicated organizational structures and agility in responding to market changes, they tend to be less innovative and export-oriented than larger companies, as evidenced by various studies conducted by Radicic and Pugh [5].

Radicic and Petković [6] discovered that digital transformation's effectiveness on SME innovation is restricted, with its influence varying depending on company size. They argue that digital technologies might not foster innovation due to the ease of replicating the knowledge they contain. Nonetheless, digitalization increases the chances of innovation for forward-thinking SMEs that do not partake in research and development (R&D).

In this sense, external knowledge sources are critical for innovation in SMEs. They complement internal R&D activities in R&D-based SMEs and strengthen weak innovative capacity in non-R&D-based SMEs [7]. To contribute to this discussion, we address the following research questions (RQ) in a systematic literature review: What are German SMEs' main trends (RQ 1) and future perspectives (RQ 2)? The aim was to provide a review of the state-of-the-art literature on sustainability and digitalization in SMEs in Germany.

2. Small- and Medium-Sized Enterprises in Germany

The significant challenge of sustainability lies in overcoming personal selfishness, which is crucial for protecting ecosystems and achieving the triple goals of economic performance, environmental protection, and social progress. Decentralizing production through small- and medium-sized enterprises is essential for accomplishing sustainable development goals such as promoting sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all, as well as building resilient infrastructure, promoting inclusive and sustainable industrialization, and fostering innovation [8].

In this sense, the Mittelstand is a global benchmark for SDG-oriented economies. Mittelstand refers to a specific group of private German companies well-known internationally for their quality and innovation. In this article, Mittelstand refers to a German company that is typically small to medium in size that is owned and controlled by a single family and operates globally [9].

The Mittelstand focus on the long term allows them to tap into additional valuable resources. Due to their ownership setup and historical connections to predominantly rural or small-town areas, Mittelstand companies emphasize building relationships with important figures within the local community. Over time, they establish strong "ties" with suppliers, customers, research institutions, educational institutions, local authorities, and community financial institutions. Some of the main characteristics include [10]:

- Niche focus and customer collaboration: These companies adopt a highly focused strategy, which enables them to develop exceptional expertise and efficiencies to provide customized services and maintain a competitive edge.
- Preference for self-financing: Mittelstand companies prefer to self-finance, which enhances their independence and allows them to pursue their preferred strategies.

- Long-run mindset: The business's longevity is more important to Mittelstand executives than achieving short-term payoffs.
- Superior employee relations: Mittelstand companies prioritize enhanced training, high involvement of employees in decision-making, and maintain a flat hierarchy.

Regarding employee relations, Germany has a unique vocational training system that distinguishes Mittelstand firms in the labor market. Through a dual apprenticeship model, apprentices split their time, with 60% spent at the firm and 40% attending a vocational college. This approach aims to cultivate specialized skills specific to the company, resulting in reduced labor mobility and the prevalence of long-term employment contracts [11].

Successful examples of these family-owned firms are led by different generations, with an average company age of nearly 100 years. The factors contributing to the historical success of family-owned Mittelstand firms continue to be a crucial basis for successful digitalization in the modern era [12].

3. Research Methods

This section explores two aspects of the research process: data collection and analysis (Figure 1). In total, 55 articles were reviewed from the Scopus database using the Atlas TI 24.1 software package. The references were gathered by searching for definitions, frameworks, research questions, hypotheses, primary findings, and direct reports from interviewees.

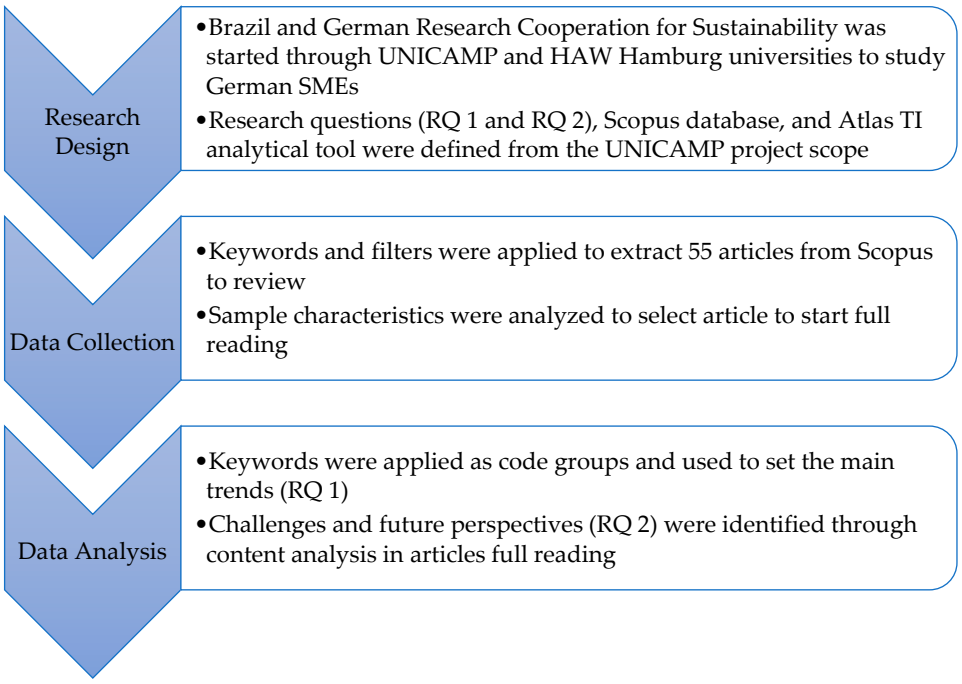

Figure 1. Research method flowchart. Source: Authors' creation.

3.1. Data Collection

Despite the exploratory aspect of the research, some scope restrictions were used to make it possible to find a tractable sample size. Given that the primary purpose is the study of small- and medium-sized enterprises, the commonly used acronym "SME" was used as a research input, followed by an asterisk that represents the flexibility of including an extension of the word, for example, "SMEs". Likewise, we used the asterisk for the entry "German", which could, for example, appear as "Germans". Based on these two keywords, the Boolean operator "and" was used to find documents that had in their title, summary, or keywords the intersection of the subjects SME and German.

To limit the sample scope, a series of contingencies were imposed, such as the limitation of documents. Findings were limited to the "journal" source type, aiming for greater

text quality. Another limitation was the subarea of "business and management", given the target audience of the research. Finally, the most recurring keywords were selected to narrow the sample further. At the end of this construction, a result of 94 articles was obtained. The "advanced query/search string" used in the Scopus database in December 2023 is given as follows: Sure, here is the text from the image: A(TITLE-ABS-KEY (sme*) AND TITLE-ABS-KEY (german*)) AND (LIMIT-TO (SRCTYPE, "j")) AND (LIMIT-TO (SUBJAREA, "BUSI")) AND (LIMIT-TO (EXACTKEYWORD, "Digitalization") OR LIMIT-TO (EXACTKEYWORD, "Performance") OR LIMIT-TO (EXACTKEYWORD, "Entrepreneurship") OR LIMIT-TO (EXACTKEYWORD, "Digital Transformation") OR LIMIT-TO (EXACTKEYWORD, "Industry 4.0") OR LIMIT-TO (EXACTKEYWORD, "Innovation") OR LIMIT-TO (EXACTKEYWORD, "Sustainability") OR LIMIT-TO (EXACTKEYWORD, "Risk Management")).

Based on that query, 44 articles were selected from the initial sample of 94. This initial selection was based on analyzing bibliographic data extracted into Excel. The database was structured based on an ordering classification based on three sequencing rules: the most cited first, the most recent first, and finally, alphabetically according to the main keywords:

For each keyword, a target of 50% of the sample was used as a selection criterion. The most cited and recent articles were prioritized, as was the relevance of the author's keywords, to add greater diversity to the sample. This initial selection comprised a body of 44 articles supplemented by a reconsideration of unselected articles.

After a final check, the articles not selected were reconsidered, and 11 more articles were added to the scope of the review, forming a final review sample of 55 articles. This last addition was based on reading the titles, which assessed the relevance of the articles to the research. Among these new articles added, the majority were recent, with few citations but great potential to contribute to the research proposal.

3.2. Data Analysis

This topic reports the process for obtaining search results. The data analysis process is presented based on three subtopics that represent the activities of the analysis process: marking the sample characteristics, finding the sample core analysis, and, finally, quoting, coding, and analyzing the content.

3.2.1. Marking the Sample Characteristics

To obtain a general description of the sample, some points in the database were flagged for characterization. The following signs were made according to the spreadsheet columns:

- "Cited by" column: A gradient of colors from darkest to lightest, where the darkest represents the most relevant. The same color with different tones grouped the order of magnitude of quotes. The first most cited article on each topic was highlighted.
- "Year" column: Articles published within the last five years were highlighted in color.
- "Title" column: The most relevant titles due to the presence of the search keywords (SME and German) were highlighted.
- "Source Title" column: The magazines with the highest recurrence in the sample were highlighted.

3.2.2. Finding the Sample Core Analysis

Due to the large amount of material to be processed, it was necessary to prioritize articles for review, where the most relevant articles were selected according to an evaluation of their titles and abstracts. In total, 26 articles were selected as the highest quality within the sample based on their titles. A smaller group, called anchor articles, represented the sample core analysis and was selected from these articles. This group has 15 articles that constitute the most relevant article from each of the eight thematic groups of analysis and the articles with the most significant potential to contribute to the research questions, providing a sample with the most cited and most recent articles.

This central group of articles passed through the entire analysis process and was read in full, quoted, coded, and analyzed. This research strategy generated two iterations of analysis: the first focused on the central sample composed of 15 articles, to generate a central axis of analysis, and the second iteration focused on thematic groups, composed respectively of the following numbers of articles: digitalization (6), digital transformation (5), Industry 4.0 (6), performance (4), innovation (14), entrepreneurship (8), sustainability (8), and risk management (4).

3.2.3. Quoting, Coding, and Analyzing the Content

The references were gathered by searching for definitions, frameworks, research questions, hypotheses, primary findings, and direct reports from interviewees.

The coding technique applied considered words and expressions extracted directly from the text.

The central sample was analyzed to outline the perception of the main definitions. Then, the analyses of each thematic group sought to construct the trends of each topic related to the keywords "SME*" and "GERMAN*".

4. Results and Discussion

This section presents trends and prospects for SMEs in Germany. Figure 2 graphically illustrates the key findings of the study.

