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Circular Business Model Strategies Progressing Sustainability in the German Textile Manufacturing Industry

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Abstract: The EU Textile Strategy for Sustainable and Circular Textiles calls for circularity along the whole value chain of textiles. However, little is known about how circularity is already embedded in German manufacturing textile industries due to a lack of literature. Having conducted a survey study in December 2022 and January 2023, the results of 56 participating German manufacturing textile industries will be presented by applying descriptive statistics and qualitative analysis. The study shows that there is already an understanding of circularity including circular strategies in the German textile manufacturing industry. There are companies that apply the following circular business model strategies: upcycling and recycling, product-as-a-service, repair and reuse, and material innovation. Closed-loop supply chain companies are not yet prominent. Many manufacturing textile companies are not prepared yet for a circular transformation. Another finding is that the EU Strategy for Sustainable and Circular Textiles is so far insufficiently known by the respondents of the sample. A more structured provision of information or financial state support should be discussed.

Keywords: circular economy; textile industry; sustainable development; business strategies; business models; circular models; circular paradoxes; EU textile strategy

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1. Introduction

The problems of overconsumption and overproduction and the associated problem of environmental pollution are unfortunately not new phenomena. As early as 1987, the Brundlandt Report stated that unsustainable consumption and production patterns were the cause of environmental problems [1]. The strategy for improving these conditions in the long term is called sustainable development [1]. The textile industry is one of the industries with the greatest environmental impact, both globally and in Germany [2,3]. Therefore, it is most important and necessary to protect, save, and conserve finite resources. EU-wide, limits and regulations have been and are being set on manufacturing companies in the textile industry for the coming years, such as those set by the EU Strategy for Sustainable and Circular Textiles [2], and by national strategies [4]. These regulations, limits, and recommendations are guided by the European Green Deal, which calls for the significant improvement and minimisation of environmental impacts by 2030 [5]. In order to implement these requirements and sustainably comply with the planetary boundaries, operational business models must be revised and, if necessary, changed. This applies to the business model components of value proposition, value creation and delivery, as well as value capture [6,7]. The literature does not currently provide any information on the extent to which the strategies of the circular economy have been and are being adopted and implemented in textile companies. However, it is questionable to what extent these regulations, which will also affect the textile industry in the near future, have already been put into practice. For this reason, the present article deals with the overriding question: how does the German textile industry face up to the circular economy?

The aim is to assess the status quo of the German textile industry with regard to the circular economy and related business models. Specifically, this means asking:

- Is the EU Textile Strategy for Sustainable and Circular Textiles already known about in companies?
- In which specific business model areas have circular changes been or will they be made?
- How can circularity be promoted or progressed in the textile industry and where are the challenges to establish circularity in the textile enterprise?

These questions were collected between December 2022 and January 2023 in a digital survey of German textile companies. In this paper, the responses of a sample of 56 questionnaires were analysed and evaluated using a correlation and contingency analysis.

2. Circularity in the Textile Industry in Germany

2.1. Circular Economy and Sustainability in the German Textile Industry

The German textile industry has a rich history that can be traced back to the Middle Ages [8]. During this time, the production of textiles was mostly done by hand in small workshops, with the finished products being sold in local markets. In the 18th and early 19th centuries, the textile industry can be seen as the driving force introducing new technologies and techniques [9]. After the two world wars, textile manufacturers were already facing new challenges on the supply side at the end of the 1950s [10]. Producers from southern Europe, Asia, and Africa entered the market. The industry was thus in competition with foreign suppliers who, in addition to benefiting from weaker regulation, benefited in particular from lower social and labour costs [9]. However, from the 1980s, the industry succeeded in transforming itself to become competitive again. There was a structural change away from apparel, home, and household textiles to technical textiles [9]. As a result of the historical development of the textile industry, the German textile industry settled mainly in the following federal states [8]:

- North Rhine-Westphalia;
- Baden-Württemberg;
- Bavaria;
- Saxony.

Today, the textile industry in Germany is a supplier industry and an important sector of the economy, mainly focused on the production of clothing, footwear, home textiles, and technical textiles [2,11]. Germany is an important location for the production of high-end segments of the market, such as fashion and technical textiles, and is home to many renowned brands and manufacturers [12]. The German textile and clothing industry employs approximately 124,000 people in 1400 companies, of which about 690 companies belong to the textile industry and 200 companies belong to the clothing industry, with a total turnover of 29.0 billion euros [13]. In Germany, the size structure of companies in the textile industry is very small [3,13]. About 95% of the companies belong to small- and medium-sized enterprises, and about half of the companies employ less than 50 employees [13]. The market segment of technical textiles has become the mainstay of the German textile industry, accounting for over 60 percent of industry sales [13]. To make a comparison with another European country, the Germany textile industry is second behind Italy. In 2020, this industry segment had 1206.5 million euros in sales and over 76,000 employees [13].

However, the textile and fashion industry does not only produce textiles, but also environmental pollution [14]. Planet Earth is in an alarming state, with man-made emissions rising and finite resources dwindling simultaneously. European textile consumption is the fourth largest cause of climate change and environmental impacts [15]. It is also among the top five areas of consumption facing pressure in terms of raw material use and greenhouse gas emissions [15]. More than 1.5 million Europeans work in the textile and clothing industry [15], making it an important economic sector and employer for many people. The textile industry faces numerous, multi-layered challenges with regard to

sustainability [2,3,11,13]. On the one hand, it can be noted that the purchase prices for raw materials, semi-finished products, machinery, and energy have increased excessively since the coronavirus crisis in 2021 compared to previous years [13]. This is accompanied by the problem that these material costs account for the highest proportion of all cost types in the textile industry, namely over 40% in 2020 [13]. Ecological challenges are found within the entire textile chain, but above all, this concerns cultivation, production, and textile finishing [15]. These include the use of pesticides in large quantities, which ultimately find their way into wastewater [16]. In Germany, textile finishing is one of the industries with the highest wastewater generation, which is heavily contaminated by the use of chemicals, e.g., chemicals for pre-treatment and dyeing. The drying processes of textile finishing take place at high temperatures, likewise causing high energy consumption and CO_2 emissions [2,13]. It is undisputed that the textile industry contributes significantly to environmental pollution and climate change. Currently, it is considered the fourth largest cause of these challenges [15].

One way to achieve sustainability is to move away from a linear economy towards a circular economy [17,18]. In this context, problems of a linear economy occur when more and more resources are taken from the environment for production and are ultimately returned to the environment as non-recyclable waste, additionally inducing high emissions [19]. As can be seen in Figure 1, the linear economy ends with the disposal of products and materials, for example, by incinerating them. There is no recirculation and closure of the material flows. Consequently, within the linear economy, no limits on using finite resources are placed, no material flows are closed, and sustainability as a whole is not considered [20,21].

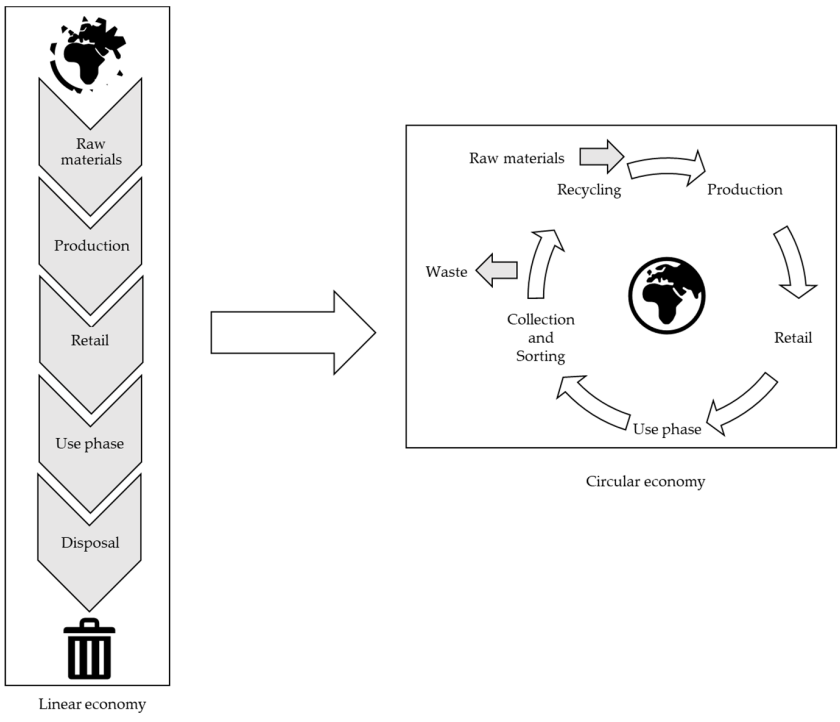

Figure 1. From linear economy to circular economy: (**a**) flowchart of linear economy; (**b**) flow chart of circular economy, own source.

The circular economy has a significant and clear relationship with sustainable development, which has already been stated by numerous publications [22,23]. The circular economy is aimed at the consumption and production of goods in a way that respects planetary boundaries. Moreover, there is a hierarchical relationship between the two components. Sustainable development represents superordinated, environmental, economic, and social

goals to comply with planetary boundaries. The circular economy can be a subordinate tool addressing and trying to fix the root causes of the problems [20]. Circular economies refer to circular or closed-loop supply chains, in which products facing their end-of-life are circled back into the value chain through 10R strategies, i.e., recover, recycle, repurpose, remanufacture, refurbish, repair, re-use, reduce, rethink, and refuse [24,25]. In doing so, changes must happen on both the consumer and producer side, which means individual consumption as well as value creation patterns must be reconsidered and, if necessary, changed. Within this system, waste is reduced to a minimum as existing materials and products are kept in circulation and in the economy for as long as possible. This extends the life cycle of these goods.

Likewise, transitioning into a circular economy is considered one of the most important transformation areas of the 2030 Agenda and addresses several SDGs, but especially SDG 8, 9, 11, 12, 13, and 14 [19]. SDG 12, "Sustainable consumption and production patterns", is focussed on implementing a circular economy and is therefore also titled a cross-sector goal. This goal includes a holistic strategy for a full circular economy that minimizes the use of natural resources, increases efficiency, and challenges current production methods [19]. SDG 12 has numerous implications for other areas, e.g., a circular economy also aims at economic growth (SDG 8) and improved innovation capacity (SDG 9) [16]. Consequently, sustainable economic activity is not possible within a linear economy [15,16,20]. Although facing lots of paradoxes, trade-offs, and challenges, a circular economy is considered a sustainable and future alternative to the linear economy and represents clear progress towards more sustainability [26–29]. The implementation of circular business models can support the fostering or progression of sustainability.

2.2. Circular Business Models

Business models in general are significant tools for studying and understanding how a company works and operates [27]. For this purpose, a business model can be divided and examined in three different areas [6]:

1. Value proposition;
2. Value creation and delivery;
3. Value capture.

The first area deals with the company's value proposition. It answers which value is created and which target group is addressed [6]. The focus of the business model is area two, which focuses on value creation and delivery. Classically, this is done by selling products and services with economic value in return. In sustainable business models, environmental and/or social value is also created [28]. The last area covers value capture, i.e., in what way the company earns money and what its strategy is. Cost structures, profit flows, and strategic goals for the long-term preservation of the company are examined [6]. Due to the global pressure to meet sustainability goals, business models must change and be aligned with environmental, social, and economic value creation. These changes result in business models, some of which are new, and can be regarded as innovations. In this context, business model innovations hold great potential to promote sustainable development and thus also the circular economy [6,29]. To do this, companies must integrate sustainability into their existing business model or establish it in their newly developed business model from the outset [30,31]. The circular economy is based on business models that eliminate end-of-life concepts and focus on reducing, reusing, and recycling instead, among other initiatives. These types of business models aim to drive sustainable development and thus also increase or maintain economic prosperity, social equity, and the quality of the environment [31]. Often the challenge is figuring out ways of creating economic added value from social and ecological changes in the company in order to ensure its long-term survival [30,32–34].

