

The Impact of Digital Technologies on Material Product Innovations: A Literature Review

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Abstract. The enormous power of change inherent in digital technologies has the potential to fundamentally influence the current economic structure (Geurts and Cepa 2023). At company level, digital technologies can trigger changes that affect both the company itself and certain activities, for example the configuration of manufacturing or commercial processes (Liu et al. 2023). Moreover, there are already investigations in the scientific literature that indicate that the use of digital technologies could have an influence on the successful emergence of innovations in organizations (Forliano et al. 2023). However, digital technologies are often associated with the ability to strip products that can be touched of their materiality (Geurts and Cepa 2023). In this context, the question has to be asked whether digital technologies can also promote and support the development of material products. For this reason, this study examines the influence of digital technologies on the creation of material product innovations. The aim of this study is to create an overview from which the possible effects of digital technologies on the emergence of material product innovations are compiled and then assessed. The focus of this study is primarily on companies, as the provision of novelties is one of the necessary prerequisites for continued market participation (Ortiz-Villajos and Sotoca 2018). Furthermore, product innovations can support companies for example to enhance their position in relation to rivals, the revenue they generate and their external perception on the market (Agustia et al. 2022). The research method used in this study is based on a systematic literature review. In addition, a further intention of this work is to provide suggestions for practice. In this regard, the purpose is to support people who deal with the topic of innovation in companies. They should gain an overview of the possible application potential of digital technologies in the innovation process of material product innovations through this study. At the same time, this study also serves to provide suggestions for upcoming scientific investigations. Finally, the limitations of this study are also highlighted.

Keywords: digitalization, digital technologies, innovations, material products

1 Introduction

The ability of companies to provide innovative achievements is one of the criteria that can help determine their success in the business world (Ortiz-Villajos and Sotoca 2018). The fundamental importance of innovations as a means of differentiation from other market participants is a topic covered by the scientific community (Zawislak et al. 2012). In addition, scientific investigations have also indicated that innovations can have a beneficial impact on corporate results (Karabulut 2015). Innovations in terms of products in particular can also support the more economical use of available assets and positively influence the external perception of a company (Agustia et al. 2022).

Dealing with innovations can also be beneficial for skills within the company. This is because the creation of innovations often requires up-to-date skills and abilities. It is therefore necessary to keep these up to date in order to be able to fulfill a possible innovation mission (González-Blanco, Rodríguez-Domínguez, and Guisado-González 2024).

However, the creation of product innovations seems to be associated with ever greater challenges in recent times. This could amongst others be attributed to the following factors, such as the growing requirements in the generation of novel products, the intense contest among companies for customers and markets, which is nowadays raging across countries and continents, and the decrease in the lifespan of products (Elverum and Welo 2015).

Among many other factors, the digital change can also have an impact on a company's range of offerings (Schulz et al. 2023). Digital technologies in particular have contributed to this process of change in the corporate environment (Berger et al. 2021). In relation to the range of offers, they are also associated with the ability to dissolve the material components of a range of offers (Geurts and Cepa 2023).

In this sense, the question arises as to whether digital technologies have caused the downfall of material products? A complete disappearance of material products and thus also of material product innovation from people's everyday lives, however, seems very difficult to imagine from today's perspective. A second question therefore arises, which aims to find out whether digital technologies can also have a positive impact on the creation of material product innovations? For these reasons, the overarching aim of this study is to investigate the extent to which digital technologies can support the emergence of material product innovations as part of a systematic literature analysis.

For ease of understanding, the structure of the paper is explained below. After the presentation and explanation of the background to the creation of this paper, the following chapter deals with the scientific foundations regarding the topics of material product innovations and digital technologies. These two subject areas represent the two most important pillars of this work and are discussed in advance for better classification within the work. The following chapter is then dedicated to explaining the scientific approach used in this paper. This chapter sets out the research questions on which this study is based and describes the research methodology of a systematic literature analysis used in the paper. For reasons of transparency and comprehensibility, the query text for the literature search, the literature database used and the selection process for the inclusion of literature sources for the literature analysis are described in this context. In the succeeding chapter, the results of the literature analysis are discussed and the research questions of this study are answered. The penultimate chapter of this paper serves to draw conclusions from the results obtained and to make recommendations for companies. Finally, the intention within the last chapter is to outline the constraints associated with the study conducted in this paper and to provide suggestions for emerging topics or areas of research.

2 Thematic Foundations

The following two sections of this chapter are dedicated to the two main topics of this paper. They are intended to provide a closer insight into the scientific foundations of the areas of material product innovations and digital technologies.

The approach chosen in this chapter is therefore based on works from the field of entrepreneurship. In this field, for example, it is not uncommon for academic studies with a similar methodological focus to clarify the thematic foundations in a separate chapter (Kraus, Breier, and Dasí-Rodríguez 2020).