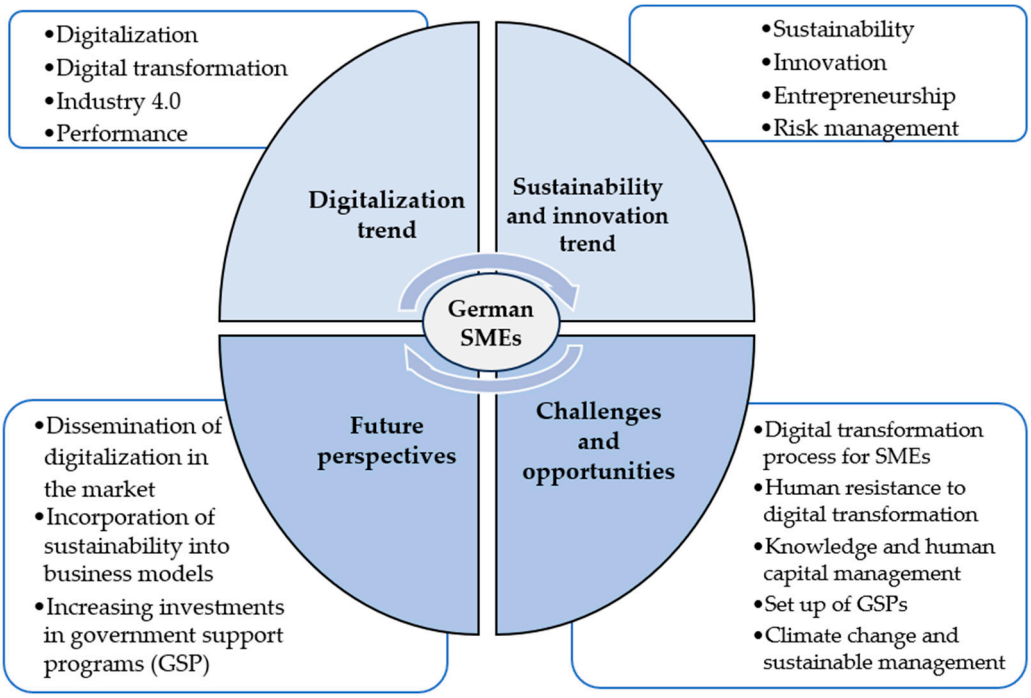

Figure 2. Trends, future perspectives, and challenges and opportunities in the German SME literature. Source: Authors' creation.

Initially, a general description of the sample of 55 articles reviewed in the research is presented, then each of the trends that were identified are analyzed, and finally, future perspectives are consolidated.

4.1. Sample Description

The sample of articles selected for review consisted of 55 articles. The most cited article in this group had 665 citations, entitled "Fortune favors the prepared: How SMEs approach Business Model Innovations in Industry 4.0". The second most cited has 281 citations and is titled "Industrial revolution—Industry 4.0: Are German manufacturing SMEs the first

victims of this revolution?". In the median of the sample in terms of citation numbers, the article "Concentration on the Few: Mechanisms behind a Falling Share of Innovative Firms in Germany" can be seen with 18 citations.

The most recent articles date from 2023, with ten articles in this condition. The most cited among them has 15 citations and is titled "Impact of Digitalization on Technological Innovations in Small- and Medium-sized Enterprises (SMEs)". The oldest article in the sample is "Integration of e-commerce by SMEs in the manufacturing sector: A data envelopment analysis approach" from 2005, cited 18 times. On the average publication date of the articles, the article "Business Model Innovation in Small- and medium-sized Enterprises: Strategies for Industry 4.0 Providers and Users" from 2009 was cited 148 times.

The most recurrent journals in the sample were "Technological Forecasting and Social Change" and "Research Policy", which appeared 5 and 3 times in the initial sample, 4 and 2 times among the most relevant, and 3 and 1 times among the articles selected as anchors. In addition to these journals, the "International Journal of Entrepreneurship and Small Business" appeared 7 times in the initial universe of 94 articles. However, of these, only three were included in the initial sample, and only one made up the group of anchor articles. This is due to difficulty accessing articles through the research group's institutions. The first two journals in the sample were the second and third in the initial universe of 94 articles.

Table 1 shows the core sample with the most relevant articles.

Table 1. Most relevant articles in the sample.

Key Perspective	Authors	Title
Digital Transformation	Hermann et al. (2023) [7]	Digital transformation in SMEs: A taxonomy of externally supported digital innovation projects
Digitalization	Pfister and Lehmann (2023) [4]	Measuring the Success of Digital Transformation in German SMEs
	Cravotta and Grottke (2019) [13]	Digitalization in German family firms—some preliminary insights
	Radicic and Petković (2023) [6]	Impact of digitalization on technological innovations in small and medium-sized enterprises (SMEs)
Entrepreneurship	Ettl and Simon (2017) [14]	Entrepreneurs' views on corporate social responsibility communication in SMEs-insights from Germany
	Müller et al. (2018) [15]	Fortune favors the prepared: How SMEs approach business model innovations in Industry 4.0
Industry 4.0	Sommer (2015) [2]	Industrial Revolution—Industry 4.0: Are German manufacturing SMEs the first victims of this revolution?
	Müller (2019) [16]	Business model innovation in small- and medium-sized enterprises: Strategies for industry 4.0 providers and users
Innovation	Nestle et al. (2019) [17]	Establishing open innovation culture in cluster initiatives: The role of trust and information asymmetry
	Rammer and Schubert (2018) [18]	Concentration on the few: mechanisms behind a Falling Share of innovative firms in Germany
	Strobel and Kratzer (2017) [19]	Obstacles to innovation for SMEs: Evidence from Germany
Performance	Wagner and Paton (2014) [20]	Strategic toolkits: seniority, usage, and performance in the German SME Machinery and equipment sector
Risk Management	Henschel (2006) [21]	Risk management practices in German SMEs: An empirical investigation
	Steeger and Hoffmann (2016) [22]	Innovation and family firms: ability and willingness and German SMEs
Sustainability	Hörisch et al. (2015) [23]	Implementation of Sustainability Management and Company Size: A Knowledge-Based View

Source: Authors' creation.

4.2. Digitalization Trend

In the current trend toward the digitalization of organizations, we can identify four key perspectives (Table 2). The first perspective is digitalization, which focuses on technological advancements and information management strategies to optimize business operations. The second perspective is digital transformation, which emphasizes the effects and conse-

quences that result from the implementation of new information technologies. The third perspective is Industry 4.0, which emphasizes the production sector and the integration of logistics chains through information processes and connectivity across a network of industry actors. Finally, the fourth perspective is performance, which emphasizes the strategic management of outcomes achieved by implementing new technologies. While these perspectives have no clear boundaries, a crossover of different approaches is expected in various articles. However, a structural logic of approaching the subject can be understood by considering four key elements: technology, its application and effects, systematization of technology, and its management.

Table 2. Key points on the digitalization trend.

Key Perspective	Emphasis	Key Point	References
Digitalization	Technological advancements and information management strategies	• Scaling business using decentralized strategies	Radicic and Petković (2023) [6]
		• Technological innovation, organizational culture, and the availability of skilled personnel also influence the process	Hassan et al. (2021) [24]
		• Digital value chains and big data analytics positively affect product and process innovations	Saleem et al. (2020) [25]
Digital Transformation	Implementation of new information technologies	• Shifting from physical retail sales to a digital marketplace	Solberg et al. (2020) [26]
		• Accurate calculations and better control of company performance	Birkel and Wehrle (2022) [27]
		• Levels of control reduce the risk investments	Pfister and Lehmann (2023) [4]
		• Risks and benefits are shared in the supply chain	Hermann et al. (2023) [7]
Industry 4.0	Connectivity across a network of industry actors	• Connecting the systems through the Internet	Prodi et al. (2022) [28]
		• Control over the production and quality	Muller et al. (2019) [16]
		• Reduce costs, improve time-to-market and adapt to changed legislation	Sommer (2015) [2]
Performance	Strategic management of outcomes	• Organizational structure that fosters collaboration and supports adopting new practices to facilitate technological innovation	Walker et al. (2015) [29]
		• Monitoring the foreign party's actions helps prevent significant surprises	Lewicki and Brinsfield (2011) [30]
		• Toolkits bolster decision-making capabilities and enhance performance	Wagner and Paton (2014) [20]

Source: Authors' creation.

4.2.1. Digitalization

Incorporating and utilizing digital technologies is known as digitalization, which is crucial for businesses to remain competitive and innovative in their respective industries [31]. Digitalization has transformed markets, allowing small- and medium-sized enterprises to scale their business using decentralized strategies [6]. This has enabled fast growth for some companies previously limited by size [32].

However, many small- and medium-sized businesses still hesitate to adopt digital tools and applications, missing out on opportunities to improve their business models [13,33].

The low intention to use digital sales channels is one of the main barriers to adoption, but the administrative backend has the highest use intentions and current use [34].

While financial resources undoubtedly play a significant role in digitalization, their impact is not the sole factor [35]. Other factors, such as technological innovation, organizational culture, and the availability of skilled personnel, also influence the process [24,36]. For example, despite limited resources, local owner-operated retail outlets (LOOROs) can utilize digital resources like electronic inventory management systems, customer relationship management software, online shops, and marketing automation tools to overcome limitations and establish strategic advantages [37].

Finally, digital value chains and the utilization of big data analytics benefit product and process innovations within SMEs, regardless of their size [25]. Adopting management strategies that promote learning from diverse internal and external channels can enable SMEs to achieve levels of innovation comparable to those of organizations focused on R&D [38].

4.2.2. Digital Transformation

The literature defines digital transformation in various ways. However, some common perspectives include implementing digital technologies, their impact on business processes and models, and their effects on all aspects of human life [39]. This involves ongoing initiatives with interrelated actors, such as shifting from physical retail sales to a digital marketplace [26].

Digitized processes have made operations faster and more efficient across all business areas with the help of intelligent dashboards, modern software, and user-friendly tools. This reduces the number of working steps required to collect and present key performance indicators (KPIs). Data quality has also improved, leading to more accurate calculations and better control of company performance. In addition, many processes have become more accessible, automated, and streamlined, resulting in increased simplicity. Lastly, waste has been minimized with data optimization software [27].

For example, product information systems provide comprehensive details, features, and specifications for products to aid in the buying process. These systems boast user-friendly navigation, a fully searchable portfolio and content, secure payment methods, and a straightforward single-sign or partner login for quick and easy purchasing. This benefits small- and medium-sized businesses, helping them increase brand awareness and visibility and revitalize their brand [40]. Furthermore, production, equipment, and process efficiency experience high levels of control and reduce the risk of investments [4].

This new economic logic, that risks and benefits are shared in the supply chain by the rental and insurance contracts, makes the usually high manufacturing investment costs possible for SMEs through a new capital structure [7]. The specialization of enterprises in their own core business proposal-sharing processes and equipment is only possible through the evolution of information systems. With more information and real-time information, economic actors can feel more comfortable engaging in rental contracts [41].

4.2.3. Industry 4.0

Industry 4.0 is a term that refers to the integration of digital technology in the manufacturing process. This involves connecting information and communication technologies with production facilities, including machines, products, devices, and online content [42]. Cyber-physical systems (CPS) are intelligent machines, storage systems, and production facilities that can exchange information, initiate actions, and control each other [43]. The Industrial Internet of Things (IIoT) has been formed by connecting these systems through the Internet, leading to significant technological advancements in areas such as engineering, manufacturing, material flow, and supply chain management [28].

The benefits of implementing Industry 4.0 technologies reinforce two basic competition strategies: differentiation and specialization [15]. These strategies are not exclusive and can be used together. With technological developments, the effectiveness of these strategies

reaches new levels of efficiency [44]. By having access to processing capacity for their customers' information, businesses can increasingly provide tailored solutions for their consumers, thus adding the value proposition of a differentiated level of service, as well as increasing control over the production and quality of products and services, achieving greater cost efficiency [29].

According to Yu and Schweisfurth [45], manufacturing companies consider robots, digital communication, automatic data analysis, and visualization as the most relevant technologies. Simulation, 3D printing, and cloud computing are moderately relevant to these companies. Although small- and medium-sized enterprises (SMEs) also recognize the importance of these technologies, they have lower degrees of implementation than larger companies [46].