Based on the spectrum of sustainable topic areas, sustainable business models can be divided into three different levels of innovation [6,7,28]:

1. Technological;

2. Social;
3. Organisationally oriented innovations.

The technological group primarily includes innovations arising from a technical innovation, for example, within production processes. Social innovations address changes in social components, for example, innovations in customer offerings changing customer behaviour. Organisationally oriented innovations involve novel concepts entailing organisational change in the company, for example, changes in responsibilities [6]. Three different archetypes belong to each item of this group. According to [6], the circular economy and closed loops are classified in the group of technologically oriented innovations and in the archetype "create value from waste". This concept is based on the characteristics of the circular economy, i.e., material cycles are closed and waste is minimised as a result. Thus, it can be stated that the value proposition is to restructure waste streams into useful and valuable inputs for production. It should be emphasised that this archetype is not primarily concerned with efficiency, but rather with the fact that the products and materials can be recirculated. This can, but need not, result in efficiency advantages. Consequently, it can be stated that value creation consists of converting life cycle waste into inputs for other forms of value creation. In addition, partnerships are being expanded and new ones are being forged to convert waste into inputs. In the area of value capture, as positive aspects can be expected, circularity reduces economic and ecological costs, including a reduction in ecological footprints, and in water and material consumption [6]. Ref. [7] elaborates and recommends a hierarchical distinction of different circular archetypes, based on the classification of circular business models in [6]. The higher level represents technology having the goal of creating value from waste. The second level represents the social goals of circular business models: sufficiency, functionality, and stewardship. Each of these subdivisions will be further differentiated as "scaled-up" and "purposed" in the following. Goal-oriented, sustainable business model innovations serve to realign corporate strategy. Their aim is to generate social and environmental value rather than economic value. For this reason, the long-term existence of companies is a challenge. In contrast, scaled-up organisations are those that expand their technology and create aggregated sustainability solutions. They focus on the mass market and at the same time act profit-oriented and environmentally conscious.

In general, this model (see Figure 2) is based on the foundation that the rate of increase in circulatory ability can be positively influenced by the social level. Consequently, a faster implementation of circular business models emerges [6,7]. Furthermore, the model can be used to classify existing business models with regard to their sustainable orientation.

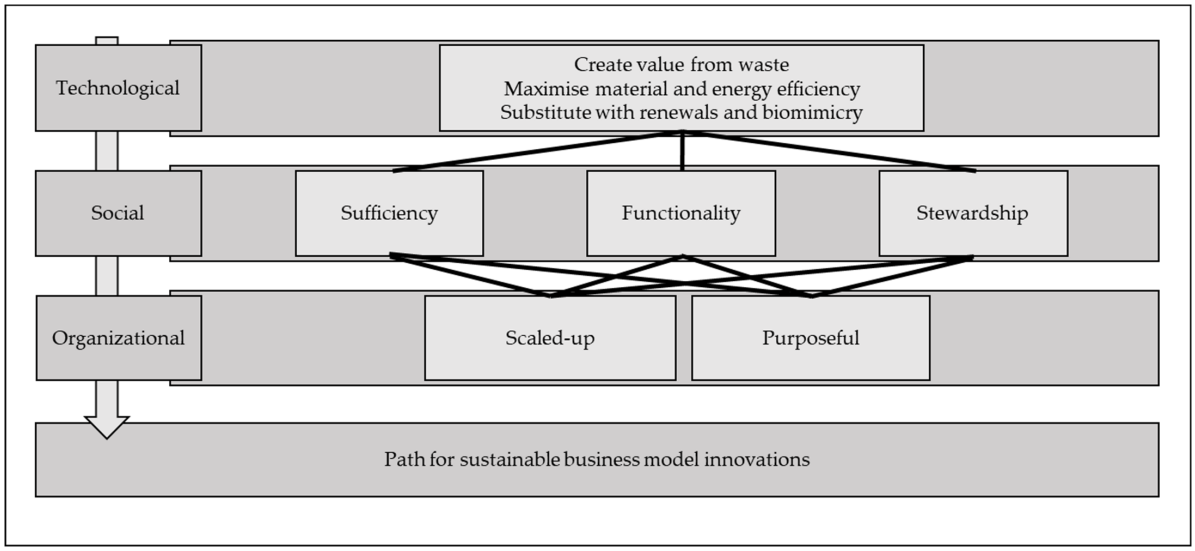

Figure 2. Hierarchical model for sustainable business model innovations, amended based on [7].

In addition to sustainability guidelines, laws and targets have been launched, such as Agenda2030 or the German national sustainability strategy, the EU Strategy for Sustainable and Circular Textiles, which was launched in 2022 [15]. The strategy aims to minimize, if not stop, negative impacts on the environment by listing several key measures. These include, for example, combating greenwashing, establishing design requirements for textiles, and extending producer responsibility. From this, it also emerges that the textile industry must become more circular, energy- and resource-efficient, and climate-neutral in order to eliminate current challenges and take advantage of opportunities. These measures are intended to make textiles more durable, repairable and, above all, circular [2,11]. For this reason, the strategy explicitly states that circular business models should be designed and companies operating in the reuse and repair sector should be integrated into the value chain [2,11]. For this purpose, incentives should be created. Textiles are often disposed of as waste when they cannot be used any longer. Less than one percent of the material used in clothing is merely recycled [15]. Large quantities of raw materials are lost through disposal. The circular economy aims to counteract this loss so that raw materials and their material flows are kept in circulation and are not disposed of [16]. This approach is sustainable in many ways, for example, it protects the environment, because raw materials are reused and recycled. From a business perspective, the circular economy holds the opportunity to change and develop new technologies and business models [16]. Numerous research projects support the closing of the textile cycle [16]. German manufacturing textile companies can become more circular by [35]:

1. Adopting sustainable practices—reducing waste, water usage, and energy consumption in production;
2. Implementing closed-loop supply chain management—tracking and managing the flow of materials, products, and waste;
3. Encouraging product reuse and repair—providing maintenance and repair services to extend product life;
4. Investing in sustainable materials—using biodegradable, recycled, and low impact materials;
5. Collaborating with stakeholders—partnering with suppliers, customers, governments, and non-profits to drive change;
6. Measuring and reporting impact—tracking progress and reporting sustainability performance to stakeholders.

It also became clear that digitalisation plays a decisive role on the way to a circular economy [36,37]. At present, the main obstacle is that transport chains and mass flows have not been sufficiently digitalised [15]. However, this would be necessary in order to record material flows without gaps. On the other hand, it will only be possible to track the origin of materials through digital data in order to meet sustainability standards [38]. However, the efficiency gains achieved through digitalisation can have a negative impact by leading to rebound effects [39]. Nevertheless, digitalisation can enable more sustainable development and therefore should be integrated and considered in research and in practice into the textile circular economy [11,40,41].

In summary, the research gap remains and there is a need to investigate the status quo of the German textile industry in terms of circular corporate practice. It needs to be clarified whether the EU Strategy for Sustainable and Circular Textiles is known at all and/or whether measures have already been taken in practice to make business models more circular.

3. Research Methodology

Investigating the status quo on sustainability and digitalisation in the manufacturing textile companies, a survey was conducted between December 2022 and January 2023. The survey addressed the understanding of sustainability, digitalisation, business models, and circularity. The area of the investigation was limited to Germany as the main interest was to investigate how German manufacturing textile companies already integrate requirements

of sustainability and circularity as well as circular business models. Table 1 shows the methodological design.

Table 1. Methodological design.

Research design	Cross-sectional design, non-experimental research methods: survey research and correlational study	-	Limesurvey survey with pre-structured question blocks and selected open-ended question areas
		-	Survey period December 2022 to January 2023
		-	Target group: German textile industry
Data collection	Questionnaire/ digital survey	-	Digital questionnaire in German language
		-	Topics: sustainability, circularity, digitalisation, and business models.
		-	Likert scale and dichotomous scales—nominally and ordinally scaled items
Data evaluation	Descriptive statistics	-	Descriptive statistics: contingency and correlation analysis by SPSS
	Qualitative analysis	-	Keyword analysis and aggregation

The research design comprised a cross-sectoral design applying non-experimental research methods. The cross-sectional design was used to observe and collect snapshots of an industry's understanding, opinions, or behaviours with regards to sustainability, circularity, business models, and digitisation at a single fixed point in time. The survey research was conducted by collecting standardised information and identifying potential relations or correlations between the respective topics of sustainability, circularity, business models, and digitisation. Cause-effect-relations are not part of this study.

Ensuring representativeness, the used design applied random sampling [42]. A digital survey was distributed mainly containing closed questions and lasting about 20 min. So, quantitative research methods were used for data evaluation [42]. The survey was offered to German manufacturing textile companies via newsletters or digital delivery. The assurances of anonymity and data protection were guaranteed. The respondents either had to agree, disagree, or to state their degree of agreement by responding based on a 5-point Likert scale with the spectrum of *is completely true* to *does not apply at all*. Several questions offered the possibility to give further written feedback, examples, or another space for a personal response. The questionnaire included five main sections: (I) general sociometric data was requested, including location, number of employees, etc. (II) sustainability, (III) digitalisation, (IV) circular economy, and (V) business models.

The sustainability section was introduced; the questions dealt with the relevance, challenges, and potential of sustainable development in the textile industry and in the respondent's company. The section concerning digitalisation was introduced; the questions in this section were about the relevance of digitalisation, but also about the potential of and challenges in the respondent's company. Among others, the questions addressed the potential of digitisation in respective areas and needed areas of change. Circularity was introduced by a short excerpt of text and by showing a popular figure of the circular economy and its elements: in a circular economy (right-hand flow), resources are kept in a closed-loop system over the longest possible use phase instead of being disposed of, as they are in a linear economy (left-hand flow). The questions included "areas where you expect to face the greatest challenges in establishing circularity as it relates to your business" and "how can circularity be promoted in the textile industry". Finally, the business models section also included a short excerpt of text and its own illustration based on [6]. The topic of closed-loop capability mostly required the modification of existing types or the development of new types of business models or their subsectors. A business model relates to the ways a company operates and how it generates profits from it. To build or change a business model, it can be divided into three different areas, these being value proposition, value creation and delivery, and value capture. The last part of the questionnaire dealt specifically with the business models of the respondents' companies in relation to circularity.

These questions investigated areas in which changes have already been made, and which changes were made.

In our conduction of an online survey, the main goal was the collection of a diversity of opinions of a large number of people in a given time frame. The questionnaire was highly standardised for ensuring the time-efficient collection of relevant topics in the transformational process of the textile industry, and thus, it exposed valid tendencies due to the higher number of responses. The questionnaire was pre-tested on several people with a scientific or textile background and, based on the feedback, was accordingly amended. The questionnaire was programmed in Limesurvey. The given data were processed in SPSS and analysed by the tools of descriptive statistics, e.g., univariate descriptive statistics for frequencies and multivariate descriptive statistics (see Table 1). The written feedback, given under free-space questions, was qualitatively analysed and summarised [43]. Investigating the qualitative statements was helpful for obtaining further insights into the potential and challenges of, and the progress towards, sustainability and circularity for establishing circular business models. The text statements were inductively transformed into categories presented in the result section.

4. Results

4.1. Descriptive Statistics—Sociometric Data

In total, 56 completed questionnaires were received. The following figures and tables show some basic facts describing the socio-demographic data of the sample.

Figure 3 shows the functional position of the employees completing the questionnaire. These job positions were explicitly addressed in the cover letter of the questionnaire in order to receive grounded answers. Accordingly, the majority, 23 questionnaires, were answered by management. Under "Other", other roles were mentioned in free text: textile developer, chief sustainability manager, sales manager, CSR manager, owner, and unspecific employee. Two respondents skipped the answer.