2.1 Material Product Innovations

The range of offers has a high economic significance for the companies, as they represent the company's main revenue-generating activities. This range of offers can include both material products and services. The characteristics of a tangible product range include amongst other things its physicality, the storage options it offers (Holzbaur 2007), the external appearance of the product and the wrapping that surrounds the actual material product (Bruhn 2024).

This distinguishes them from service offerings, which generally have no physical substance and therefore for example cannot fulfill the criterion of preservability (Redler and Ullrich 2021).

Material product offerings and non-material service offerings can be offered independently of each other in the market, although these two types of offerings can also be mixed with each other (Raubold 2011). The importance of novelties in an entrepreneurial context cannot be overestimated. This is because it has a significant influence on the business basis and also on the activities of companies that build on it to promote their market presence (Marti and Puertas 2023). The origin of product novelties is either based on changes that take place on the demand side. These can be expressed, for example, through the

search for new or improved product solutions. Alternatively, advances in engineering can also contribute to the creation of new products (Homburg 2020).

However, in order to provide impactful activities in the area of novelties, organizations need to be aware of the assets available to them and use them in a targeted manner. The assets required for this can be located both inside and outside the business environment (Jiang, Yang, and Gai 2023). In the context of this study, the focus is mainly on innovations in the form of material products. The emphasis on material product innovations is significant because the results of scientific studies even suggest that innovations in the field of material products could be closely linked to corporate success (Lin 2018). The pursuit of economic success is therefore considered one of the most important driving forces for companies when it comes to creating and commercializing product innovations. A high degree of congruence between the specific market expectations and the product innovation on offer is seen as a fundamental factor for the success of the innovation (Vahs, Brem, and Oswald 2023). However, in addition to the functions and nature of the innovation, the sequence of the various activities that contribute to the creation of the product novelty are also among the aspects that can have a beneficial and positive effect on product innovations (Homburg 2020). Moreover, scientific studies suggest, with regard to the long-term success of companies, that both the ability to innovate gradually and the ability to make significant leaps in innovation are equally important (Forés and Camisón 2016).

Ultimately, however, introducing new products to the market allows companies to respond better to changing customer requirements and improve their own position on the market in the long term (Lin 2018).

2.2 Digital Technologies

In the recent past, digital change has gradually found its way into the world of business. The responsibility for this development is primarily to be found in the new technologies of digital origin (Brodny and Tutak 2022). In the context of digital-based technologies, a differentiated view is necessary, as this is not a specific technology, but in some cases very different solutions that are summarized under the generic term mentioned (Zhang and Li 2024).

The emergence of digital technologies is a cross-sectoral development that can support companies from a wide range of business fields (Holmström et al. 2024). In this context, even the specific characteristics of a company only play a subordinate role, as this development can affect all companies equally (Soluk, Kammerlander, and Darwin 2021).

The disruptions brought about by digital technologies are driving companies to rethink their current approach (Miller and Wang 2024). This is significant not least because the use of new technologies can create opportunities for future market projects (Trabucchi and Bughanza 2019). On the downside, the extensive development of digital technologies also means that companies could possibly be confronted with a number of unprecedented obstacles (Zou et al. 2024).

The use of technologies that have emerged in the course of digitalization facilitates companies' access to information. This can, for instance, give them the opportunity to understand the newly evolving needs of their customers better and earlier (Wang, Cao, and Cai 2024; Liu et al. 2023). In addition, digital technologies can under certain circumstances help companies to establish a connection with the demanders of the products they manufacture on a global level. At the same time, they can also offer companies the opportunity to involve demanders in their product development process in order to make the company's future product innovations more demand-oriented (Audretsch et al. 2023). However, the innovation creation process supported by digitalization is not only limited to cooperation with demanders. With the assistance of digital solutions, cross-company projects can also be launched with other market participants with the aim of generating innovations. Digital solutions provide considerable help, for example in the exchange within the framework of partnerships of different companies (Lafuente, Vaillant, and Rabetino 2023).

Moreover, there are already many positive statements in the scientific literature that there is a connection between increasing digitalization in the economy and novelties (Li et al. 2023). Further advantages can

result from the application of advanced and digitally enabled solutions, which also offer economy the opportunity to design the innovation process more economically (Liu et al. 2023). It is therefore also assumed that the use of these digitalization-based technologies can also influence the way in which companies create their novelties (Dana et al. 2022).

The digital twin technology makes it possible, for example, to create a virtual replica of a material product. This should make it possible to obtain data that can ultimately support the further development of the product in the real world (Timperi et al. 2023). However, it should be noted that the advantages gained through digital technologies can go hand in hand with an increase in challenges in the market, as the use of digital technologies in conjunction with electronic end devices can have a positive impact on the level of knowledge of all market participants on both the supply and demand side (Zare and Persaud 2024).