The primary motives behind adopting Industry 4.0 technology include cost reduction, enhancing time-to-market, and adjusting to revised regulations [2]. However, significant hurdles to implementation comprise limited expertise, excessive concentration on operational aspects rather than overall company advancement, inadequate grasp of its strategic significance, insufficient human resources, and the necessity for ongoing employee training [47]. German SMEs face several challenges in adopting Industry 4.0, such as a lack of financial resources, low production numbers, low degrees of standardization, and a lack of understanding of integration [48].

4.2.4. Performance

According to Kallmuenzer and Scholl-Grissemann [49], managerial innovation is a critical factor in two key ways: first, research has shown that managerial and technological innovations work together to improve outcomes, and second, innovative management practices can enable product and process development advancements in family firms. This occurs by establishing an organizational structure that fosters collaboration and supports adopting new practices to facilitate technological innovation [29].

In this sense, diversifying a business has numerous advantages, such as achieving scope economies and increased market power, making more efficient use of existing resources and capabilities, reducing risk and variability in performance, and protecting against future uncertainties [50]. One of the ways to diversify the business involves internationalization. In this context, digitalization favors an environment of trust between parties due to the greater information shared on the network in real-time [51]. Consequently, monitoring the foreign party's actions helps prevent significant surprises and allows SMEs to focus on critical performance indicators [30].

Furthermore, research indicates that committed decision-makers tend to lead better-performing enterprises [20]. These findings may affect human resources discussions concerning succession planning [52]. Prominent executives and decision-makers are advised to use strategic toolkits to understand their business environment better and make informed decisions [53]. These toolkits comprise management analytics, frameworks, models, and philosophies to enhance comprehension of the internal and external business landscape. Ultimately, these toolkits bolster decision-making capabilities and enhance performance [20].

4.3. Innovation Trend

In the current trend toward organization innovation, we can identify four key perspectives (Table 3) with the same core logic as the previously analyzed trend. The first perspective is innovation, which focuses on the object of the trend, which is related to putting new successful solutions in the market. The second perspective is entrepreneurship, which emphasizes how it happens, which is more like how it can be spread in the markets. The third perspective is sustainability, which emphasizes the systemic aspect of innovation because, as it is already known, economies need to cope with climate change and social pressure on their operations. Finally, the fourth perspective is risk management, which emphasizes monitoring and controlling operations to achieve the best outcomes. As noted, these perspectives have no clear boundaries, and a crossover of different approaches is

expected in various articles. However, a structural logic of approaching the subject can be understood by considering the same four key elements: technology, application, system, and management.

Table 3. Key points on the innovation trend.

Key Perspective	Emphasis	Key Point	References
Innovation	Putting new successful solutions in the market	• Micro-sized firms face a higher probability of negative returns on their R&D investments	Müller (2019) [16]
		• Innovation creates asymmetry in firms	Rammer and Schubert (2018) [18]
		• Innovation brokers can add value to networks with diverse organizations	Strobel and Kratzer (2017) [19]
		• Information asymmetry and lack of trust are major obstacles to an open innovation culture in cluster initiatives	Nestle et al. (2019) [17]
Entrepreneurship	How solutions can be spread in the markets	• Innovation sets the groundwork for firm differentiation	Aquilante and Vendrell-Herrero (2021) [54]
		• Innovative companies can begin exporting at a lower level of productivity than non-innovative	Müller et al. (2018) [15]
		• Foreign market entry mode is a crucial decision	Dörr et al. (2022) [55]
		• Some external hindrances are legal regulations, lack of capital and information, and cultural and language differences	Ettl and Simon (2017) [14]
Sustainability	Systemic aspect of innovation	• Significant gap between the micro-level actions taken by businesses and the macro-level environmental outcomes	Hörisch et al. (2015) [23]
		• External pressure and incentives, a legal or public-private partnership framework is necessary to raise awareness	Isensee et al. (2023) [56]
		• Sustainability training for SME employees positively impacts their confidence and sustainable actions at work	Schröder et al. (2023) [57]
Risk Management	Monitoring and control of operations	• Large enterprises have integrated risk management into their business planning	Turpin (2002) [58]
		• Time constraints and lack of access to relevant guidance are the main obstacles to risk assessment	Steeger and Hoffmann (2016) [22]
		• SMEs rely on intuition over quantitative methods for decision-making	Henschel (2006) [21]

Source: Authors'.

4.3.1. Innovation

Innovative small firms often do not prioritize intellectual property rights (IPRs) as they do not attach much importance to innovation protection [59]. However, greater innovativeness increases the likelihood of small firms becoming preoccupied with appropriating innovation outcomes [60]. The level of investment in R&D positively impacts the likelihood of documenting an innovation, particularly regarding product innovation, as opposed to process innovation [61]. Micro firms encounter a heightened risk of experiencing unfavor-

able returns on their R&D expenditures, attributed to the distinct cost and risk profile of such investments and the associated decision risks [16,62].

SMEs usually do not have a big budget for R&D or R&D departments [63]. However, they develop new products or processes through experience-based knowledge and creative thinking [64]. From a macroeconomic point of view, focusing on larger firms raises the risk of developing an industrial monoculture [65]. This monoculture would be increasingly dominated by a few large firms involved in the automotive, chemical, mechanical, and electrical engineering industries [66]. This happens because innovation creates asymmetry in companies that become more competitive [18].

While reducing innovation initiatives to save costs may be tempting, doing so can ultimately erode established market positions [67]. Though this is a complex and time-consuming undertaking, the most significant risk is that firms cannot resume their innovation activities due to a lack of the necessary competencies [68]. Innovation brokers can add value to networks with diverse organizations by leading innovation initiation, innovation process management, and network composition [19].

Open innovation is a process that involves sharing knowledge across organizational boundaries [69]. However, information asymmetry and lack of trust are major obstacles that hinder the development of an open innovation culture in cluster initiatives [17]. When there are information asymmetries, conflicts may arise and hinder the innovation process, which is consistent with previous research [70,71]. On the other hand, a high level of trust has been found to positively impact the intensity and efficiency of information exchange among economic actors [72].

4.3.2. Entrepreneurship

Developing new products, services, and processes is crucial for creating, surviving, and growing entrepreneurial ventures [73]. Integrated solutions embody three core attributes that resonate with innovation: Firstly, they must generate value to qualify as innovative; secondly, they establish the foundation for distinguishing a firm from its competitors; lastly, both product and service innovations fall under the purview of technological innovations [54]. Integrated solutions are custom-designed to deliver desired outcomes tailored to particular clients or customer segments, making them intrinsically different from existing market offerings and providing enhanced differentiation opportunities [74].

Innovation and exporting also have a positive correlation, as improved products and processes lead to differentiation and competitive advantage, forming the basis of this association [75]. The consensus is that innovative companies enhance their domestic competitiveness through product and process innovation, facilitating their entry into foreign markets [76]. Innovative companies may initiate their export activities at a lower productivity level than non-innovative counterparts because their exported products distinguish themselves from competitors within international markets [15].

The choice of foreign market entry mode is a crucial decision for a firm when it enters a new country's market as it determines the organization's structure in the host country [55]. There are two categories of entry modes: equity entry modes and non-equity entry modes [77]. Equity entry modes include direct investments in the host country, like joint ventures or wholly-owned subsidiaries. Non-equity entry modes include indirect and direct exporting and contractual agreements like licensing. Studies show that entry mode choices significantly impact a firm's performance [78].

Equity-based entry modes necessitate a more substantial initial allocation of resources, yet they afford closer proximity to host country markets and customers [79]. Conversely, non-equity entry modes demand fewer resources upfront and offer greater adaptability to the firm. However, firms lack market proximity, making it difficult to monitor foreign market developments [80]. Despite the growing importance of internationalization for SMEs, many are still not engaging in cross-border activities due to external hindrances such as legal regulations, lack of capital and information, and cultural and language differences [14].

4.3.3. Sustainability

Large corporations often receive considerable attention concerning sustainability initiatives [48,81]. However, small- and medium-sized enterprises (SMEs) are vital in driving sustainability efforts, given their prevalence as Europe's most common form of business [82]. Nevertheless, there is a significant gap between the micro-level actions taken by businesses and the macro-level environmental outcomes, which governments, businesses, and researchers must address through sustainable actions [23].

Effective sustainability management requires various tools and approaches [83]. However, the proliferation of these tools poses a challenge to scholars and practitioners, who may find it difficult to maintain a comprehensive understanding of the existing approaches [84]. Thus, it is critical to remain attentive and well-informed about the latest developments in the field to ensure the successful implementation of sustainability initiatives [85].

SMEs may lack awareness of the benefits of sustainability activities, leading to a lack of motivation to seek information or join voluntary networks. To create external pressure and incentives, a legal or public–private partnership framework is necessary to raise awareness [56]. While companies tend to use similar tools regardless of size, SMEs may be less aware of available tools due to resource constraints [86]. Conversely, raising the visibility of large enterprises to the media, NGOs, and the government can lead to enhanced responsiveness to stakeholder demands and the adoption of sustainability management tools [87].

A skilled workforce can engage in several sustainable actions that positively impact the sustainability performance of a small- or medium-sized enterprise [88]. Prior research has demonstrated that providing sustainability training to SME employees positively impacts their confidence and sustainable actions at work [60]. This training also contributes to SMEs' financial success [89]. Employees gain theoretical and practical knowledge of sustainability, including resources, technologies, human behavior, costs, environmental impacts, public health, and more, enhancing their ability to act sustainably [90].

4.3.4. Risk Management

Risk management is essential for identifying, analyzing, and responding to uncertainties while balancing risks and opportunities. The actual outcome may deviate from the estimated value, resulting in better or worse outcomes. Risk has quantifiable attributes, while uncertainty is unpredictable, making risk management an ongoing process that requires continuous attention [91]. In large enterprises, directors and risk managers are responsible for risk management, while internal audits supervise and review risk management in over half of these enterprises. These organizations commonly review risks annually or quarterly, with a monitoring horizon of 2–5 years. The majority of large enterprises have integrated risk management into their business planning, indicating the importance of this process [58].

SMEs face two significant risk assessment obstacles: time constraints and lack of access to relevant guidance [22]. Many SMEs find the time required for different aspects of risk assessment challenging. However, with the right information and guidance, SMEs can effectively conduct risk assessments. When devising a risk management strategy, it is imperative to consider the resource constraints of SMEs. Any risk management approach must be tailored to the specific needs of SMEs and should not require a substantial financial or personnel investment [92].

Entrepreneurs' attitudes influence small firms' risk management practices, with SMEs prioritizing their business entity over managing individual risks [93]. Despite identifying and evaluating risks, owners may still overlook certain risks. SMEs rely on intuition over quantitative methods for decision-making [21]. As enterprises grow, they tend to make more rational decisions. Start-ups often underestimate risks and face uncertainty, requiring quick decision-making [94].

4.4. Future Perspectives

The analyzed trends have noted three future perspectives (Table 4). One perspective comes the trend of digitalization, another from sustainability, and a third emerges from the transversal direction of government support. The first perspective is related to the dissemination of digitalization in the market. The second is the incorporation of sustainability into business models. The third is increasing investments in government support programs.

Table 4. Key points on the future perspectives.