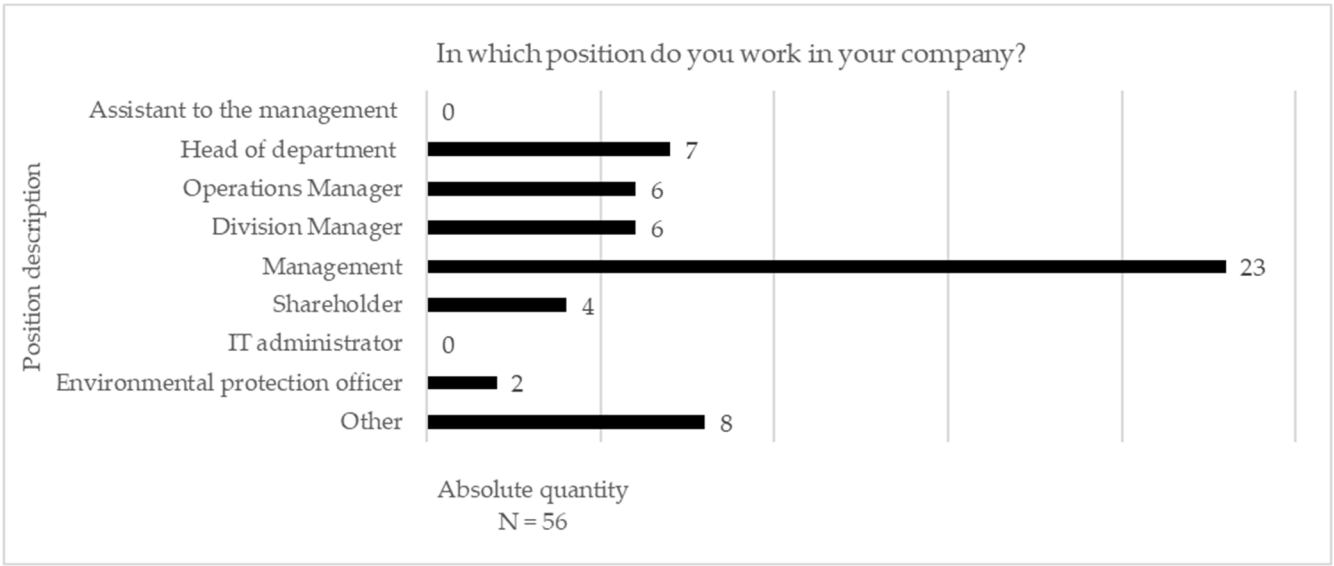

Figure 3. Functional position of respondents.

In addition, the companies were asked to indicate their company headquarters in relation to the federal state. Saxony, North Rhine-Westphalia, and Baden-Württemberg were the most represented with a total of 18, 14, and 6, respectively (see Figure 4). Three out of four textile conurbations in Germany are represented accordingly. Only Bavaria is less represented, with just 7%.

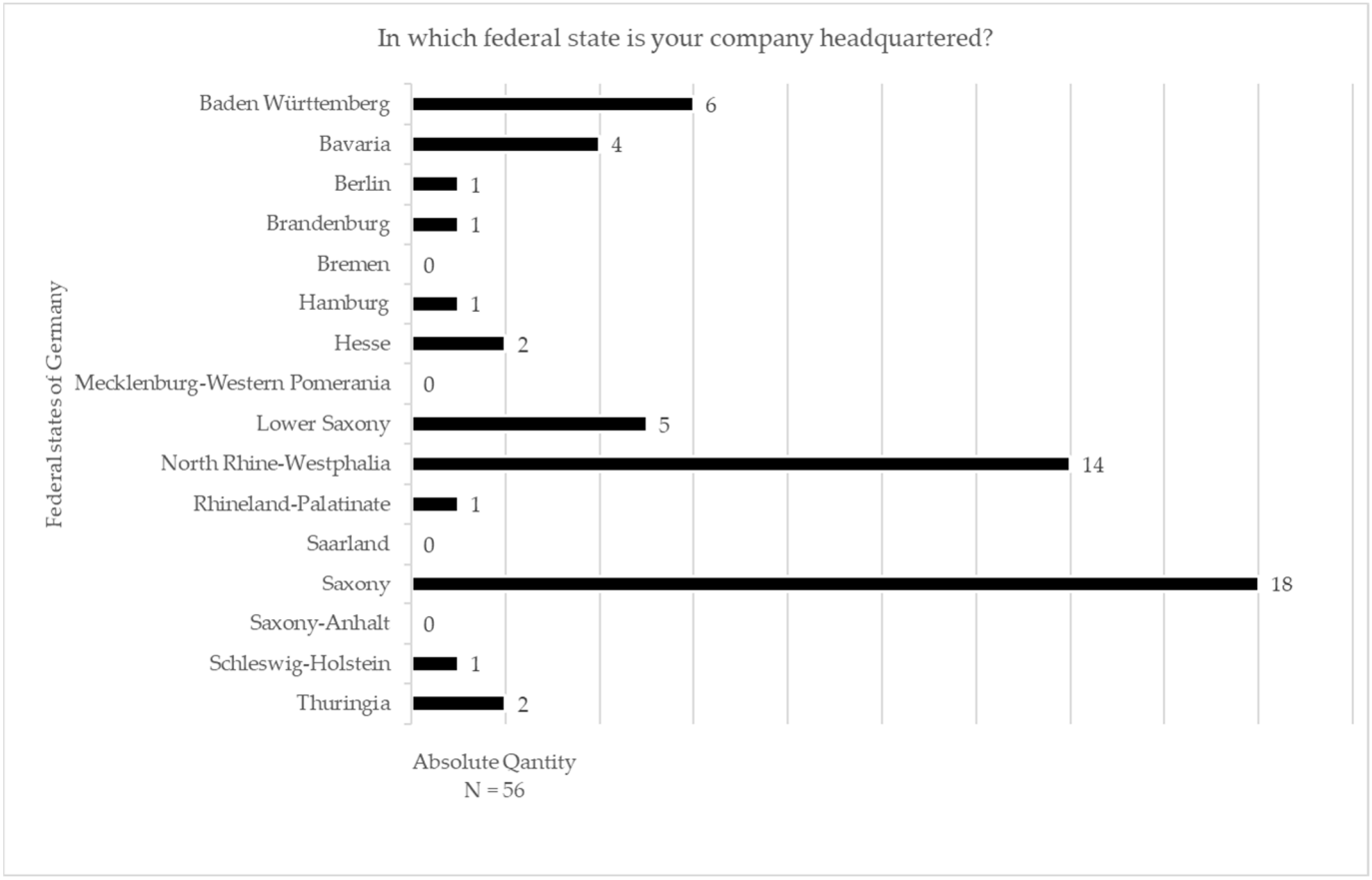

Figure 4. Regional distribution of the headquarters.

Table 2 provides an overview of the number of employees and the related relationship to company size. It can be noted that 82.14% of the surveyed companies are micro, small, or medium-sized enterprises and only 17.86% reflect large enterprises.

Table 2. Overview of the number of employees and the size of the company.

	Microenterprise	**Small-Scale Enterprise**	**Medium-Sized Enterprise**	**Large-Scale Enterprise**
Number of employees	1–10	11–50	51–250	250+
Number of companies	9	12	25	10

Figure 5 gives an overview of the companies' foundation years and the respective share of the sample. The majority of the companies were founded from 1950 up to now.

The information on textile processing was based on the question "which textile value-added stages can be passed through in your company?". Table 3 shows the unequally distributed levels of textile processing. Weaving and finishing represents a core of the companies' activities.

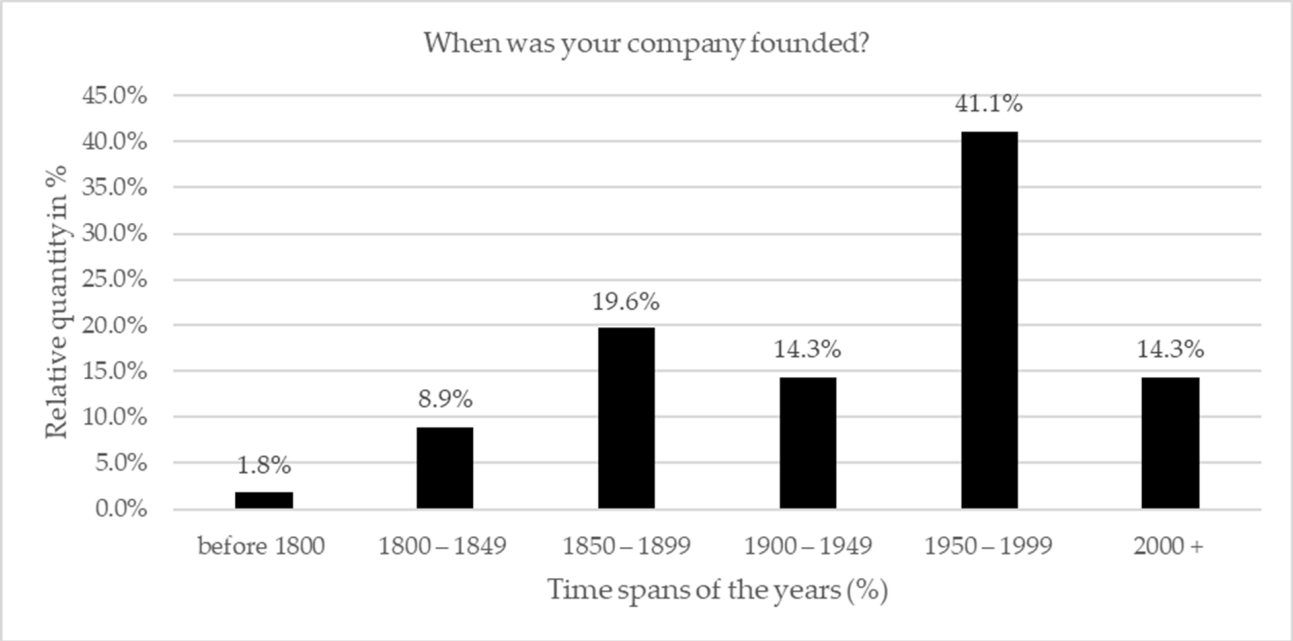

Figure 5. Year of companies' foundation.

Table 3. Value-added textile processing.

Level of Textile Processing	Number	Share
Raw material production, e.g., seed production, cultivation, and harvesting	1	1.79%
Ginning, e.g., separation of fibres, seeds, and impurities	1	1.79%
Spinning, e.g., production of yarns	5	8.93%
Area formation: knitting	8	14.29%
Area formation: weaving	14	25.00%
Area formation: fleece	3	5.36%
Embroidery	9	16.07%
Finishing, e.g., dyeing, printing, and finishing	26	46.43%
Finishing, e.g., cutting, sewing, and packaging	21	37.50%
Raw material recycling, e.g., sorting, tearing, and separating	5	8.93%
Other	18	32.14%

4.2. Descriptive Statistics—Sustainability Data

The major fibre is polyester followed by polyamide and natural fibres. Figure 6 shows the numbers of the variety of fibres in the sample. The bars represent the total number of companies processing or producing the respective fibres. Single numbers are sorted by the clustered companies' foundation years. The total numbers (#) per year are presented in brackets after the respective years on the right side of the figure.

Having been asked 'are you aware of the EU Strategy for Sustainable and Circular Textiles?', 32 (57.14 %) company representative said *yes* and 24 (42.86 %) said *no*.

Sustainability-related management concepts can also foster circularity. Figure 7 represents the total number of implemented sustainable management concepts. It reveals that many companies do not have implemented sustainable management concepts. The contingency analysis confirms this by the respective relations between the management concepts.

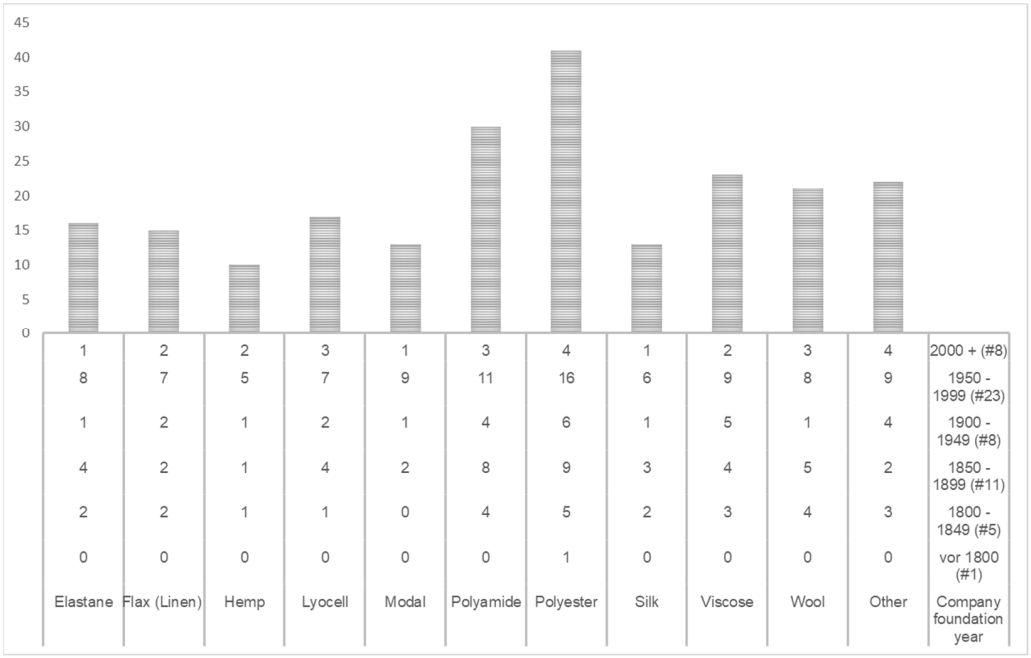

Figure 6. Number and distribution of fibres in the sample.