Key Perspective	Emphasis	Key Point	References
Digitalization	Dissemination of Digitalization in the Market	• Reorganize for optimal responses in dynamic markets	Teece (2018) [95]
		• Creating more effective and customer-centric products	Estensoro et al. (2022) [96]
		• SMEs take a gradual approach to digitalization	Gruber (2019) [97]
Sustainability	Incorporation of Sustainability into Business Models	• SMEs face challenges implementing complex tools like sustainability accounting or advanced employee training schemes	Kotey and Folker (2007) [98]
		• SMEs can use collaborative initiatives to gain access to and exchange relevant ecology and sustainability-associated information	LePoutre and Heene (2006) [99]
Digital Transformation	Increasing Investments in Government Support Programs	• Innovation spending in Germany has significantly increased in the last two decades	OECD (2021) [100]
		• Changes in the institutional environment significantly affect entrepreneurial outcomes	Cheng et al. (2024) [101]

Source: Authors'.

4.4.1. Dissemination of Digitalization in the Market

Digitalization is viewed differently in the information systems and management literature. Some see it as a source of innovation [102], while others see it as a generic resource [103]. Digitalization integrates computer technologies to enhance organizational processes, products, or services [104]. SMEs that strategically digitalize tend to adjust to changing customer preferences and reorganize for optimal responses in dynamic markets [95]. Product innovation increases profitability, while process innovation reduces costs and improves quality [105].

The integration of digital technologies has the potential to enhance connectivity, facilitate information sharing, and foster user participation in product innovation. As Chavez et al. [106] noted, such advancements can be leveraged to increase collaboration within and outside organizations, thereby driving innovation and improving operational efficiency. Through digital tools, firms can create an open and inclusive platform for idea generation, enabling customers, employees, and other stakeholders to contribute to innovation. In this way, digital technologies offer a robust means for firms to better understand user needs, preferences, and behaviors, ultimately creating more effective and customer-centric products [96].

Germany is a decisive innovator and ranks 11th in the EU for digitalization [107]. Digitalization offers multiple innovation benefits for firms, but SMEs face difficulties in adopting it due to limited resources and other factors, such as the lack of strategy, organizational culture, and inadequate business models [108]. Entrepreneurial skills and digital orientation have been shown to help decision-makers in SMEs assess innovations for their organization [109]. Gruber [97] underscores four key reasons why SMEs adopt digital transformation at a sluggish pace, given as follows: (1) small enterprises are less susceptible

to the urgency of digitalization; (2) they frequently lack the resources and foresight to grasp the implications of digital transformation; (3) SMEs tend to adopt a step-by-step approach to digitalization; (4) constrained financial resources in micro- and small-sized firms impede investment in digitalization.

4.4.2. Incorporation of Sustainability into Business Models

Businesses of all sizes face sustainability issues, including rising energy prices, employee health and safety concerns, carbon emissions, and waste reduction. They must take responsibility for their environmental and societal impact by following laws and regulations, reacting to public pressures, and implementing proactive initiatives and strategies. However, due to the required time and resources, SMEs face challenges implementing complex tools like sustainability accounting or advanced employee training schemes. Additionally, managing all relevant stakeholders, such as customers, suppliers, regional organizations, and NGOs, would consume much time and be a scarce resource for SMEs [98].

Integrating sustainability and innovation can benefit businesses by reducing costs and risks, increasing sales and reputation, and building innovation capabilities. However, dealing with sustainability-related issues is challenging for most organizations [110]. Although many tools have been developed to assist businesses, most are designed for larger corporations, and SMEs may require different approaches. Germany has significantly promoted digitalization among SMEs, and the country has set up specialized competence centers dedicated to this endeavor. It boasts a more significant proportion of enterprises utilizing cutting-edge technologies such as big data analytics and AI compared to the EU average [111]. Notably, 57% of German enterprises exhibit a medium to high dedication to environmentally friendly initiatives through ICT [3].

SMEs can use collaborative initiatives to gain access to and exchange relevant ecology and sustainability-related information. This can help increase their absorptive capacity for innovation performance [99]. Corporate culture plays a significant role in this approach. Corporate culture refers to shared assumptions learned by a group to solve problems of external adaptation and internal integration, which are considered valid and taught to new members [112].

4.4.3. Increasing Investments in Government Support Programs

Public authorities offer a range of incentives to support SMEs in their digital transformation endeavors. For instance, in Germany, the "Mittelstand Digital" network grants SMEs access to the knowledge and capabilities of digital innovation units, which are dedicated organizational groups responsible for conceptualizing, developing, and integrating digital innovation into businesses [113]. In Germany, innovation expenditure has witnessed a notable surge over the past two decades. Between 1995 and 2013, firms escalated their spending from EUR 60.7 billion to EUR 145.2 billion, indicating a compound annual growth rate of 5.0%. Nevertheless, this increase in innovation outlays has predominantly been propelled by large firms boasting over 500 employees, leading to a rise in the proportion of innovation spending attributed to large enterprises from 58% to 76% [100].

The policies that affect efficient resource reallocation and business liquidation can immediately impact entrepreneurship [114]. In Germany, insolvency law is a significant institutional factor affecting entrepreneurship. Strong liquidity support for SMEs and a temporary suspension of the obligation to file for insolvency have been implemented. Previous research has shown that changes in the institutional environment significantly affect entrepreneurial outcomes, including both entrepreneurial exits and firm entry [101]. While supporting SMEs during a crisis is crucial, prolonging Germany's insolvency regime moratorium could worsen market congestion, hindering entrepreneurship [41].

SMEs that are not investing in internal R&D can benefit from digitalization and enhance innovation performance [115]. However, policymakers often overlook these firms. Government support is necessary to promote the adoption of digital technologies and improve innovation performance, particularly for micro- and small-sized firms. Recent

research indicates that non-R&D SMEs in Germany stand to gain from policies that foster technology adoption and diffusion [16]. In January 2021, the Federal Government introduced its inaugural data strategy, aimed at promoting innovative data utilization and sharing across Europe. Despite not yet fully embracing big data analytics, SMEs can derive positive effects on product innovation, particularly in small- and medium-sized enterprises. These benefits underscore the distinctions between SMEs of varying sizes and those involved in R&D versus non-R&D activities [62].

4.5. Challenges and Opportunities

The analyzed trends identified five topics that can be sources of challenges and opportunities: the digital transformation process for SMEs, human resistance through digital transformation, knowledge, and human capital management, climate change and sustainable management, and the establishment of government support programs (Table 5).

Table 5. Key points on challenges and opportunities.

Key Perspective	Emphasis	Key Point	References
Digital Transformation	Digital Transformation Process for SMEs	• Collaborating with competitors in highly innovative, dynamic, and complex industries	Brandenburger and Nalebuff (1996) [116]
		• External support plays a vital role in their success	Chrisman and McMullan (2004) [117]
		• Management should create an innovative and digital-friendly environment across all hierarchical levels	Pfister and Lehmann (2023) [4]
	Human Resistance Through Digital Transformation	• High investments in automation may contradict shareholder desires for short-term profits	Bollweg et al. (2020) [34]
		• Some managers of SMEs resist change due to their missing personality traits and emotions	Ettl and Simon (2017) [14]
		• Employees avoid new technology due to concerns about job security	Carayannis et al. (2006) [118]
	Knowledge and Human Capital Management	• Smaller enterprises may have difficulty attracting qualified employees due to their inability to offer competitive wages and job security	O'Gorman (2006) [119]
		• Family businesses have close relationships with customers and are problem-solvers	Soluk and Kammerlander (2021) [41]
		• Startups accumulate many capital resources that enable them to establish themselves quickly	Cravotta et al. (2018) [120]
	Set up of Government Support Programs	• Policymakers should avoid a one-size-fits-all approach to digitalization in SMEs	Hermann et al. (2024) [121]
		• Economic development policy should prioritize the quality of start-ups over the quantity of start-ups	European Commission (2019) [122]
Sustainability	Climate Change and Sustainable Management	• As consumers become more environmentally conscious, market niches can be explored to offer sustainable products	Abu-Farha and Khraisheh (2008) [123]
		• It is not possible to postpone Global warming, which has already reached 1.2 °C, and it is expected to increase to 2.7–3.2 °C	IPCC (2022) [124]

Source: Authors.

4.5.1. Digital Transformation Process for SMEs

Embarking on a company's digital transformation is a multifaceted endeavor, encompassing adjusting business practices, skill sets, organizational cultures, and value propositions. This process often involves various terms such as Industry 4.0, digital "servitization", digital supply chains, or specific technologies. For example, Jabbour et al. [125] characterized it as a fusion of digitally empowered supply chain management, Industry 4.0, big data predictive analytics, and sustainable supply chain management, whereas Paschou et al. [126] emphasized the interaction between digital technologies and "servitization".

In this sense, family-owned small- and medium-sized enterprises (SMEs) should consider joining a "coopetitive" network to establish long-lasting relationships, enhance social connections, and exchange valuable information, particularly on succession strategies, which are a prevalent concern and challenge for family businesses [127]. "Coopetition" [116] refers to collaborating with competitors in highly innovative, dynamic, and complex industries. This strategy holds particular importance in industries characterized by brief product life cycles, substantial R&D investments, significant technological standards, and the convergence of diverse technologies [128]. Coopetition, the collaboration between competitors, can assist businesses in acquiring essential resources and knowledge, thereby mitigating knowledge imbalances concerning innovation [129].

SMEs struggling to progress in their digital transformation journey can benefit significantly from external support. This support aids in closing disparities in technology adoption, skills, and resources while empowering and training SMEs. As SMEs progress along their digital transformation path, external assistance plays a crucial role in their success [117]. For instance, as highlighted by Agrawal et al. [130], primary hindrances to supply chain (SC) digital transformation include the absence of urgency, industry-specific directives, insufficient digital skills and talent, and the high costs associated with implementation and operation. To tackle these challenges, management should foster an innovative and digitally receptive atmosphere throughout all organizational levels [4]. Furthermore, companies should invest in fresh skills and capabilities, such as digital analytics, and collaborate to craft a digitalization roadmap, facilitating a fruitful SC transformation journey.

4.5.2. Human Resistance through Digital Transformation

The impact of Industry 4.0 on employment in industrial sectors is influenced by various factors, including a country's social protection policies, education policies, and workforce structure. "Bounded automation" suggests that labor costs, power dynamics within the organization, and job profile characteristics limit the pace of automation and digitization [131]. Expected trends include more human-machine interactions, less routine work and more cognitive efforts, new ergonomic principles, and greater emphasis on soft skills and on-the-job learning [46].

Low wages and lenient employment regulations can act as barriers to increasing labor automation. Sometimes, sticking with labor-intensive processes may be less expensive than investing in automation technology. Moreover, substantial investments in automation may conflict with shareholders' aspirations for immediate profitability, whereas elevated wages can incentivize automation [34]. In highly industrialized nations, the scarcity of a skilled workforce and diminished prospects for enhancing productivity might constrain the returns on additional capital investment [13].

Some SME managers exhibit resistance to change because of their inherent personality traits and emotional dispositions [14]. They maintain that emotions constitute the distinguishing characteristic of small businesses and that sales transactions remain fundamentally interpersonal despite the availability of social media platforms [26]. Employees avoid new technology due to concerns about job security. SMEs often lack the resources, knowledge, and culture to adopt new technology [118].

4.5.3. Knowledge and Human Capital Management

Key players in smaller enterprises are typically the business owners and select employees who oversee specific business functions such as sales [132]. The owner's departure can negatively impact the firm's future, and successors may have to relearn everything. The personalized knowledge of these individuals can be critical for a firm's survival. In SMEs, key employees and controlling owners possess indispensable expertise that provides a competitive advantage [133]. Given SMEs' long-term relationships with stakeholders, the long-term absence of such individuals may have negative implications for the company's well-being [134].

Various factors can contribute to costs associated with employee turnover, including the recruitment process, such as conducting a job analysis, searching for candidates, selecting the right person, and providing training [135]. Smaller enterprises may have difficulty attracting qualified employees due to their inability to offer competitive wages and job security [119]. The departure of even one team member can exacerbate this shortage of resources, and the costs of decreased productivity and workflow disruptions must not be underestimated [136].

Family businesses have close relationships with customers and are problem solvers, which gives them an advantage over startups because they have been in their market for decades or centuries, giving them a wealth of experience [41]. This experience helps them avoid unmanageable strategic options, saving them time and money that would otherwise be wasted in unnecessary trials. In contrast, Silicon Valley startups accumulate many capital resources that enable them to establish themselves quickly [120]. Using a marketing budget that exceeds their annual revenue, they can quickly become known worldwide in the virtual space and learn from their customers using the lean startup approach's build-learn-concept measure [33].

4.5.4. Set Up of Government Support Programs

Governmental authorities in various countries have launched digital innovation units to support SMEs in their digital innovation projects. These units, such as the "Mittelstand Digital" initiative in Germany, are publicly funded external agencies that can support SMEs by sharing knowledge and compensating for missing competencies and resources. However, the vast numbers of new and disruptive technologies can often overwhelm SMEs, making it difficult for them to initiate digital innovation projects. Studies have shown that SMEs can struggle in this regard [137].

A well-designed funding program should employ a selection mechanism that combines internal and external selection and filters at multiple levels. Policymakers should avoid a one-size-fits-all approach to digitalization in SMEs [121]. This applies to SMEs of different sizes and, in comparison, to larger firms. Policymakers should create an environment for SME digitalization, which can promote knowledge sharing and agility and enhance global competitiveness [41].

One possible optimal approach could be to provide essential funding to start-up centers and incubators while factoring in fixed costs alongside a customized arrangement that distinguishes between various types of founders based on their unique requirements and circumstances. Most scientists recommend that economic development policy prioritizes the quality of start-ups over the quantity of start-ups [122]. As a result, support programs should be focused on a smaller number of companies. However, selecting the appropriate beneficiaries can be challenging since there are no dependable indicators or guaranteed solutions for creating growth and jobs [138].

4.5.5. Climate Change and Sustainable Management

SMEs often lack awareness and understanding of sustainable management practices, unlike their larger counterparts, who can dedicate specific teams to address them. The primary reason for this gap is the lack of knowledge about sustainable solutions and tools. To bridge this gap, support networks for SMEs can provide an excellent opportunity to

explore and develop sustainable solutions that are economically attractive and effective for the business.

As consumers become more environmentally conscious, market niches can be explored to offer sustainable products [4]. Incorporating innovative technologies can be a powerful tool to enhance sustainability and improve product efficiency [139]. The choice of raw materials can significantly impact the environmental footprint, and using lightweight materials and cutting-edge superplastic forming techniques can minimize it [123].

Additionally, toxic substances used in production can harm the environment and workers' health [140]. Using gas-based minimum quantity lubrication or extending the lifetime of these fluids can minimize their negative impact [141]. As stated, it is not possible to postpone global warming, which has already reached 1.2 °C, and it is expected to increase to 2.7–3.2 °C by the end of the century, which is higher than the target set by the Paris Agreement to keep the planet safe [124].

5. Conclusions

It is difficult to think that companies of different sizes have the same capacity for competition in the business environment. However, the digital revolution has brought new perspectives to the market, enabling small enterprises to present better strategies that may lead them to be the next market leader. However, probabilistically, this possibility is hard to achieve. Large companies usually have competitive advantages, while small- and medium-sized enterprises are more vulnerable.

More than increasing the number of large companies in the market, economies have a fundamental interest in competitive markets with many independent actors. Thus, given the disruptive potential of new technologies introduced into the market by the fourth industrial revolution, governments see themselves as responsible for providing financial and technological support for the participation of small- and medium-sized companies in this digital market transformation.

It is noted that the most developed economies are predominantly made up of small- and medium-sized enterprises. In this sense, the interest is that there are many medium-sized companies rather than a few large companies. Large companies are relevant to economies, but small- and medium-sized enterprises present greater resilience. Due to their specificities, small- and medium-sized enterprises can be important economic resources considering the constant global changes. This theme is particularly relevant for developing strategies to achieve decent work, economic growth, innovation, and infrastructure (SDGs 8 and 9).

In this sense, this research provides some trends and future perspectives for SMEs. Two major trends were identified: digitalization and innovation. For each of these trends, four perspectives could be organized according to the structural logic of approaching the subject, which can be understood by considering the same four key elements: technology, application, system, and management. The main ideas from each perspective were discussed throughout the text and summarized in tables.

Some practical and theoretical implications of the study are the identification of an overview of key elements for market transformation in the coming years and consideration of topics that should affect the configuration of markets in the future. This discussion can benefit academics, business managers, and public program managers from a panoramic view of current issues companies and governments face in transforming society and the economy by introducing new technologies and climate change.

Finally, this study's method was developed in an exploratory manner, so the main limitation lies in the descriptive subjectivity of the themes identified in the sample of articles reviewed. However, a structure of topics that covered the research objective of describing trends and future perspectives for small- and medium-sized enterprises based on studies related to the German economy could be organized.

5.1. Key Findings on German SMEs

The literature review on German SMEs reveals that digitalization and digital transformation are key trends that are shaping the futures of these companies. The adoption of advanced technologies such as big data and Industry 4.0 connectivity enables greater operational efficiency and innovation. Decentralized information management strategies and the implementation of new information technologies facilitate the transition from physical sales to the digital market, providing more precise control of business performance and reducing risky investments. These technological advances not only improve production and quality but also enable SMEs to adapt quickly to regulatory changes and reduce operating costs.

In the area of innovation, the literature highlights the importance of new solutions and the dissemination of innovative practices in markets. Microenterprises, despite facing greater risks of negative returns on R&D, benefit significantly from innovation, which creates a competitive asymmetry. Open innovation and collaboration networks, mediated by innovation hubs, are essential to overcome barriers such as information asymmetry and lack of trust. Furthermore, innovation not only differentiates companies domestically but also facilitates entry into foreign markets, even with lower productivity levels. However, the research also points to external challenges such as legal regulations, lack of capital, and cultural differences, which affect SMEs' ability to innovate and internationalize.

Sustainability is emerging as a growing priority for German SMEs, driven by external pressures and incentives. The gap between micro-level actions and macro-level environmental outcomes highlights the need for a more integrated and collaborative approach to sustainability. The literature indicates that legal or public–private partnerships and sustainability training for employees are key to raising awareness and promoting sustainable actions. SMEs that adopt sustainable practices not only improve their corporate image but also explore new market niches for environmentally friendly products. Furthermore, integrated risk management into business strategies is essential to mitigate time constraints and the lack of relevant guidance, ensuring a more robust and resilient approach to corporate sustainability.

5.2. Practical Implications of the German SME Review

Digitalization has a significant impact on German SMEs, fostering operational efficiency and innovation. The implementation of advanced technologies and information management strategies enables these companies to scale their businesses in a decentralized manner, taking advantage of the connectivity and control provided by Industry 4.0. This results in digitalized value chains that use big data to improve product and process innovations, increasing competitiveness and adaptability to regulatory changes. However, SMEs must be aware of the need for a robust organizational culture and skilled personnel to maximize the benefits of digitalization.

Innovation and entrepreneurship play crucial roles in the development of SMEs, enabling new solutions to be introduced to the market. Despite the risks associated with investing in research and development (R&D), innovation can create a significant competitive advantage. Innovative companies often have greater export capacity, even with lower productivity levels. However, information asymmetry and lack of trust can make it difficult to build a culture of open innovation, highlighting the importance of innovation hubs to facilitate partnerships and add value to business networks.

Sustainability is emerging as a critical aspect of the future of German SMEs. The pressure to adopt sustainable practices, driven by conscious consumers and environmental regulations, presents both challenges and opportunities. SMEs can use collaborative initiatives and sustainability training for employees to increase their effectiveness and confidence in environmental practices. In addition, integrating risk management into business plans can help mitigate obstacles associated with time constraints and a lack of relevant guidance. Taking a proactive approach to sustainability can not only improve corporate image, but also open up new market niches for sustainable products.

5.3. Theoretical Implications of the German SME Review

The theoretical implications of the research on German SMEs in the era of digitalization highlight the need for a new understanding of business dynamics in digital environments. Digitalization and digital transformation are reshaping organizational structures and business models, suggesting that traditional management and innovation theory must incorporate the centrality of technology and the interconnectivity of digital value chains. The interconnectedness of systems via the Internet and the use of big data for product and process innovation point to the need for theories that explain how companies can manage and use such data effectively to maintain their competitiveness.

Research on innovation and entrepreneurship in German SMEs challenges existing theories about the returns on R&D investments, particularly in micro-enterprises. The greater likelihood of negative returns on R&D investments in these companies suggests a review of theories that view innovation as a uniformly positive and linear process. Furthermore, the importance of innovation hubs for adding value to networks and overcoming information asymmetry and lack of trust suggests that theories of open innovation and inter-organizational collaboration need to be adjusted to reflect the particularities and challenges of SMEs, especially in cluster initiatives.

Sustainability, as an emerging trend among German SMEs, suggests significant theoretical implications for environmental management and corporate social responsibility. The gap between micro-level actions and macro-level environmental outcomes indicates that sustainability theories should consider the interdependence between business practices and broader environmental impacts. The need for legal or public–private partnerships to raise awareness and promote sustainable actions underscores the importance of theories that integrate multiple stakeholders in the sustainability process. Furthermore, the emphasis on sustainability training for employees and its positive influence on business actions requires a reassessment of human resource development theories and their role in implementing sustainable practices.

5.4. Proposals for Future Studies

Future studies on German SMEs could focus on longitudinal analysis of the effects of digitalization and digital transformation on operational efficiency and competitiveness. Research could investigate how different levels of adoption of digital technologies affect long-term performance, considering variables such as innovation, productivity, and the ability to adapt to regulatory changes. In addition, studies could explore the role of organizational culture and workforce qualifications in maximizing the benefits of digitalization and identifying best practices for integrating new technologies in SME environments.

Another proposal for future studies would be to examine the dynamics of innovation and entrepreneurship in SMEs, focusing on the barriers and facilitators of open innovation. Research could investigate how information asymmetry and lack of trust influence the formation of partnerships and collaborative networks, as well as the role of innovation hubs in mitigating these challenges. Studies could also analyze the impact of government policies and support programs in promoting sustainable innovation, identifying how different types of support influence SMEs' ability to implement innovative and sustainable practices. Furthermore, research could focus on effective strategies to integrate sustainability into the daily operations of SMEs, considering the impact of collaborative initiatives and training in sustainable practices.