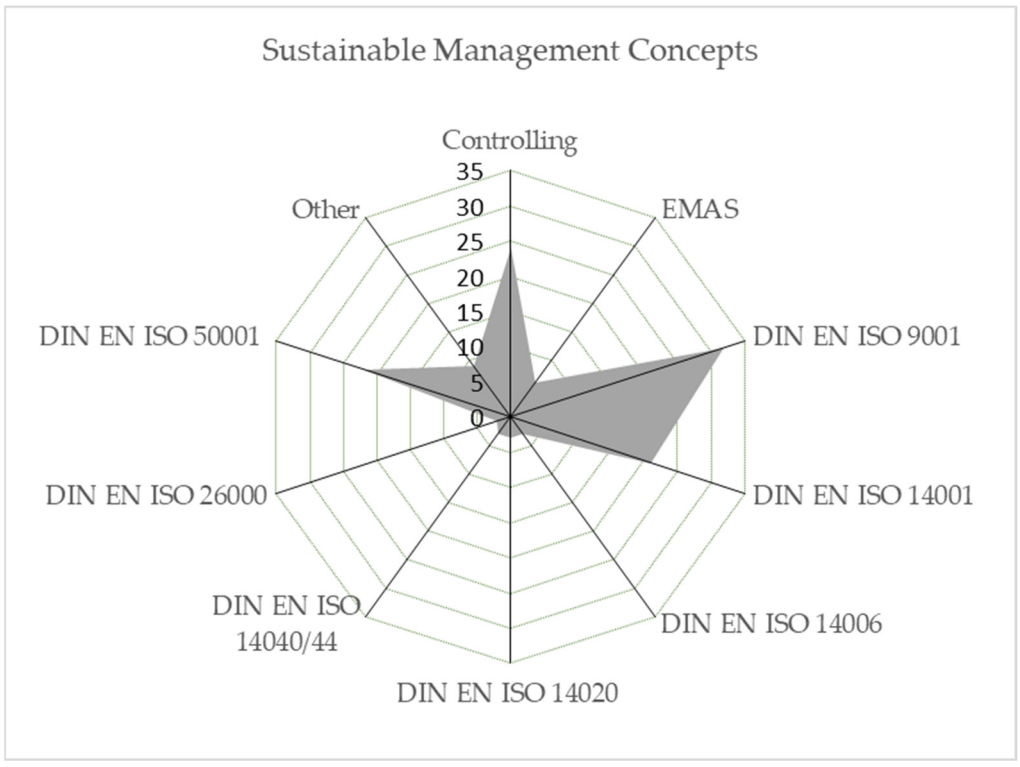

Figure 7. Overview of implemented sustainability management concepts (N = 56).

4.3. Correlation and Contingency Analysis

The data and tables of the correlation and contingency analysis are presented in Appendix A. The correlation analysis demonstrates a lack of sustainability and digitalisation strategies, including a lack of people or resources, and the need for knowledge and support. The relations also show that there are several potential areas of sustainability and digital transformation at the same time. Circularity in the textile industry should be promoted by a mixture of activities and is highly related to the former areas. The value proposition, the

value creation and delivery, as well as the value capture of the companies investigated are strongly linked to each other and explicitly associated with innovations and new business models. The contingency analysis (Table A2) shows many relations between the respective textile labels. The main status of sustainability and digitalisation objectives is to inform about or analyse them instead of to design or implement them. There are concerns about data protection and security, especially in the ginning process.

4.4. Qualitative Data—Sustainability Business Model Components

The following table, Table 4, summarizes the additional ideas for progressing sustainability, circularity and digitalisation in the textile industry. The given examples show the options of combining sustainability, circularity, and digitalisation. The given answers also state the need for further regulation and financial support.

Table 4. Overview of other added areas of potential regarding digitalisation, sustainability, and circularity.

Potential of Digitalisation: Other	Potential of Sustainability: Other	Promote Circularity in the Textile Industry: Other
Management - Management and digital document management - Platform economy - Skilled labour support and replacement due to shortages - More efficient use of working time - Phygital products - Data evaluation Tools - Third-party cloud storage and online analytics tools - New distribution channels and channels - Inventory - Machine networking - Process visualisation Ecosystem - Recording of energy consumption - Reduction of waste - Upgrading existing machine technology	Differentiation - Made in Germany or EU - Differentiation from Asian suppliers - Relevant certificates accompany the step-by-step path to more sustainable, bio-based raw materials Entrepreneurial - Image and marketing - Corporate value - Positioning the company for the future and being able to meet future reporting obligations - Forward-looking/sustainable thinking and action - Opening up new business areas and customer groups - Technological edge Savings - Material savings and increased sales through repairs - Cost reduction - Potential in raw material use (but expensive) Health & safety - Employee protection - Health of customers	Regulation - Clear legal framework strictly regulating greenwashing - Online trade regulated by law with regard to returns - Ban composite packaging - Varietal purity and better standards - Dispose of and recycle packaging materials which are generated without the possibility of shipping abroad Incentives and financial support - Create and facilitate recycling offers - Support programs for companies - Financial support to create recyclable products - Sustainable inputs need to be accompanied by financial benefits - Financial support for relocation of production from Asia to the EU Education and cooperation - Better consumer information, education, and transparency - Work with other countries (e.g., Africa) as a large share of used and potentially recyclable textiles are exported Vision - Circular economy: synthetically processed natural fibre grades as well as pure organics - Circular economy based on synthetically produced plastics must be the exception in the future, as long as no substitutes are available yet Hurdles: - Regulatory involvement often leads to slowing down development, not speeding it up - Economic efficiency is not always a given - Lack of solutions for material diversity

The survey showed that in the area of *value proposition*, 11 (19.64%) companies had already implemented circular measures, 18 (32.14%) had planned measures, and 27 (48.21%) had no measures planned. In the area of *value creation and delivery*, 11 (19.64%) companies had already implemented measures, 19 (33.93%) companies were planning measures, and 26 (46.43%) were not planning any measures. In the third segment, *value capture*, 9 (16.07%) companies already had circular measures implemented, 15 (26.79%) companies had planned measures, and 32 (57.14%) companies had not planned any measures.

Figure 8 summarises the stated activities in line with the three business model components of value proposition, value creation and delivery, as well as value capture. The answers show a limitation of the value capture area.

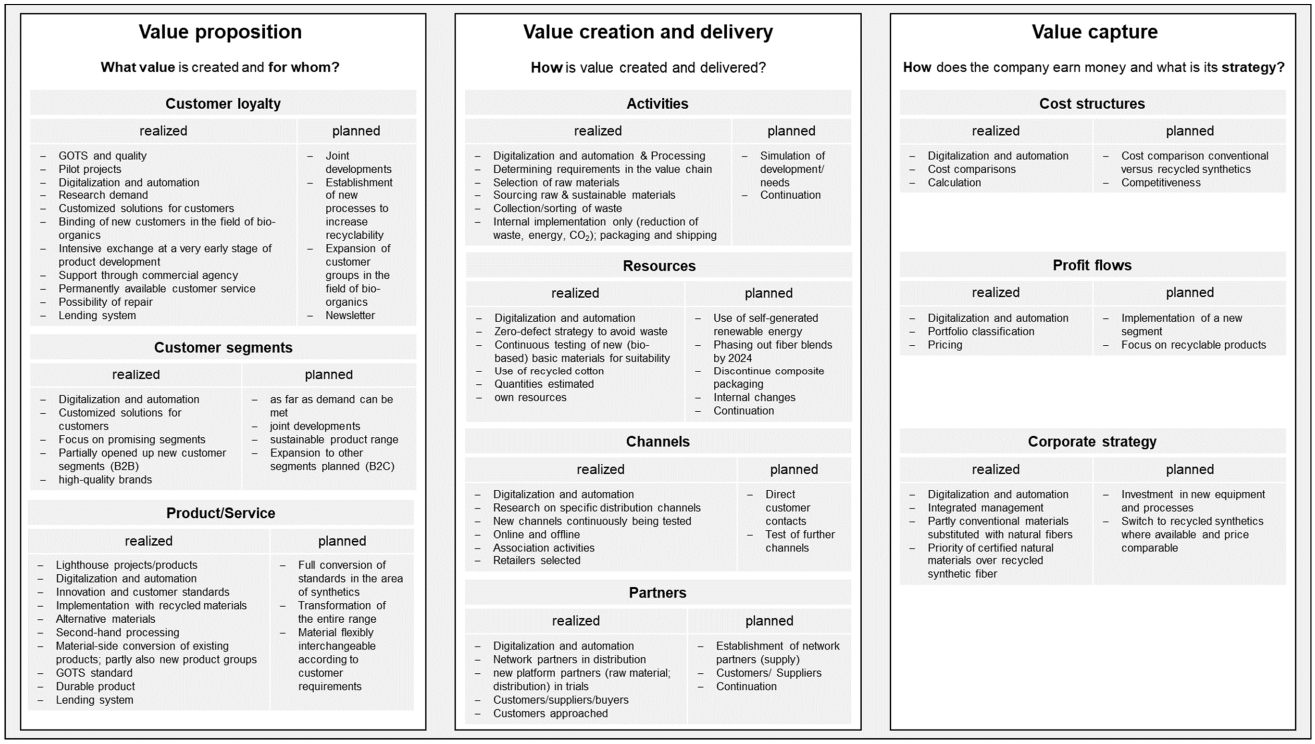

Figure 8. Overview of the stated circular business model components, own source.

5. Discussion

5.1. EU Textile Strategy

Although the company representatives recognised the need for change in terms of circularity and sustainability, and by means of digitalisation, there was a lack of knowledge and manpower to foster the circular transformation of their own companies (see Appendix). There is a call for financial support and strict regulation in the EU. This might reveal a paradox as 43% of the respondents said they did not know about the EU Strategy for Sustainable and Circular Textiles. With regards to the research question 'Is the "EU Textile Strategy for Sustainable and Circular Textiles" already known in the companies?', it clearly has to be stated the majority of the sample knew about the EU Textile Strategy whereas only a fifth of the companies indicated they already had implemented measures progressing circularity. This represents a clear activity gap. To progress the German textile industry towards more sustainable and circular practices, in line with the EU Textile Strategy, future activities and investigations are needed. As indicated by the respondents, recycling technologies can be developed further. Reflecting the levels of textile processing and the garments (Tables 3 and 4, Figures 6 and 8), there is huge potential for the investigation of new recycling technologies and methods for recovering materials from used textiles. This includes more efficient methods for mechanical recycling, chemical recycling, and biodegradable materials. Especially, the design for circularity—providing new materials

that are more easily recyclable or biodegradable, as well as designing garments that can be easily disassembled with components that can be reused or recycled—can clearly foster the 10R strategies in the textile industry. From a systemic perspective, circularity does not have a starting point as there are ongoing changes in circularity—either stepwise or volatile—in all areas, technological, social, and organisational [6,7], that relate with each other, impact one another, and can change other business models dramatically. This might be a reason for companies not already having implemented the g business model strategy of a closed-loop supply chain. Traceability and transparency technology can increase the number of ways of achieving circularity. This could include using blockchain or other technologies to track the flow of materials and ensure that they are responsibly sourced and processed [44].