5.5. Final Considerations

In conclusion, this literature review on German SMEs reveals that digitalization, innovation, and sustainability are crucial pillars for their development and competitiveness in the current scenario. Companies that adopt advanced technologies and innovative practices while facing the challenges of digital transformation are better prepared to compete and adapt to market changes. Furthermore, the integration of sustainable practices and effective risk management are essential to ensure resilient and environmentally responsible growth.

The research underscores the importance of a holistic and collaborative approach, where organizational culture, workforce skills, and strategic partnerships play a central role in maximizing the benefits of these emerging trends. These findings provide a comprehensive framework for SMEs and policymakers to develop effective strategies to foster a more innovative, sustainable, and competitive business ecosystem.

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References

1. World Trade Organization (WTO). World Trade Report 2016: Levelling the Trading Fields for SMEs. 2016. Available online: https://www.wto.org/english/res_e/booksp_e/world_trade_report16_e.pdf (accessed on 14 December 2023).
2. Sommer, L. Industrial revolution—Industry 4.0: Are German manufacturing SMEs the first victims of this revolution? *J. Ind. Eng. Manag.* **2015**, *8*, 1512–1532. [CrossRef]
3. European Commission. Digital Economy and Society Index 2021—Country Reporting. Germany. 2021. Available online: https://digital-strategy.ec.europa.eu/en/library/digital-economy-and-society-index-desi-2021 (accessed on 14 December 2023).
4. Pfister, P.; Lehmann, C. Measuring the Success of Digital Transformation in German SMEs. *J. Small Bus. Strategy* **2023**, *33*, 1–19. [CrossRef]
5. Radicic, D.; Pugh, G. Performance effects of external search strategies in European small and medium-sized enterprises. *J. Small Bus. Manag.* **2017**, *55*, 76–114. [CrossRef]
6. Radicic, D.; Petković, S. Impact of digitalization on technological innovations in small and medium-sized enterprises (SMEs). *Technol. Forecast. Soc. Chang.* **2023**, *191*, 122474. [CrossRef]
7. Hermann, A.; Gollhardt, T.; Cordes, A.K.; von Lojewski, L.; Hartmann, M.P.; Becker, J. Digital transformation in SMEs: A taxonomy of externally supported digital innovation projects. *Int. J. Inf. Manag.* **2023**, *74*, 102713. [CrossRef]
8. D'Adamo, I.; Di Carlo, C.; Gastaldi, M.; Rossi, E.N.; Uricchio, A.F. Economic Performance, Environmental Protection and Social Progress: A Cluster Analysis Comparison towards Sustainable Development. *Sustainability* **2024**, *16*, 5049. [CrossRef]
9. Kraus, P.; Stokes, P.; Cooper, S.C.; Liu, Y.; Moore, N.; Britzelmaier, B.; Tarba, S. Cultural Antecedents of Sustainability and Regional Economic Development—A Study of SME 'Mittelstand' Firms in Baden-Württemberg (Germany). *Entrep. Reg. Dev.* **2020**, *32*, 629–653. [CrossRef]
10. De Massis, A.; Audretsch, D.; Uhlaner, L.; Kammerlander, N. Innovation with Limited Resources: Management Lessons from the German Mittelstand. *J. Prod. Innov. Manag.* **2018**, *35*, 125–146. [CrossRef]
11. Heider, A.; Gerken, M.; van Dinther, N.; Hülsbeck, M. Business model innovation through dynamic capabilities in small and medium enterprises—Evidence from the German Mittelstand. *J. Bus. Res.* **2021**, *130*, 635–645. [CrossRef]
12. de Groote, J.; Soluk, J.; Laue, S.L.; Heck, M.; Kammerlander, N. How can family-owned Mittelstand firms use their unique resources to master the digitalization age? The role of family historical, venture, and collaborative capital. *Bus. Horiz.* **2023**, *66*, 133–152. [CrossRef]
13. Cravotta, S.; Grottke, M. Digitalization in German family firms—Some preliminary insights. *J. Evol. Stud. Bus.* **2019**, *4*, 1–25. [CrossRef]
14. Ettl, K.; Simon, J. Entrepreneurs' views on corporate social responsibility communication in SMEs insights from Germany. *Int. J. Entrep. Innov. Manag.* **2019**, *23*, 425–445. [CrossRef]
15. Müller, J.M.; Buliga, O.; Voigt, K.I. Fortune favors the prepared: How SMEs approach business model innovations in Industry 4.0. *Technol. Forecast. Soc. Chang.* **2018**, *132*, 2–17. [CrossRef]

16. Müller, J.M. Business model innovation in small- and medium-sized enterprises: Strategies for industry 4.0 providers and users. *J. Manuf. Technol. Manag.* **2019**, *30*, 1127–1142. [CrossRef]
17. Nestle, V.; Täube, F.A.; Heidenreich, S.; Bogers, M. Establishing open innovation culture in cluster initiatives: The role of trust and information asymmetry. *Technol. Forecast. Soc. Chang.* **2019**, *146*, 563–572. [CrossRef]
18. Rammer, C.; Schubert, T. Concentration on the few: Mechanisms behind a falling share of innovative firms in Germany. *Res. Policy* **2018**, *47*, 379–389. [CrossRef]
19. Strobel, N.; Kratzer, J. Obstacles to innovation for SMEs: Evidence from Germany. *Int. J. Innov. Manag.* **2017**, *21*, 1750030. [CrossRef]
20. Wagner, R.; Paton, R.A. Strategic toolkits: Seniority, usage and performance in the German SME machinery and equipment sector. *Int. J. Hum. Resour. Manag.* **2014**, *25*, 475–499. [CrossRef]
21. Henschel, T. Risk management practices in German SMEs: An empirical investigation. *Int. J. Entrep. Small Bus.* **2006**, *3*, 554–571. [CrossRef]
22. Steeger, J.H.; Hoffmann, M. Innovation and family firms: Ability and willingness and German SMEs. *J. Fam. Bus. Manag.* **2016**, *6*, 251–269. [CrossRef]
23. Hörisch, J.; Johnson, M.P.; Schaltegger, S. Implementation of Sustainability Management and Company Size: A Knowledge-Based View. *Bus. Strategy Environ.* **2015**, *24*, 765–779. [CrossRef]
24. Hassan, S.S.; Reuter, C.; Bzhalava, L. Perception or capabilities? An empirical investigation of the factors influencing the adoption of social media and public cloud in German SMEs. *Int. J. Innov. Manag.* **2021**, *25*, 2150002. [CrossRef]
25. Saleem, H.; Li, Y.; Ali, Z.; Mehreen, A.; Mansoor, M.S. An empirical investigation on how big data analytics influence China SMEs performance: Do product and process innovation matter? *Asia Pac. Bus. Rev.* **2020**, *26*, 537–562. [CrossRef]
26. Solberg, E.; Traavik LE, M.; Wong, S.I. Digital mindsets: Recognizing and leveraging individual beliefs for digital transformation. *Calif. Manag. Rev.* **2020**, *62*, 105–124. [CrossRef]
27. Birkel, H.; Wehrle, M. Small- and Medium-Sized Companies Tackling the Digital Transformation of Supply Chain Processes: Insights from a Multiple Case Study in the German Manufacturing Industry. *IEEE Trans. Eng. Manag.* **2022**, 1–16. [CrossRef]
28. Prodi, E.; Tassinari, M.; Ferrannini, A.; Rubini, L. Industry 4.0 policy from a sociotechnical perspective: The case of German competence centres. *Technol. Forecast. Soc. Chang.* **2022**, *175*, 121341. [CrossRef]
29. Walker, R.M.; Chen, J.; Aravind, D. Management innovation and firm performance: An integration of research findings. *Eur. Manag. J.* **2015**, *33*, 407–422. [CrossRef]
30. Lewicki, R.J.; Brinsfield, C. Framing trust: Trust as a heuristic. In *Framing Matters: Perspectives on Negotiation Research and Practice in Communication*; Donohue, W.A., Rogan, R.G., Kaufman, S., Eds.; Peter Lang Publishing: New York, NY, USA, 2011; pp. 110–135.
31. Gartner. Digitalization, IT Gloassary. Available online: https://www.gartner.com/en/information-technology/glossary/digitalization (accessed on 22 December 2018).
32. Kowal, D.; Radzik, M.; Domaracká, L. Assessment of the Level of Digitalization of Polish Enterprises in the Context of the Fourth Industrial Revolution. *Sustainability* **2024**, *16*, 5718. [CrossRef]
33. Kofler, I.; Marcher, A. Inter-Organizational Networks of Small and Medium-Sized Enterprises (SME) in the Field of Innovation: A Case Study of South Tyrol. *J. Small Bus. Entrep.* **2018**, *30*, 9–25. [CrossRef]
34. Bollweg, L.; Lackes, R.; Siepermann, M.; Weber, P. Drivers and barriers of the digitalization of local owner operated retail outlets. *J. Small Bus. Entrep.* **2020**, *32*, 173–201. [CrossRef]
35. Legner, C.; Eymann, T.; Hess, T.; Matt, C.; Böhmann, T.; Drews, P.; Ahlemann, F. Digitalization: Opportunity and Challenge for the Business and Information Systems Engineering Community. *Bus. Inf. Syst. Eng.* **2017**, *59*, 301–308. [CrossRef]
36. Kaplan, A.M.; Haenlein, M. Users of the world, unite! The challenges and opportunities of social media. *Bus. Horiz.* **2010**, *53*, 59–68. [CrossRef]
37. Falk, M.; Hagsten, E. An Exploration of Growth in Computer Software Micro Firms. *J. Small Bus. Entrep.* **2018**, *30*, 233–252. [CrossRef]
38. Pantano, E. Innovation Drivers in Retail Industry. *Int. J. Inf. Manag.* **2014**, *34*, 344–350. [CrossRef]
39. Vial, G. Understanding digital transformation: A review and a research agenda. *J. Strateg. Inf. Syst.* **2019**, *28*, 118–144. [CrossRef]
40. Gast, J.; Kallmünzer, A.; Kraus, S.; Gundolf, K.; Arnold, J. Coopetition of Small-and Medium-Sized Family Enterprises: Insights from an IT Business Network. *Int. J. Entrep. Small Bus.* **2019**, *38*, 78–101. [CrossRef]
41. Soluk, J.; Kammerlander, N. Digital transformation in family-owned Mittelstand firms: A dynamic capabilities perspective. *Eur. J. Inf. Syst.* **2021**, *30*, 676–711. [CrossRef]
42. Beier, G.; Matthess, M.; Shuttleworth, L.; Guan, T.; de Oliveira Pereira Grudzien, D.I.; Xue, B.; Pinheiro de Lima, E.; Chen, L. Implications of Industry 4.0 on industrial employment: A comparative survey from Brazilian, Chinese, and German practitioners. *Technol. Soc.* **2022**, *70*, 102028. [CrossRef]
43. ZEW. *Digitalisierung Im Mittelstand: Status Quo, Aktuelle Entwicklungen und Herausforderungen, Aktuelle Entwicklungen und Herausforderungen, Forschungsprojekt im Auftrag der KfW Bankengruppe*; KfW Bankengruppe: Frankfurt, Germany, 2016.
44. Upchurch, M. Robots and AI at work: The prospects for singularity. *New Technol. Work. Employ.* **2018**, *33*, 205–218. [CrossRef]
45. Yu, F.; Schweisfurth, T. Industry 4.0 technology implementation in SMEs—A survey in the Danish-German border region. *Int. J. Innov. Stud.* **2020**, *4*, 76–84. [CrossRef]