However, a transformation to a circular economy can present some paradoxes, such as the fact that, while the circular economy aims to reduce waste and keep resources in use for as long as possible, it also requires the production of new products and materials to replace those that reach the end of their life [26]. Another paradox is that companies established in a linear business model may face severe financial difficulties in changing their operations to fit a circular model, due to the cost and effort involved in changing production processes and supply chains [45]. Finally, there may be cultural and consumer behaviour challenges to adopting circular models, as consumers may need to change their purchasing habits and prioritise reusable and sustainable products over disposable ones, which also impacts value capture strategies [11,16]. This is linked to the collecting and sorting (variety shown in Table 3) as well as tracing or tracking of textiles at their end-of-life [44]. Take-back schemes and the development of more efficient sorting technologies ensuring textile materials contain the quality of recyclability to an appropriate extent can increase closed loops. All the potential areas of achieving circularity, shown in Table 4, are, thus, closely linked to a clear call for regulations, e.g., on online trade, composites, greenwashing, and waste shipping. The following hypotheses stress the need for a systemic transformation in the textile manufacturing industry—particularly against the background of the addressed paradoxes.

H1: *A closed loop supply chain strategy is easier to reach the more the EU Strategy for Sustainable and Circular Textiles are known and progressed by the EU.*

H2: *The smaller the perceived paradoxes the greater the level of circularity.*

The study also shows a paradox in terms of sustainable management concepts. There is progress towards sustainability and circularity when sustainability management systems are implemented [46], yet, the sample shows that there is no direct relation between the implementation of these and the progression towards circularity and sustainability by DIN ISO Norms for small and medium-sized companies. The literature indicates a relationship between ISO norms and sustainability management concepts, and progress towards sustainability or success in achieving it [47]. ISO standards such as ISO 14001 and ISO 26000 provide a framework for companies to manage their environmental and social impacts, and to continuously improve their sustainability performance. Adherence to these standards can demonstrate a commitment to sustainability, and can help companies identify areas for improvement, track progress, and achieve sustainability goals. However, implementing ISO norms is only one aspect of progress towards and success in achieving sustainability. It is important for companies to take a comprehensive approach towards sustainability, which includes engaging stakeholders, setting meaningful goals and targets, and regularly reporting on progress. Ultimately, the success of a sustainability governance initiative is determined by the positive impact it has on the environment and society. Although there was a statement on better circular standards (see Table 4), standards are only one option for progressing towards circularity. In addition, these standards should address the whole value chain, and there would also be a need for liability in order to secure equity and fair competition. The lack of implemented sustainability management concepts needs further investigation. Here, the in-depth investigation of the following hypothesis can produce greater clarity.

H3: *The implementation of sustainable management concepts increases the level of circularity of the manufacturing textile company.*

5.2. Business Model Change

Addressing the research question 'In which specific business model areas have circular changes been or will be made?', the examples in Figure 8 and Table 4 and other results of the sample give good insights. The circular business components can be systemised and summarised as follows: in the sample, changing the value proposition while transitioning into circular business strategies in the textile industry is realised by:

- Addressing societal and environmental challenges or focusing on sustainability—promoting the environmental and social benefits of circular products and services can increase customer appeal and loyalty.
- Creating customer loyalty and enhancing brand reputation—being a circular business can make it more attractive to customers and stakeholders.
- Differentiating from competitors—by becoming a circular business, companies can differentiate themselves from their competitors and position themselves as leaders in sustainable and environmentally responsible practices.
- Improving product quality—by using high-quality, sustainable, and biodegradable materials, companies can increase the durability and longevity of their products, providing better value to customers.
- Offering new services or unique customer experiences—incorporating the product-as-a-service model, repair and maintenance services, and product recycling programs into the customer experience can create new sources of revenue and increase customer engagement and satisfaction.

The following strategies are good examples of making value creation and delivery more circular:

- Attracting investment—demonstrating a commitment to sustainability and the circular economy can attract investment from impact-driven investors [48].
- Creating new revenue streams—circular business models can create new revenue streams through product-as-a-service, repair and maintenance services, and product recycling programs.
- Improving product quality—implementing closed-loop supply chain management can increase product quality and extend product life.
- Providing transparency and traceability—can increase customer trust and confidence in the products [44].
- Streamlining operations—reducing waste and inefficiencies in production and distribution can lower costs and improve operational efficiency.
- Sustaining supply chain partnerships—by reducing inefficiencies and increasing loyalty in terms of sustainability standards along the whole value chain, circular business models can increase supply chain stability.

Value capture can be increased while transforming into circular business strategies in the textile industry by:

- Circularity products—offering circular products that are environmentally friendly, sustainable and high-quality can attract new customers, leading to increased sales and profits.
- Improving supply chain stability—implementing closed-loop supply chain management and network collaborations can reduce supply chain risk.
- Meeting regulatory requirements—as regulations on waste and sustainability become stricter, companies that adopt circular business models will be better positioned to meet these requirements and avoid penalties.
- Reducing waste and inefficiencies—circular business models aim to reduce waste in production, distribution and consumption, which can lower costs and increase efficiency.

However, although there are many business model components, the companies face many difficulties in establishing circular business models, especially concerning the value capture component (see Figure 8). Company representatives addressed the need for support programs for recycling offers and recyclable products, relocating production or realising sustainability impact (see Table 4). This seems to be a challenge to progressing towards circularity in own business models. Moreover, as the circular business model innovations of the sample are characterised as a vivid mixture of technological (e.g., sorting of waste, upgrading, new processes, etc.), social (e.g., quality, lending, repair, zero-defect) and organisational (e.g., digitalisation and automation, standards, health) practices and innovations, a clear hierarchical path for sustainable business model innovations [6,7] is not recognizable. In line with [49] early transition and learning processes take place on multiple dimensions. Maybe hierarchical paths for circular business model innovations emerge when new regimes (circularity) have stabilised.

In light of digitalisation opportunities (see Table 4 and Appendix A) a more circular perspective of the business models is required, too. The respondents stressed the role of digitalisation for progressing sustainability and circularity (Table 4 and Figure 8). [50] evaluated options for digital progress in business model components. The authors clearly indicated specific impacts of digital technologies on circular business model components. Comparing the findings and recommendations of [50], the highlighted digital measures, which the textile companies in this sample have already implemented, are highly met, but offer space for further adjustments, e.g., easy tracking (value capture) and monitoring or industrial symbiosis with key suppliers (value delivery) (p. 11). [51] also mention various contributions to a circular economy and progress towards circular business models, but the authors mainly highlight pivotal challenges in the digital transition to progressing towards circularity, like data privacy, algorithmic bias, economic inequality and exclusion or epistemological risks that need to be discussed and regulated. Consequently, progressing towards circular business models a more systemic perspective and digital closed-loop-strategies are necessary—including a precise analysis of sustainability impact and improvements in light of sustainability in order to avoid rebound effects [37,52].

H4: *The more the digitisation measures of a company are aligned with the company's cost structure and managed in an integrative manner, the better the opportunities for value creation.*

5.3. Promotion of Circularity

Facing the research question "How can circularity be promoted in the textile industry and where are challenges to establish circularity in the textile enterprise?" the respondents stated clear regulation, incentives and financial support, education and cooperation, vision, differentiation strategies and entrepreneurial attitudes, circular-oriented management and tools, etc. can progress and promote circularity and sustainability (see Table 4, Figure 8 and Appendix A). Basic finance and value chain networks seem to have impact on progress towards circularity. The company representatives stated that there is a need for financial support, and that value creation and delivery is linked to network partners (see Figure 8). Although attracting investments is so pivotal, [47,53] stated that SMEs often do not operate in vivid and wide network structures due to resource limitations; thus, they often do not receive immediate and helpful financial support from network partners. This might be changed by the provision of direct state financial support or an exchange offering cooperation options. SMEs can further attract sustainability investments by demonstrating their commitment to sustainability, and by showing that their business practices align with the values of potential investors. SMEs aiming to attract sustainability investments should demonstrate a sustainability strategy. Having a clear and comprehensive sustainability strategy in place can help SMEs to demonstrate their commitment to sustainability and attract investment from those who value sustainability. In addition, they should also communicate sustainability effectively, e.g., through their sustainability goals and their progress towards sustainability, to potential investors and stakeholders. This can be done

through sustainability reports, presentations, and engaging in conversations with potential investors as well as by showing evidence of sustainability performance, e.g., energy efficiency improvements, waste reduction, and the obtainment of certifications. Building partnerships with organisations that are dedicated to promoting sustainability, such as non-profits, governmental organisations, or sustainability-focused investment firms, can enhance opportunities to provide resources, expertise, and access to investment opportunities. Attracting sustainability investments requires a long-term commitment to sustainability and continuous improvement. This leads to further hypotheses:

H5: *The better textile companies are embedded in networks, partnerships, and financial ecosystems, the better they can attract investments from investors for establishing circular change.*

H6: *Having a low threshold of network exchange can attract investments from investors for SMEs' progress towards circularity.*

6. Conclusions

Closing the scientific knowledge gap in the highlighted area "how does the German textile industry face up to the circular economy?", this investigation can contribute to circular practices in the German textile manufacturing industry. Although only 57 % of the respondents said they knew about the EU Strategy for Sustainable and Circular Textiles, this sample also demonstrated that the transformation towards a circular economy can create circular business models in the German textile manufacturing industry. Amending linear orientated business models into circular ones can create new sources of value and improve the quality or efficiency of and progress the sustainability of operations in the textile industry. The study shows that there is already an understanding of circularity and circular strategies in the German textile manufacturing industry. A minority of the companies apply the following circular business model strategies:

- Upcycling and recycling—converting waste textiles into new products;
- Product-as-a-service—renting out clothing instead of selling it;
- Repair and reuse—promoting repair and maintenance services to extend the life of products;
- Material innovation—using sustainable and biodegradable materials to reduce waste.

A clear systemic gap is obvious as the existence of the following strategy is not confirmed by the results:

- Closed-loop supply chain—implementing sustainable practices in the entire supply chain from production to disposal.

The study also reveals that many manufacturing textile companies are not prepared yet for a circular transformation. They neither know about the EU Strategy for Sustainable and Circular Textiles nor do they have appropriate management strategies or manpower. Digitalisation opportunities are recognised, but a stringent method of implementation for this is not available yet nationwide. The results also show that a circular transformation is a systemic task and that the process can be stimulated and progress in different ways, e.g., through regulations, incentives and support, networks and cooperation, and education and information. The company representatives clearly stated the need for clearer regulations regarding online trade, greenwashing, composites, varietal purity and standards going beyond current guidelines, and EU strategies and laws. They also stressed the need for better consumer information and education for enabling consumers to make sustainable purchasing decisions. Finally, the study stresses the systemic character of a circular transition in general and in the textile industry in particular, and consequently, the need for collaboration along the whole value chain. This implies the need for a new understanding of values amongst all chain partners and a realignment of the value chain as a whole.

6.1. Limitations

The results and their interpretation are subject to the following limitations: mainly, the lack of different settings and sample types posed limitations on drawing direct cause and effect conclusions from the data and results [42]; the descriptive analysis was only based on relations that might have indicated some effects; the qualitative data is limited to the respondents' perceptions and answers as we could not prove the implementation of measures due to data security; the sample was limited to the area of German textile manufacturing, so transferability of the results is limited to areas showing comparable conditions and legal requirements to this area. As approximately 95% of German manufacturing textile companies are small and medium-sized enterprises and approximately 50% of companies employ less than 50 employees [13], that 82.14 % of the companies in this sample were SMEs indicates representativeness, but the figure of 37.5 % for companies in the sample that employed less than 50 employees (Table 2) is below the ideal level. The companies were distributed across the federal states (Figure 4) to some extent, but not fully representatively. Thus, the sample did not fully reflect the population accurately [42]. Consequently, the results of the sample reflect the tendency of companies to be small and medium-sized enterprises in the German textile manufacturing industry.