46. Helmrich, R.; Weber, E.; Wolter, M.I.; Zika, G. The Consequences of Industry 4.0 for the Labour Market and Education. In *The Future of Education and Labor. Arts, Research, Innovation and Society*; Bast, G., Carayannis, E., Campbell, D., Eds.; Springer International Publishing: New York, NY, USA, 2019.
47. Telukdarie, A.; Dube, T.; Munsamy, M.; Murulane, K.; Mongwe, R. Navigating Digital Challenges for SMEs: A Two-Tier Approach to Risks Mitigation and Sustainability. *Sustainability* **2024**, *16*, 5857. [CrossRef]
48. Müller, J.M.; Voigt, K.I. Sustainable Industrial Value Creation in SMEs: A Comparison between Industry 4.0 and Made in China 2025. *Int. J. Precis. Eng. Manuf.—Green Technol.* **2018**, *5*, 659–670. [CrossRef]
49. Kallmuenzer, A.; Scholl-Grissemann, U. Disentangling antecedents and performance effects of family SME innovation: A knowledge-based perspective. *Int. Entrep. Manag. J.* **2017**, *13*, 1117–1138. [CrossRef]
50. Singh, D.A.; Gaur, A.S.; Schmid, F.P. Corporate diversification, TMT experience, and performance: Evidence from German SMEs. *Manag. Int. Rev.* **2010**, *50*, 35–56. [CrossRef]
51. Holtgrave, M.; Onay, M. Success through trust, control, and learning? Contrasting the drivers of sme performance between different modes of foreign market entry. *Adm. Sci.* **2017**, *7*, 9. [CrossRef]
52. Eriksson, T.; Ortega, J. The Adoption of Job Rotation: Testing the Theories. *Ind. Labor Relat. Rev.* **2006**, *59*, 653–666. [CrossRef]
53. Khanagha, S.; Volberda, H.; Sidhu, J.; Oshri, I. Management innovation and adoption of emerging technologies: The case of cloud computing. *Eur. Manag. Rev.* **2013**, *10*, 51–67. [CrossRef]
54. Aquilante, T.; Vendrell-Herrero, F. Bundling and exporting: Evidence from German SMEs. *J. Bus. Res.* **2021**, *132*, 32–44. [CrossRef]
55. Dörr, J.O.; Licht, G.; Murmann, S. Small firms and the COVID-19 insolvency gap. *Small Bus. Econ.* **2022**, *58*, 887–917. [CrossRef]
56. Isensee, C.; Teuteberg, F.; Griese, K.M. How can corporate culture contribute to emission reduction in the construction sector? An SME case study on beliefs, actions, and outcomes. *Corp. Soc. Responsib. Environ. Manag.* **2023**, *30*, 1005–1022. [CrossRef]
57. Schröder, S.; Wiek, A.; Farny, S.; Luthardt, P. Toward holistic corporate sustainability—Developing employees' action competence for sustainability in small and medium-sized enterprises through training. *Bus. Strategy Environ.* **2023**, *32*, 1650–1669. [CrossRef]
58. Turpin, M. *Risikomanagement in Europa 2002. Eine Untersuchung mittelständischer Unternehmen (Risk Management in Europe 2002. An Investigation of Medium-Sized Enterprises)*; Marsh and McLennan Companies: London, UK, 2002.
59. Thomä, J.; Bizer, K. To protect or not to protect? Modes of appropriability in the small enterprise sector. *Res. Policy* **2013**, *42*, 35–49. [CrossRef]
60. Hossain, M. Frugal innovation: Conception, development, diffusion, and outcome. *J. Clean. Prod.* **2020**, *262*, 121456. [CrossRef]
61. Dreßler, M.; Paunovic, I. Strategic brand innovation—An explorative study of up- and downstream brand innovation practices in SME wineries. *Int. J. Wine Bus. Res.* **2023**, *35*, 66–88. [CrossRef]
62. Baumann, J.; Kritikos, A.S. The link between R&D, innovation and productivity: Are micro firms different? *Res. Policy* **2016**, *45*, 1263–1274. [CrossRef]
63. Martínez-Peláez, R.; Escobar, M.A.; Félix, V.G.; Ostos, R.; Parra-Michel, J.; García, V.; Ochoa-Brust, A.; Velarde-Alvarado, P.; Félix, R.A.; Olivares-Bautista, S.; et al. Sustainable Digital Transformation for SMEs: A Comprehensive Framework for Informed Decision-Making. *Sustainability* **2024**, *16*, 4447. [CrossRef]
64. Mitze, T.; Kreutzer, F. Relocation, innovation, and the difference that firm size makes: Insights for global sourcing strategies of SMEs. *J. Int. Entrep.* **2023**, *21*, 354–384. [CrossRef]
65. Bennat, T.; Sternberg, R. CEO characteristics and the Doing-Using-Interacting mode of innovation: A new upper echelons perspective. *Ind. Innov.* **2022**, *29*, 1202–1230. [CrossRef]
66. Leithold, N.; Haase, H.; Lautenschläger, A. Stage-Gate® for SMEs: A qualitative study in Germany. *Eur. J. Innov. Manag.* **2015**, *18*, 130–149. [CrossRef]
67. Dressler, M.; Paunovíc, I. Business model innovation: Strategic expansion of german small and medium wineries into hospitality and tourism. *Adm. Sci.* **2021**, *11*, 146. [CrossRef]
68. Batterink, M.H.; Wubben EF, M.; Klerkx, L.; Omta SW, F. Orchestrating innovation networks: The case of innovation brokers in the agri-food sector. *Entrep. Reg. Dev.* **2010**, *22*, 47–76. [CrossRef]
69. Chesbrough, H.; Bogers, M. Explicating open innovation: Clarifying an emerging paradigm for understanding innovation. In *New Frontiers in Open Innovation*; Chesbrough, H., Vanhaverbeke, W., West, J., Eds.; Oxford University Press: Oxford, UK, 2014; pp. 3–28.
70. Coleman, J.S. Social Capital in the Creation of Human Capital. *Am. J. Sociol.* **1988**, *94*, S95–S120. [CrossRef]
71. Dosi, G. Sources, procedures, and microeconomic effects of innovation. *J. Econ. Lit.* **1988**, *26*, 1120–1171.
72. Lane, P.J.; Salk, J.E.; Lyles, M.A. Absorptive capacity, learning, and performance in international joint ventures. *Strateg. Manag. J.* **2001**, *22*, 1139–1161. [CrossRef]
73. Neumeyer, X.; Santos, S.C.; Morris, M.H. Overcoming barriers to technology adoption when fostering entrepreneurship among people with low incomes: The role of technology and digital literacy. *IEEE Trans. Eng. Manag.* **2021**, *68*, 1605–1618. [CrossRef]
74. Brax, S.A.; Jonsson, K. Developing integrated solution offerings for remote diagnostics. *Int. J. Oper. Prod. Manag.* **2009**, *29*, 539–560. [CrossRef]
75. Cassiman, B.; Golovko, E. Innovation and internationalization through exports. *J. Int. Bus. Stud.* **2011**, *42*, 56–75. [CrossRef]
76. Gassmann, O.; Keupp, M.M.; Zurich, E. The Internationalisation of R&D in Swiss and German Born Globals: Survey and Case Study Evidence. *Int. J. Entrep. Small Bus.* **2007**, *4*, 214–233.

77. Hollender, L.; Zapkau, F.B.; Schwens, C. SME foreign market entry mode choice and foreign venture performance: The moderating effect of international experience and product adaptation. *Int. Bus. Rev.* **2017**, *26*, 250–263. [CrossRef]
78. Chen, H.; Hu, M.Y. An analysis of determinants of entry mode and its impact on performance. *Int. Bus. Rev.* **2002**, *11*, 193–210. [CrossRef]
79. Sommer, L. Internationalization processes of small- and medium-sized enterprises-a matter of attitude? *J. Int. Entrep.* **2010**, *8*, 288–317. [CrossRef]
80. Eggers, F.; O'Dwyer, M.; Kraus, S.; Vallaster, C.; Güldenberg, S. The impact of brand authenticity on brand trust and SME growth: A CEO perspective. *J. World Bus.* **2013**, *48*, 340–348. [CrossRef]
81. Klewitz, J.; Zeyen, A.; Hansen, E.G. Intermediaries driving eco-innovation in SMEs: A qualitative investigation. *Eur. J. Innov. Manag.* **2012**, *15*, 442–467. [CrossRef]
82. Sohns, T.M.; Aysolmaz, B.; Figge, L.; Joshi, A. Green business process management for business sustainability: A case study of manufacturing small and medium-sized enterprises (SMEs) from Germany. *J. Clean. Prod.* **2023**, *401*, 136667. [CrossRef]
83. Niehoff, S.; Matthess, M.; Zwar, C.; Kunkel, S.; Guan, T.; Chen, L.; Xue, B.; de Oliveira Pereira Grudzien, D.I.; Pinheiro de Lima, E.; Beier, G. Sustainability related impacts of digitalisation on cooperation in global value chains: An exploratory study comparing companies in China, Brazil and Germany. *J. Clean. Prod.* **2022**, *379*, 134606. [CrossRef]
84. Förster, B. Technology foresight for sustainable production in the German automotive supplier industry. *Technol. Forecast. Soc. Chang.* **2015**, *92*, 237–248. [CrossRef]
85. Perez-Sanchez, D.; Barton, J.R.; Bower, D. Implementing environmental management in SMEs. *Corp. Soc. Responsib. Environ. Manag.* **2003**, *10*, 67–77. [CrossRef]
86. Hansen, E.G.; Klewitz, J. Publicly mediated inter-organizational networks: A solution for sustainability-oriented innovation in SMEs? In *Entrepreneurship, Innovation and Sustainability*; Wagner, M., Ed.; Greenleaf: Sheffield, UK, 2012; pp. 254–278.
87. Uhlaner, L.M.; Berent-Braun, M.M.; Jeurissen, R.J.M.; de Wit, G. Beyond size: Predicting engagement in environmental management practices of Dutch SMEs. *J. Bus. Ethics* **2011**, *109*, 411–429. [CrossRef]
88. Bacq, S.; Alt, E. Feeling capable and valued: A prosocial perspective on the link between empathy and social entrepreneurial intentions. *J. Bus. Ventur.* **2018**, *33*, 333–350. [CrossRef]
89. Sánchez-Marín, G.; Lozano-Reina, G.; Beglaryan, M. HRM policies and SMEs performance: The moderating role of CSR orientation. *Cent. Eur. Bus. Rev.* **2021**, *11*, 85–110. [CrossRef]
90. Sass, W.; Boeve-de Pauw, J.; Olsson, D.; Gericke, N.; de Maeyer, S.; van Petegem, P. Redefining action competence: The case of sustainable development. *J. Environ. Educ.* **2020**, *51*, 292–305. [CrossRef]
91. Weber, M.M.; Kokott, P. Organizational Resilience and the Attention-Based View of the Firm—Empirical Evidence from German SMEs. *Sustainability* **2024**, *16*, 4691. [CrossRef]
92. O'Hara, R.; Dickety, N.; Weyman, A. Good practice in assessing workplace risks by small and medium-sized enterprises. *Risk Manag. Int. J.* **2005**, *7*, 31–41. [CrossRef]
93. Thun, J.H.; Drüke, M.; Hoenig, D. Managing uncertainty-an empirical analysis of supply chain risk management in small and medium-sized enterprises. *Int. J. Prod. Res.* **2011**, *49*, 5511–5525. [CrossRef]
94. Durst, S.; Wilhelm, S. Do you know your knowledge at risk? *Meas. Bus. Excell.* **2013**, *17*, 28–39. [CrossRef]
95. Teece, D.J. Business models and dynamic capabilities. *Long Range Plan.* **2018**, *51*, 40–49. [CrossRef]
96. Estensoro, M.; Larrea, M.; Müller, J.M.; Sisti, E. A resource-based view on SMEs regarding the transition to more sophisticated stages of industry 4.0. *Eur. Manag. J.* **2022**, *40*, 778–792. [CrossRef]
97. Gruber, H. Proposals for a digital industrial policy for Europe. *Telecommun. Policy* **2019**, *43*, 116–127. [CrossRef]
98. Kotey, B.; Folker, C. Employee training in SMEs: Effect of size and firm type—Family and nonfamily. *J. Small Bus. Manag.* **2007**, *45*, 214–238. [CrossRef]
99. LePoutre, J.; Heene, A. Investigating the impact of firm size on small business social responsibility: A critical review. *J. Bus. Ethics* **2006**, *67*, 257–273. [CrossRef]
100. Koumas, M.; Dossou, P.-E.; Didier, J.-Y. Digital Transformation of Small and Medium Sized Enterprises Production Manufacturing. *J. Softw. Eng. Appl.* **2021**, *14*, 607–630. [CrossRef]
101. Cheng, C.-H.; Tang, B.-J.; Cheng, Y.-R. Strategies and Tools for Small- and Medium-Sized Enterprises (SMEs) to Move toward Green Operations: The Case of the Taiwan Metal Industry. *Sustainability* **2024**, *16*, 4705. [CrossRef]
102. Qin, J.; van der Rhee, B.; Venkataraman, V.; Ahmadi, T. The impact of IT infrastructure capability on NPD performance: The roles of market knowledge and innovation process formality. *J. Bus. Res.* **2021**, *133*, 252–264. [CrossRef]
103. Usai, A.; Fiano, F.; Petruzzelli, A.M.; Paoloni, P.; Farina Briamonte, M.F.; Orlando, B. Unveiling the impact of the adoption of digital technologies on firms' innovation performance. *J. Bus. Res.* **2021**, *133*, 327–336. [CrossRef]
104. Rachinger, M.; Rauter, R.; Müller, C.; Vorraber, W.; Schirgi, E. Digitalization and its influence on business model innovation. *J. Manuf. Technol. Manag.* **2019**, *30*, 1143–1160. [CrossRef]
105. Mohnen, P.; Hall, B.H. Innovation and productivity: An update. *Euroasian Bus. Rev.* **2013**, *3*, 47–65. [CrossRef]
106. Chavez, R.; Yu, W.; Jacobs, M.A.; Feng, M. Data-driven supply chains, manufacturing capability and customer satisfaction. *Prod. Plan. Control* **2017**, *28*, 906–918. [CrossRef]
107. Mashingaidze, M.; Phiri, M.A.; Bomani, M. Strategy formulation amongst small and medium manufacturing enterprises: An emerging market case study. *J. Gov. Regul.* **2021**, *10*, 158–166. [CrossRef]