In addition, there are limits in terms of the validity of the data due to the data collection method. As we offered a digital questionnaire via the Internet, we could not create controlled conditions [42], because the respondents decided their conditions, i.e., how, when, and where, they answered the questionnaire. We also received feedback that some respondents did not like gendered language of the questionnaire, and that others did not believe their feedback was absolutely anonymous, while a further few did not answer any kind of questionnaires. This might partly explain the response rate. We had 56 fully answered questionnaires and 125 partly answered ones. However, assuring the anonymity of the respondents when they participated in the survey addressed data protection requirements and respected the sincerity and cooperation of the respondents in their provision of personal, sensitive data. As the assurance of anonymity involved the possibility of the respondents manipulating data by intentionally giving false answers, and since we did not and could not prove the correctness of the answers, we have to face this possibility of data manipulation and name it as a limitation. The use of scales is an immanent limitation. In scientific surveys, Likert scales represent ordinal scale levels showing possible or actual impacts through time. In line with these surveys, scales with several items were introduced in a similar way in this study, all responses were categorised and unipolarly presented, and a sample was above the threshold of being greater than or equal to 30. The sample size covered 56 responses and was above the threshold of N = 30; hence, a normal distribution was then assumed. Qualitative responses were not valued in a metric way and are consequently represented in an aggregated way. Their deeper meaning should be further investigated through representative interview studies.

6.2. Outlook

As circular business models often lack mentions of seed capital and since the value capture component is difficult to fulfil, due to its systemic embedment of these models, textile companies should strategically invest in networks, partnerships, and collaborations in financial ecosystems in order to overcome the transformative hurdles. Practical and scientific implications address investments and research in collecting and sorting schemes, including tracing or tracking technologies along the whole value chain, ensuring actual progress towards sustainability. Further investigations should refer to new circular business models, including rental or subscription models, as well as new forms of collaboration between manufacturers, retailers, and consumers ensuring materials are kept in use for as long as possible. Since further progress towards a circular economy and sustainability requires multi-stakeholder collaboration, an analysis of the opportunities, success factors, and paradoxes in establishing and maintaining these networks is required. Digital transformation does not always lead to more progress towards sustainability and circularity. In this

area, conditions, limits, and enabling ecosystems should be investigated further to clearly highlight the dilemmas and rebound effects [39,52].

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Spearman's correlation.

Category Pairs	Survey N = 56
Potential of sustainability: increase in social responsibility in present and future generations//sustainable management concepts: EMAS	0.577 **
Potential of sustainability: increase in social responsibility in present and future generations//sustainable management concepts: ISO 9001	0.608 **
Potential of sustainability: increase in social responsibility towards present and future generations//Potential of sustainability: image promotion	0.541 **
Potential of sustainability: image promotion//Potential of sustainability: maintain competitiveness	0.592 **
Potential of sustainability: maintain competitiveness//Potential of sustainability: customer requirements	0.591 **
Potential of sustainability: cost reduction//Potential of sustainability: process improvement within production	0.610 **
Potential of sustainability: customer requirements//Potential of sustainability: political requirements	0.508 **
Potential of sustainability: process improvement within production//Potential of sustainability: quality improvement	0.764 **
Potential of sustainability: reduction in production times//Potential of sustainability: cost reduction	0.617 **
Reduction in production times//Potential of sustainability: process improvement within production	0.762 **
Potential of sustainability: reduction in production times//Potential of sustainability: quality improvement	0.656 **
Potential of sustainability: resource saving//Potential of sustainability: process improvement within production	0.624 **
Potential of sustainability: resource saving//Potential of sustainability: quality improvement	0.541 **
Potential of sustainability: resource saving//Potential of sustainability: reduction in production times	0.539 **

Table A1. *Cont.*

Category Pairs	Survey N = 56
Hurdle: no strategy or insufficient strategy for gradual integration of sustainability//Hurdle: no contact person with the relevant expertise available	0.540 **
Sustainability is important for the development of innovations//Potential of sustainability: development of new services and/or products	0.561 **
Sustainability is important for the development of innovations//Potential of sustainability: image promotion	0.524 **
Sustainability is important for the development of innovations//Potential of sustainability: process improvement within production	0.556 **
Sustainability is important for the development of innovations//Potential of sustainability: resource saving	0.559 **
Sustainability is important for the development of innovations//My company would like to set up or further develop a specialist department for sustainability.	0.620 **
Sustainability is important for the development of innovations//My company is aware of its own impact of production on the environment	0.635 **
My company is aware of its own impact of production on the environment//No or insufficient strategy for gradual integration of sustainability	−0.550 **
Digitalisation is the conversion of analogue information into digital data//Digitalisation is a redesign of existing business processes using digital technologies	0.563 **
Digitalisation is the reshaping of the business model and the core competencies of the company//Potential of digitalisation: image promotion	0.516 **
Potential of sustainability: increase in social responsibility in present and future generations//Potential of digitalisation: image promotion	0.575 **
Potential of digitalisation: political requirements//Potential of sustainability: increase in social responsibility in present and future generations	0.567 **
Potential of digitalisation: political requirements//Potential of digitalisation: image promotion	0.516 **
Potential of digitalisation: process improvement within production//Potential of digitalisation: competitiveness	0.605 **
Potential of digitalisation: quality improvement//Potential of sustainability: resource saving	0.500 **
Potential of digitalisation: quality improvement//Potential of digitalisation: development of new services and/or products	0.512 **
Potential of digitalisation: quality improvement//Potential of digitalisation: process improvement within production	0.585 **
Potential of digitalisation: process improvement of manufacturing//Potential of sustainability: resource saving	0.523 **
Need for digital action: facilitate documentation, e.g., tracking, transparency//Company is interested in training and/or information events around sustainability in the textile industry	0.505 **
My company would like to set up or further develop a digitalisation department.//My company would like to set up or further develop a department for sustainability	0.577 **
Promote circularity in the textile industry: strengthen R&D//Need for digital action: facilitate documentation, e.g., tracking, transparency	0.530 **
Promote circularity in the textile industry: strengthen R&D//Promote circularity in the textile industry: stimulate education and knowledge transfer	0.514 **
Promote circularity in the textile industry: promote market transparency//Potential of sustainability: increase social responsibility towards present and future generations	0.547 **
Promote circularity in the textile industry: promote market transparency//Promote circularity in the textile industry: accelerate institutional anchoring	0.539 **
Promote circularity in the textile industry: promote market transparency//Promote circularity in the textile industry: setting norms and standards	0.622 **

Table A1. *Cont.*

Category Pairs	Survey N = 56
Promote circularity in the textile industry: stimulate public procurement//Potential of sustainability: increase social responsibility in present and future generations	0.509 **
Promote circularity in the textile industry: stimulate public procurement//Promote circularity in the textile industry: accelerate institutional anchoring	0.558 **
Promote circularity in the textile industry: regulatory instruments//Promote circularity in the textile industry: setting norms and standards	0.531 **
Promote circularity in the textile industry: regulatory instruments//Promote circularity in the textile industry: stimulate public procurement	0.520 **
Promote circularity in the textile industry: advance recycling structures//Promote circularity in the textile industry: stimulate public procurement	0.506 **
Promote circularity in the textile industry: advance recycling structures//Promote circularity in the textile industry: economic incentives	0.526 **
Promote circularity in the textile industry: circular business models//Promote circularity in the textile industry: advance recycling structures	0.545 **
Changes have been made to or are planned in the value proposition//Sustainability is important for the development of innovations	0.685 **
Changes have been made to or are planned in the area of value creation and delivery//Sustainability is important for the development of innovations	0.627 **
Changes have been made to or are planned in the area of value creation and delivery//My company is aware of its own impact of production on the environment	0.579 **
Changes have been made to or are planned in the area of value creation and delivery//Changes have been made or are planned in the value proposition	0.666 **
Changes have been made or are planned in the area of value capture//Sustainability is important for the development of innovations	0.592 **
Changes have been made or are planned in the area of value capture//Changes have been made to or are planned in the area of value proposition	0.710 **
Changes have been made or are planned in the area of value capture//Changes have been made to or are planned in the area of value creation and delivery	0.693 **

**, Spearman's rho (ρ)/correlation is significant at the 0.01 level (two-tailed); just values shown above 0.500 have sig. (two-tailed) of 0.000.

Table A2. Contingency analysis.

Category Pairs	Cramer's V *	Contin-gency Coefficient	α
Textile value chain: raw material production X Other advantages considering sustainability aspects	0.527	0.466	<0.001
Textile value chain: ginning X Hurdles to digitalisation: concerns about data protection and security	0.544	0.478	<0.001
Textile value chain: area formation—knitting X Promote circularity in the textile industry: advance recycling structures	0.590	0.508	<0.001
Textile value chain: area formation—knitting X Potential of digitalisation: process improvement of manufacturing	0.665	0.554	<0.001
Textile value chain: area formation—fleece X Potential of sustainability: maintain competitiveness	0.544	0.478	<0.001

Table A2. *Cont.*

Category Pairs	Cramer's V *	Contin-gency Coefficient	α
Textile value chain: area formation—fleece X Promote circularity in the textile industry: economic incentives	0.515	0.458	<0.001
Textile value chain: embroidery X Potential of digitalisation: process improvement of intralogistics	0.561	0.489	<0.001
Textile value chain: raw material recycling X Potential of sustainability: reduction of production times	0.590	0.508	<0.001
Fibres processed in company: Modal X Digitalisation is a redesign of existing business processes using digital technologies	0.591	0.509	<0.001
Sustainability: none of these steps (informing, analysing, designing, and implementing) has been or is being carried out X Sustainability—ensuring future generations meeting their needs	0.624	0.530	<0.001
Sustainability: none of these steps (informing, analysing, designing, and implementing) has been or is being carried out X Sustainability is important for the development of innovations	0.586	0.506	<0.001
Sustainability: none of these steps (informing, analysing, designing, and implementing) has been or is being carried out X Interest in training and information around sustainability	0.606	0.518	<0.001
Sustainability: none of these steps (informing, analysing, designing, and implementing) has been or is being carried out X Impact of production on the environment	0.666	0.554	<0.001
Sustainability: none of these steps (informing, analysing, designing, and implementing) has been or is being carried out X It is important for my company to be able to adjust the software itself	0.644	0.542	<0.001
Sustainable management concepts: controlling X Potential of sustainability: increase in social responsibility in present and future generations	0.634	0.739	<0.001
Textile eco-labels: other X Potential of digitalisation: process improvement of intralogistics	0.503	0.580	<0.001
Potential of sustainability: other X Sustainability hurdles: concerns about necessity and benefits	0.583	0.503	<0.001
Potential of sustainability: other X Changes have been made or are planned in the value proposition	0.553	0.484	<0.001
Potential of sustainability: other X Changes have been made or are planned in the area of value creation and delivery	0.496	0.445	<0.001
Federal state of the company headquarters X Sustainable management concepts: controlling	0.697	0.770	<0.001
Federal state of the company headquarters X Textile eco-labels: Bluesign	0.767	0.799	<0.001
Federal state of the company headquarters X Textile eco-labels: Cradle to Cradle	0.652	0.749	<0.001
Federal state of the company headquarters X Textile eco-labels: Blue Angel	0.737	0.787	<0.001
Federal state of the company headquarters X Textile eco-labels: IVN Best	0.666	0.756	<0.001

Table A2. *Cont.*

Category Pairs	Cramer's V *	Contin-gency Coefficient	α
Federal state of the company headquarters X Textile eco-labels: Oeko-Tex Standard 100	0.755	0.794	<0.001
Federal state of the company headquarters X Textile eco-labels: Other	0.629	0.737	<0.001
Textile value chain: raw material production X Sustainable management concepts: DIN EN ISO 50001	0.567	0.493	<0.001
Textile value chain: raw material production X Textile eco-labels: EU-Ecolabel	0.701	0.574	<0.001
Textile value chain: ginning X Textile value chain: area formation—fleece	0.567	0.493	<0.001
Textile value chain: ginning X Textile eco-labels: Made in Green—Oeko-Tex	0.567	0.493	<0.001
Textile value chain: area formation—fleece X Textile value chain: ginning	0.567	0.493	<0.001
Fibres processed in company: cotton X Fibres processed in company: polyester	0.559	0.488	<0.001
Fibres processed in company: elastane X Entrepreneurial state regarding sustainability: design	0.510	0.454	<0.001
Fibres processed in company: elastane X Fibres processed in company: lyocell	0.614	0.523	<0.001
Fibres processed in company: elastane X Fibres processed in company: polyamide	0.510	0.454	<0.001
Entrepreneurial state regarding sustainability: design X Fibres processed in company: hemp	0.666	0.554	<0.001
Entrepreneurial state regarding sustainability: design X Fibres processed in company: lyocell	0.653	0.547	<0.001
Entrepreneurial state regarding sustainability: design X Fibres processed in company: modal	0.718	0.583	<0.001
Entrepreneurial state regarding sustainability: design X Fibres processed in company: silk	0.623	0.528	<0.001
Entrepreneurial state regarding sustainability: design X Fibres processed in company: cotton	0.614	0.523	<0.001
Fibres processed in company: hemp X Fibres processed in company: lyocell	0.503	0.450	<0.001
Fibres processed in company: hemp X Fibres processed in company: cotton	0.506	0.451	<0.001
Fibres processed in company: lyocell X Fibres processed in company: modal	0.649	0.544	<0.001
Fibres processed in company: lyocell X Fibres processed in company: silk	0.557	0.487	<0.001
Fibres processed in company: lyocell X Fibres processed in company: cotton	0.612	0.522	<0.001
Fibres processed in company: modal X Fibres processed in company: silk	0.599	0.514	<0.001
Fibres processed in company: modal X Fibres processed in company: cotton	0.535	0.472	<0.001

Table A2. *Cont.*

Category Pairs	Cramer's V *	Contin-gency Coefficient	α
Fibres processed in company: polyamide X Fibres processed in company: polyester	0.650	0.545	<0.001
Fibres processed in company: polyamide X Fibres processed in company: elastane	0.510	0.454	<0.001
Fibres processed in company: silk X Fibres processed in company: cotton	0.535	0.472	<0.001
Entrepreneurial state of sustainability: inform X Entrepreneurial state of sustainability: analyse	0.750	0.600	<0.001
Entrepreneurial state of sustainability: inform X Entrepreneurial state of digitalisation: inform	0.723	0.586	<0.001
Entrepreneurial state of sustainability: inform X Entrepreneurial state of digitalisation: analyse	0.540	0.475	<0.001
Sustainable management concepts: controlling X Entrepreneurial state of digitalisation: implementing	0.538	0.474	<0.001
Sustainable management concepts: EMAS X Sustainable management concepts: DIN EN ISO 14006	0.633	0.739	<0.001
Sustainable management concepts: EMAS X Sustainable management concepts: DIN EN ISO 14020	0.555	0.693	<0.001
Sustainable management concepts: EMAS X Sustainable management concepts: DIN EN ISO 14040/44	0.623	0.733	<0.001
Sustainable management concepts: EMAS X Sustainable management concepts: DIN EN ISO 26000	0.619	0.731	<0.001
Sustainable management concepts: EMAS X Sustainable management concepts: DIN EN ISO 50001	0.533	0.678	<0.001
Sustainable management concepts: DIN EN ISO 9001 X Sustainable management concepts: DIN EN ISO 14001	0.683	0.764	<0.001
Sustainable management concepts: DIN EN ISO 9001 X Sustainable management concepts: DIN EN ISO 50001	0.592	0.716	<0.001
Sustainable management concepts: DIN EN ISO 9001 X Sustainability is important for the development of innovations	0.538	0.682	<0.001
Sustainable management concepts: DIN EN ISO 9001 X Textile eco-labels: Blue Angel	0.540	0.683	<0.001
Sustainable management concepts: DIN EN ISO 9001 X Textile eco-labels: IVN Best	0.537	0.681	<0.001
Sustainable management concepts: DIN EN ISO 9001 X Textile eco-labels: Oeko-Tex Standard 100	0.501	0.655	<0.001
Sustainable management concepts: DIN EN ISO 14001 X Sustainable management concepts: DIN EN ISO 14040/44	0.524	0.672	<0.001
Sustainable management concepts: DIN EN ISO 14001 X Sustainable management concepts: DIN EN ISO 50001	0.677	0.761	<0.001
Sustainable management concepts: DIN EN ISO 14006 X Sustainable management concepts: DIN EN ISO 14020	0.668	0.756	<0.001

Table A2. *Cont.*

Category Pairs	Cramer's V *	Contin-gency Coefficient	α
Sustainable management concepts: DIN EN ISO 14006 X Sustainable management concepts: DIN EN ISO 14040/44	0.607	0.725	<0.001
Sustainable management concepts: DIN EN ISO 14006 X Sustainable management concepts: DIN EN ISO 26000	0.650	0.748	<0.001
Sustainable management concepts: DIN EN ISO 14020 X Sustainable management concepts: DIN EN ISO 14040/44	0.514	0.665	<0.001
Sustainable management concepts: DIN EN ISO 14020 X Sustainable management concepts: DIN EN ISO 26000	0.698	0.770	<0.001
Sustainable management concepts: DIN EN ISO 14020 X Textile eco-labels: Bluesign	0.546	0.687	<0.001
Sustainable management concepts: DIN EN ISO 14020 X Textile eco-labels: Cradle to Cradle	0.531	0.677	<0.001
Sustainable management concepts: DIN EN ISO 14040/44 X Sustainable management concepts: DIN EN ISO 26000	0.673	0.759	<0.001
Sustainable management concepts: DIN EN ISO 14040/44 X Sustainable management concepts: DIN EN ISO 50001	0.557	0.694	<0.001
Sustainable management concepts: DIN EN ISO 14040/44 X Textile eco-labels: EU-Ecolabel	0.595	0.718	<0.001
Sustainable management concepts: DIN EN ISO 26000 X Sustainable management concepts: DIN EN ISO 50001	0.530	0.677	<0.001
Sustainable management concepts: DIN EN ISO 26000 X Textile eco-labels: EU-Ecolabel	0.538	0.692	<0.001
Sustainable management concepts: DIN EN ISO 50001 X Sustainable management concepts: Controlling	0.501	0.655	<0.001
Sustainable management concepts: DIN EN ISO 50001 X Textile eco-labels: EU-Ecolabel	0.575	0.706	<0.001
Sustainable management concepts: controlling X Textile eco-labels: Bluesign	0.614	0.728	<0.001
Sustainable management concepts: controlling X Textile eco-labels: Blue Angel	0.620	0.732	<0.001
Sustainable management concepts: controlling X Textile eco-labels: IVN Best	0.623	0.734	<0.001
Sustainable management concepts: controlling X Textile eco-labels: Oeko-Tex Standard 100	0.603	0.722	<0.001
Sustainable management concepts: controlling X Textile eco-labels: other	0.654	0.75	<0.001
Textile eco-labels: Bluesign X Textile eco-labels: Cradle to Cradle	0.796	0.809	<0.001
Textile eco-labels: Bluesign X Textile eco-labels: Blue Angel	0.784	0.805	<0.001
Textile eco-labels: Bluesign X Textile eco-labels: EU-Ecolabel	0.617	0.73	<0.001

Table A2. *Cont.*

Category Pairs	Cramer's V *	Contin-gency Coefficient	α
Textile eco-labels: Bluesign X Textile eco-labels: GOTS	0.699	0.771	<0.001
Textile eco-labels: Bluesign X Textile eco-labels: IVN Best	0.688	0.766	<0.001
Textile eco-labels: Bluesign X Textile eco-labels: Made in Green—Oeko-Tex	0.578	0.707	<0.001
Textile eco-labels: Bluesign X Textile eco-labels: Oeko-Tex Standard 100	0.829	0.821	<0.001
Textile eco-labels: Bluesign X Textile eco-labels: other	0.615	0.729	<0.001
Textile eco-labels: Cradle to Cradle X Textile eco-labels: Blue Angel	0.647	0.746	<0.001
Textile eco-labels: Cradle to Cradle X Textile eco-labels: EU-Ecolabel	0.503	0.657	<0.001
Textile eco-labels: Cradle to Cradle X Textile eco-labels: GOTS	0.652	0.749	<0.001
Textile eco-labels: Cradle to Cradle X Textile eco-labels: IVN Best	0.525	0.673	<0.001
Textile eco-labels: Cradle to Cradle X Textile eco-labels: Made in Green—Oeko-Tex	0.517	0.667	<0.001
Textile eco-labels: Cradle to Cradle X Textile eco-labels: Oeko-Tex Standard 100	0.718	0.779	<0.001
Textile eco-labels: Blue Angel X Textile eco-labels: EU-Ecolabel	0.639	0.742	<0.001
Textile eco-labels: Blue Angel X Textile eco-labels: GOTS	0.592	0.716	<0.001
Textile eco-labels: Blue Angel X Textile eco-labels: IVN Best	0.729	0.784	<0.001
Textile eco-labels: Blue Angel X Textile eco-labels: Made in Green—Oeko-Tex	0.652	0.749	<0.001
Textile eco-labels: Blue Angel X Textile eco-labels: Oeko-Tex Standard 100	0.747	0.791	<0.001
Textile eco-labels: Blue Angel X Textile eco-labels: other	0.659	0.752	<0.001
Impact of production on the environment X Textile eco-labels: IVN Best	0.613	0.728	<0.001
Textile eco-labels: EU-Ecolabel X Textile eco-labels: Made in Green—Oeko-Tex	0.530	0.676	<0.001
Textile eco-labels: EU-Ecolabel X Textile eco-labels: Oeko-Tex Standard 100	0.543	0.685	<0.001
Textile eco-labels: EU-Ecolabel X Textile eco-labels: other	0.513	0.664	<0.001
Textile eco-labels: GOTS X Textile eco-labels: Oeko-Tex Standard 100	0.717	0.779	<0.001
Textile eco-labels: IVN Best X Textile eco-labels: Oeko-Tex Standard 100	0.676	0.76	<0.001

Table A2. *Cont.*

Category Pairs	Cramer's V *	Contin-gency Coefficient	α
Textile eco-labels: IVN Best X Textile eco-labels: other	0.643	0.744	<0.001
Textile eco-labels: Made in Green—Oeko-Tex X Textile eco-labels: Oeko-Tex Standard 100	0.545	0.686	<0.001
Textile eco-labels: Oeko-Tex Standard 100 X Textile eco-labels: other	0.632	0.738	<0.001
Entrepreneurial state of digitalization: inform X Entrepreneurial state of digitalization: analyse	0.678	0.561	<0.001
Potential of digitalization: other X Promote circularity in the textile industry: other	0.552	0.483	<0.001

* Values shown from Cramer's V > 0.500 having $\alpha < 0.001$.