108. Kroh, J.; Luetjen, H.; Globocnik, D.; Schultz, C. Use and efficacy of information technology in innovation processes: The specific role of servitization. *J. Prod. Innov. Manag.* **2018**, *35*, 720–741. [CrossRef]
109. Khin, S.; Ho, T.C.F. Digital technology, digital capability and organizational performance: A mediating role of digital innovation. *Int. J. Innov. Sci.* **2019**, *11*, 177–195. [CrossRef]
110. Schaltegger, S. Sustainability as a driver for corporate economic success. consequences for the development of sustainability management control. *Soc. Econ.* **2011**, *33*, 15–28.
111. Stich, V.; Zeller, V.; Hicking, J.; Kraut, A. Measures for a successful digital transformation of SMEs. *Procedia CIRP* **2020**, *93*, 286–291. [CrossRef]
112. Schein, E.H. *Organizational Culture and Leadership*; John Wiley & Sons: Hoboken, NJ, USA, 2010. Available online: http://dspace.vnbrims.org:13000/jspui/bitstream/123456789/2373/1/ORGANIZATIONAL%20CULTURE%20Organizational%20Culture%20and%20Leadership,%203rd%20Edition.pdf (accessed on 14 December 2023).
113. Barthel, P.; Fuchs, C.; Birner, B.; Hess, T. Embedding Digital Innovations in Organizations: A Typology for Digital Innovation Units. In Proceedings of the 15th International Conference on Wirtschaftsinformatik, Potsdam, Germany, 8–11 March 2020; pp. 780–795. [CrossRef]
114. Dahliah, D.; Kurniawan, A.; Putra, A.H.P.K. Analysis and strategy of economic development policy for SMEs in Indonesia. *J. Asian Financ. Econ. Bus.* **2020**, *7*, 103–110. [CrossRef]
115. Rammer, C.; Crass, D.; Doherr, T.; Hud, M.; Hünermund, P.; Iferd, Y.; Köhler, C.; Peters, B.; Schubert, T. Innovationsverhalten der deutschen Wirtschaft. In *Indikatorenbericht zur Innovationserhebung 2015*; Centre for European Economic Research: Mannheim, Germany, 2016.
116. Brandenburger, A.; Nalebuff, B. *Co-opetition*; Doubleday Publishing: New York, NY, USA, 1996.
117. Chrisman, J.J.; McMullan, W.E. Outsider assistance as a knowledge resource for new venture survival. *J. Small Bus. Manag.* **2004**, *42*, 229–244. [CrossRef]
118. Carayannis, E.G.; Popescu, D.; Sipp, C.; Stewart, M. Technological learning for entrepreneurial development (TL4ED) in the knowledge economy (KE): Case studies and lessons learned. *Technovation* **2006**, *26*, 419–443. [CrossRef]
119. O'Gorman, C. Strategy and the small business. In *Enterprise and Small Business*, 2nd ed.; Carter, S., Jones-Evans, D., Eds.; Pearson: Harlow, UK, 2006; pp. 406–422.
120. Siuta-Tokarska, B.; Juchniewicz, J.; Kowalik, M.; Thier, A.; Gross-Gołacka, E. Family SMEs in Poland and Their Strategies: The Multi-Criteria Analysis in Varied Socio-Economic Circumstances of Their Development in Context of Industry 4.0. *Sustainability* **2023**, *15*, 14140. [CrossRef]
121. Burinskienė, A.; Nalivaikė, J. Digital and Sustainable (Twin) Transformations: A Case of SMEs in the European Union. *Sustainability* **2024**, *16*, 1533. [CrossRef]
122. European Commission. *Monitoring Progress in National Initiatives on Digitising Industry*; Country Report; European Commission: Berlin, Germany, July 2019.
123. Abu-Farha, F.K.; Khraisheh, M.K. An integrated approach to the superplastic forming of lightweight alloys: Towards sustainable manufacturing. *Int. J. Sustain. Manuf.* **2008**, *1*, 18–40.
124. IPCC Working Group III. 9781107025 Working Group III Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change Climate Change 2022. *Mitig. Clim. Chang.* **2022**. Available online: https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_FullReport.pdf (accessed on 14 December 2023).
125. Jabbour, C.J.; Fiorini, P.D.C.; Ndubisi, N.O.; Queiroz, M.M.; Piato, É.L. Digitally-enabled sustainable supply chains in the 21st century: A review and a research agenda. *Sci. Total Environ.* **2020**, *725*, 138177. [CrossRef]
126. Paschou, T.; Rapaccini, M.; Adrodegari, F.; Saccani, N. Digital servitization in manufacturing: A systematic literature review and research agenda. *Ind. Mark. Manag.* **2020**, *89*, 278–292. [CrossRef]
127. Cabrera-Suárez, K.; De Saá-Pérez, P.; Garcia-Almeida, D. The succession process from a resource- and knowledge-based view of the family firm. *Fam. Bus. Rev.* **2001**, *14*, 37–46. [CrossRef]
128. Budhi, M.K.S.; Lestari, N.P.N.E.; Suasih, N.N.R.; Wijaya, P.Y. Strategies and policies for developing SMEs based on creative economy. *Manag. Sci. Lett.* **2020**, *10*, 2301–2310. [CrossRef]
129. Enberg, C. Enabling knowledge integration in coopetitive R&D projects: The management of conflicting logics. *Int. J. Proj. Manag.* **2012**, *30*, 771–780.
130. Agrawal, P.; Narain, R.; Ullah, I. Analysis of barriers in implementation of digital transformation of supply chain using interpretive structural modelling approach. *J. Model. Manage.* **2019**, *15*, 297–317. [CrossRef]
131. Brown, K.; Jie, F.; Le, T.; Sharafizad, J.; Sharafizad, F.; Parida, S. Factors Impacting SME Business Resilience Post-COVID-19. *Sustainability* **2022**, *14*, 4850. [CrossRef]
132. Bracci, E.; Vagnoni, E. Managing intellectual capital in small-medium family business succession: An integrated framework. In Proceedings of the 1st EIASM Workshop on Visualizing, Measuring, and Managing Intangibles and Intellectual Capital, Ferrara, Italy, 18–20 October 2005.
133. Abelson, A.; Baysinger, B. Optimal and dysfunctional turnover: Toward an organizational level model. *Acad. Manag. Rev.* **1984**, *9*, 331–341. [CrossRef]
134. Carney, M. Corporate governance and competitive advantage in family-controlled firms. *Entrep. Theory Pract.* **2005**, *29*, 249–265. [CrossRef]

135. Zimmerer, T.W.; Scarborough, N.M.; Wilson, D. *Essentials of Entrepreneurship and Small Business Management*; Pearson: Upper Saddle River, NJ, USA, 2008.
136. Jaaskelainen, A. How to measure and manage the risk of losing key employees? In Proceedings of the IC Congress 2007, Haarlem, The Netherlands, 3–4 May 2007.
137. Mandviwalla, M.; Flanagan, R. Small business digital transformation in the context of the pandemic. *Eur. J. Inf. Syst.* **2021**, *30*, 359–375. [CrossRef]
138. Knuth, A. *Designing SME Support Programs: International Experience and Implications for Belarus*; Policy Paper Series; German Economic Team Belarus: Berlin, Germany; Minsk, Belarus, 2019.
139. O'Brien, C. Sustainable production—A new paradigm for a new millennium. *Int. J. Prod. Econ.* **1999**, *60–61*, 1–7. [CrossRef]
140. Bi, Z.M.; Wang, L. Optimization of machining processes from the energy consumption perspective: A case study. *J. Manuf. Syst.* **2012**, *31*, 420–428. [CrossRef]
141. Pusavec, F.; Kramar, D.; Krajnik, P.; Kopac, J. Transitioning to sustainable production—Part II: Evaluation of sustainable machining technologies. *J. Clean. Prod.* **2010**, *18*, 1211–1221. [CrossRef]