References

1. Hauff, V. *Unsere Gemeinsame Zukunft. Der Brundtland-Bericht der Weltkommission für Umwelt und Entwicklung*; Eggenkamp: Greven, Germany, 1987.
2. Europäische Kommission. *EU-Strategie für Nachhaltige und Kreislauffähige Textilien*; Europäische Kommission: Brüssel, Belgium, 2022.
3. Statistisches Bundesamt Anzahl der Betriebe in der deutschen Textil- und Bekleidungsindustrie nach Beschäftigtenzahl im Jahr 2021. Available online: https://de.statista.com/statistik/daten/studie/209690/umfrage/unternehmen-in-der-deutschen-textilindustrie-nach-beschaeftigtenzahl/ (accessed on 11 January 2023).
4. Vereinte Nationen. *Transformation Unserer Welt: Die Agenda 2030 für Nachhaltige Entwicklung*; Vereinte Nationen: New York, NY, USA, 2015.
5. Fetting, C. *The European Green Deal*; ESDN Office: Vienna, Austria, 2020. Available online: https://www.esdn.eu/fileadmin/ESDN_Reports/ESDN_Report_2_2020.pdf (accessed on 2 January 2023).
6. Bocken, N.M.P.; Short, S.W.; Rana, P.; Evans, S. A Literature and Practice Review to Develop Sustainable Business Model Archetypes. *J. Clean. Prod.* **2014**, *65*, 42–56. [CrossRef]
7. de Keyser, E.; Mathijs, E. A Typology of Sustainable Circular Business Models with Applications in the Bioeconomy. *Front Sustain Food Syst* **2023**, *6*, 1028877. [CrossRef]
8. Gloy, Y.-S. *Industrie 4.0 in Der Textilproduktion*; Springer Vieweg: Berlin, Germany, 2020.
9. Marschall, P.; Peters, R.; Jordan, J.; Fromhold-Eisebith, M.; Thomes, P.; Kemper, M. WiSoTex 4.0—Wirtschaftsräumliche Implikationen von Industrie 4.0 in Relationaler Perspektive: Innovation, Evolution, Organisation und Interaktion, Untersucht am Beispiel der Deutschen Textilindustrie. 2020. Available online: https://ssrn.com/abstract=3532180 (accessed on 9 January 2023).
10. Föhl, A.; Hamm, M. *Die Industriegeschichte Des Textils Technik, Architektur, Wirtschaft*; VDI: Düsseldorf, Germany, 1988; ISBN 3-18-400728-6.
11. Gözet, B.; Wilts, H. The Circular Economy as a New Narrative for the Textile Industry—Wuppertal Institute for Climate, Environment and Energy. Available online: https://wupperinst.org/en/a/wi/a/s/ad/7733 (accessed on 27 January 2023).
12. Gesamtverband der deutschen Textil- und Modeindustrie e.V. *Die Deutsche Textil-Und Modeindustrie in Zahlen*; Gesamtverband der deutschen Textil- und Modeindustrie e.V.: Berlin, Germany, 2021.
13. Gesamtverband der deutschen Textil- und Modeindustrie e.V. *Die Deutsche Textil-Und Modeindustrie in Zahlen*; Gesamtverband der deutschen Textil- und Modeindustrie e.V.: Berlin, Germany, 2022.
14. Peter John, E.; Mishra, U. A Sustainable Three-Layer Circular Economic Model with Controllable Waste, Emission, and Wastewater from the Textile and Fashion Industry. *J. Clean. Prod.* **2023**, *388*, 135642. [CrossRef]
15. Europäische Kommission; Generaldirektion Umwelt. *Nachhaltige und Kreislauffähige Textilien Bis 2030*; Amt für Veröffentlichungen der Europäischen Union, 2022. [CrossRef]
16. Forschungskuratorium Textil e.V. *Kreislaufwirtschaft—Textile Kreisläufe Schaffen, Zukunft Gestalten*; Forschungskuratorium Textil e.V.: Berlin, Germany, 2022.
17. Beyer, K.; Arnold, M.G. Social Sustainability in an Evolving Circular Fashion Industry: Identifying and Triangulating Concepts across Different Publication Groups Soziale Nachhaltigkeit in Einer Sich Entwickelnden Zirkulären Mode-Und Bekleidungsindustrie: Identifikation Und Triangulation von Konzepten Verschiedener Publikationsgruppen. *Sustain. Manag. Forum* **2022**, *30*, 29–54. [CrossRef]
18. Suárez-Eiroa, B.; Fernández, E.; Méndez-Martínez, G.; Soto-Oñate, D. Operational Principles of Circular Economy for Sustainable Development: Linking Theory and Practice. *J. Clean. Prod.* **2019**, *214*, 952–961. [CrossRef]
19. Die Bundesregierung Bericht Über Die Umsetzung der Agenda 2030 für Nachhaltige Entwicklung—Freiwilliger Staatenbericht Deutschlands zum Hochrangigen Politischen Forum für Nachhaltige Entwicklung 2021. Available online: https://www.bmz.de/resource/blob/86824/staatenbericht-deutschlands-zum-hlpf-2021.pdf (accessed on 2 January 2023).
20. Bonciu, F. The European Economy: From a Linear to a Circular Economy. *Rom. J. Eur. Aff.* **2014**, *14*, 78–91.

21. Hobson, K.; Lynch, N. Diversifying and De-Growing the Circular Economy: Radical Social Transformation in a Resource-Scarce World. *Futures* **2016**, *82*, 15–25. [CrossRef]
22. Sauvé, S.; Bernard, S.; Sloan, P. Environmental Sciences, Sustainable Development and Circular Economy: Alternative Concepts for Trans-Disciplinary Research. *Environ. Dev.* **2016**, *17*, 48–56. [CrossRef]
23. Geissdoerfer, M.; Savaget, P.; Bocken, N.M.P.; Hultink, E.J. The Circular Economy—A New Sustainability Paradigm? *J. Clean. Prod.* **2017**, *143*, 757–768. [CrossRef]
24. Govindan, K.; Salehian, F.; Kian, H.; Hosseini, S.T.; Mina, H. A Location-Inventory-Routing Problem to Design a Circular Closed-Loop Supply Chain Network with Carbon Tax Policy for Achieving Circular Economy: An Augmented Epsilon-Constraint Approach. *Int. J. Prod. Econ.* **2023**, *257*, 108771. [CrossRef]
25. Shevchenko, T.; Saidani, M.; Ranjbari, M.; Kronenberg, J.; Danko, Y.; Laitala, K. Consumer Behavior in the Circular Economy: Developing a Product-Centric Framework. *J. Clean. Prod.* **2023**, *384*, 135568. [CrossRef]
26. Greer, R.; von Wirth, T.; Loorbach, D. The Waste-Resource Paradox: Practical Dilemmas and Societal Implications in the Transition to a Circular Economy. *J. Clean. Prod.* **2021**, *303*, 126831. [CrossRef]
27. Osterwalder, A.; Pigneur, Y.; Tucci, C.L. Clarifying Business Models: Origins, Present, and Future of the Concept. *Commun. Assoc. Inf. Syst.* **2005**, *16*, 1. [CrossRef]
28. Boons, F.; Lüdeke-Freund, F. Business Models for Sustainable Innovation: State-of-the-Art and Steps towards a Research Agenda. *J. Clean. Prod.* **2013**, *45*, 9–19. [CrossRef]
29. Baden-Fuller, C.; Morgan, M.S. Towards a Conceptual Framework of "Business Models for Sustainability". *Long Range Plann.* **2010**, *43*, 156–171. [CrossRef]
30. Schaltegger, S.; Lüdeke-Freund, F.; Hansen, E.G. Business Cases for Sustainability: The Role of Business Model Innovation for Corporate Sustainability. *Int. J. Innov. Sustain. Dev.* **2012**, *6*, 95–119. [CrossRef]
31. Kirchherr, J.; Reike, D.; Hekkert, M. Conceptualizing the Circular Economy: An Analysis of 114 Definitions. *Resour. Conserv. Recycl.* **2017**, *127*, 221–232. [CrossRef]
32. Arnold, M.G.; Beyer, K. Examining the Social Side of Sustainability in the Debate on Business Model Innovations in the Textile, Clothing and Fashion Industry: A Typology Based on the Value Chain Perspective. *Int. J. Innov. Sustain. Dev.* **2022**, *16*, 322–371. [CrossRef]
33. Matthes, A.; Beyer, K.; Cebulla, H.; Arnold, M.G.; Schumann, A. *Sustainable Textile and Fashion Value Chains*; Springer International Publishing: Berlin/Heidelberg, Germany, 2021.
34. Arnold, M.G.; Beyer, K. Sustainability Transitions in Disclosures in the Fashion Industry: Comparative Insights into Social Sustainability, Circularity and Systemic Shifts. *J. Text. Sci. Fash. Technol.* **2020**, *5*, 1–11. [CrossRef]
35. United Nations Environment Programme Sustainability and Circularity in the Textile Value Chain: Global Stocktaking. Available online: https://wedocs.unep.org/20.500.11822/34184 (accessed on 23 February 2023).
36. Piscicelli, L. The Sustainability Impact of a Digital Circular Economy. *Curr. Opin. Environ. Sustain.* **2023**, *61*, 101251. [CrossRef]
37. Arnold, M.G.; Fischer, A. Digitization and Sustainability: Threats, Opportunities, and Trade-Offs. In *Responsible, Sustainable, and Globally Aware Management in the Fourth Industrial Revolution*; Fields, Z., Huesig, S., Eds.; IGI Global: Hershey, PA, USA, 2019; pp. 1–28.
38. Corvellec, H.; Stowell, A.F.; Johansson, N. Critiques of the Circular Economy. *J. Ind. Ecol.* **2022**, *26*, 421–432. [CrossRef]
39. Jacob, M. *Digitalisierung & Nachhaltigkeit—Eine Unternehmerische Perspektive*; Springer Nature: Wiesbaden, Germany, 2019; Volume 1.
40. Griese, K.-M.; Hirschfeld, G.; Baringhorst, S. Unternehmen Zwischen Digitalisierung Und Nachhaltigkeit—Eine Empirische Untersuchung. *Sustain. Manag. Forum* **2018**, *27*, 11–21. [CrossRef]
41. Vogel, J.; Thomas, O. Digitalisierung Als Enabler Nachhaltiger Veranstaltungen: Potenziale Und Handlungsfelder Durch Neue Technologien. In *Trends in Event Education*; Gehrke, G., Thilo, I., Eds.; Springer Gabler: Wiesbaden, Germany, 2020; pp. 49–71.
42. Bryman, A. *Social Research Methods*, 5th ed.; Oxford University Press: Oxford, UK, 2016; ISBN 978-0-19-968945-3.
43. Mayring, P. *Qualitative Inhaltsanalyse Grundlagen und Techniken*, 13th ed.; Beltz Verlag: München, Germany, 2022; Volume 13, ISBN 978-3-407-25898-4.
44. Kang, M.; Han, Z.; Kang, T.; Oh, Y.; Khan, M.; Saleem Parvaiz, G.; Dedahanov, A.T.; Abdurazzakov, O.S.; Rakhmonov, D.A. The Impact of Technologies of Traceability and Transparency in Supply Chains. *Sustainability* **2022**, *14*, 16336. [CrossRef]
45. Moreau, V.; Sahakian, M.; van Griethuysen, P.; Vuille, F. Coming Full Circle: Why Social and Institutional Dimensions Matter for the Circular Economy. *J. Ind. Ecol.* **2017**, *21*, 497–506. [CrossRef]
46. de Nadae, J.; Carvalho, M.M.; Vieira, D.R. Integrated Management Systems as a Driver of Sustainability Performance: Exploring Evidence from Multiple-Case Studies. *Int. J. Qual. Reliab. Manag.* **2021**, *38*, 800–821. [CrossRef]
47. Demir, A.; Budur, T.; Omer, H.M.; Heshmati, A. Links between Knowledge Management and Organisational Sustainability: Does the ISO 9001 Certification Have an Effect? *Knowl. Manag. Res. Pract.* **2021**, *21*, 183–196. [CrossRef]
48. Chapman, R. UN Principles for Responsible Investment Closing the Loop. Available online: https://www.unpri.org/download?ac=17130 (accessed on 10 January 2023).
49. Geels, F.W. Technological Transitions as Evolutionary Reconfiguration Processes: A Multi-Level Perspective and a Case-Study. *Res. Policy* **2002**, *31*, 1257–1274. [CrossRef]
50. Chauhan, C.; Parida, V.; Dhir, A. Linking Circular Economy and Digitalisation Technologies: A Systematic Literature Review of Past Achievements and Future Promises. *Technol. Forecast. Soc. Change* **2022**, *177*, 121508. [CrossRef]

51. Roberts, H.; Zhang, J.; Bariach, B.; Cowls, J.; Gilburt, B.; Juneja, P.; Tsamados, A.; Ziosi, M.; Taddeo, M.; Floridi, L. Artificial Intelligence in Support of the Circular Economy: Ethical Considerations and a Path Forward. *AI Soc.* **2022**, *1*, 1–14. [CrossRef]
52. Arnold, M.G. Challenges and Paradoxes in Researching in Circular Economy. *Circ. Econ.* **2023**, *143*, 37–46.
53. Rizos, V.; Behrens, A.; van der Gaast, W.; Hofman, E.; Ioannou, A.; Kafyeke, T.; Flamos, A.; Rinaldi, R.; Papadelis, S.; Hirschnitz-Garbers, M.; et al. Implementation of Circular Economy Business Models by Small and Medium-Sized Enterprises (SMEs): Barriers and Enablers. *Sustainability* **2016**, *8*, 1212. [CrossRef]