3 Research Approach

The approach chosen to examine and answer the research questions is based on the scientific methodology of systematic literature analysis. The reasons for this choice are, on the one hand, that this approach is a recognized technique in scientific studies and is particularly suitable for examinations in academic disciplines that are still under development (Ghorbani, Karampela, and Tonner 2022). On the other hand, it also offers the opportunity to engage intensively with the literature in a particular subject area in order to discover scientific fields that could be relevant for subsequent studies (Sauer and Seuring 2023).

Scopus served as the search interface for the literature search. This is partly because the Scopus data collection is considered established and trustworthy and therefore forms a good basis for the literature search, and partly because the data collection contains a significant amount of specialist literature that has been reviewed by experts before publication to ensure a certain level of excellence (Muritala, Sánchez-Rebull, and Hernández-Lara 2020).

This chapter is therefore organized as follows. First, the two research questions to be investigated in the scope of this study are presented and described in the following section. Subsequently, the second section of this chapter explains and describes the exact process of the literature search. In this context, both the query for the literature search and the selection criteria that limit the number of search hits are explained. In conclusion, the selected articles are presented.

3.1 Research Questions

The following two research questions form the common thread that runs through this paper. They also serve to structure this study and guide it in a goal-oriented manner.

The first research question deals with the subject of whether digital technologies can have an influence on the emergence of material product novelties. In connection with the first research question, the areas in which digital technologies can be used in the creation of material product innovations and how this use takes place will be investigated. In light of this, the first research question to be examined is formulated as follows: Do digital technologies have an influence on the creation of material product innovations?

The second research question, to the contrary, is concerned with the challenge of identifying and summarizing those digital technologies that are associated in the literature sources with being able to influence the development process of material product innovations. For this reason, the second research question to be answered is as follows: Which digital technologies can have an impact on the generation of material product innovations?

3.2 Systematic Literature Search

The systematic search for relevant scientific literature to examine and answer the two aforementioned research questions followed the subsequent procedure. In order to meet the requirements of a systematic literature analysis, the following section explains in a comprehensible manner how the search and the selection of literature sources included in this study were carried out (Lame 2019).

The first step was to start a search query based on selected key terms. The keywords used focused in particular on the aspects of digitalization, material products and innovations. Special care was taken to make the search query as open and wide-ranging as possible in order to be able to generate the highest possible number of literature sources for the topics of this paper.

The original search query that was used looked like this:

TITLE-ABS-KEY (digit* AND "material product*" OR "tangible product*" OR "physical product*" AND innovation*)

The aforementioned search query, which was launched using the Scopus literature search system, produced a total of 150 literature sources. This number of literature sources was narrowed down in the following process using various selection criteria.

The first selection criterion used in this context therefore relates to the age of the literature sources to be examined. Considering that the next stage of digital technology development has arguably only lately become the subject of research (Cho et al. 2023), this work has been aligned accordingly. For this reason, the period from 2019 to 2024 was set as the time horizon for the literature sources. As a result of this procedure, the total number of literature references was reduced by 61, bringing the total number of search hits down to 89.

The next assessment criterion was aimed at the scientific classification of the literature sources. It focused primarily on literature from the academic world that has a thematic proximity to companies. Therefore, the predefined field business, management and accounting of the Scopus database was selected. This reduced the number of literature sources by a further 63 sources, leaving 26 literature results.

The last step concerned the availability of literature references. The search was therefore limited to the fields gold and hybrid gold, which are also predefined by Scopus in its database. In consequence, this step also led to a decline in the total number of references by 20. In this way, six literature sources remained in the search. The review of the remaining literature sources revealed that all sources could be used in the literature analysis. Therefore, these six literature sources finally formed the basis for analyzing and answering the research questions in the following step.

Due to the selection process described above for determining the literature sources to be examined in the final literature analysis, the search text in the Scopus query changed as follows:

TITLE-ABS-KEY(digit* AND "material product*" OR "tangible product*" OR "physical product*" AND innovation*) AND PUBYEAR > 2018 AND PUBYEAR < 2025 AND (LIMIT-TO (SUBJAREA,"BUSI")) AND (LIMIT-TO (OA,"publisherfullgold") OR LIMIT-TO (OA,"publisherhybridgold"))

Hereafter, Table 1 provides an overview of the six selected literature sources.

Table 1: Overview of the literature sources used to address the research questions

Title of Article:	Authors:	Methodology:	Essential Conclusions:	Source:
Toolkits for innovation: how digital technologies empower users in new product development	Thomas Schäper; J. Nils Foege; Stephan Nüesch	“Two-stage laboratory experiment”	The outcomes of the paper indicate that the use of toolkits is more conducive to the development of new concepts for products than traditional prototyping. Specialists who are familiar with the process of creating novel items and have the necessary expertise have a greater chance of developing advanced product concepts. By using toolkits in the context of novelty creation, amateurs can be more productive in terms of creating novel product concepts than with the help of classic prototype fabrication.	(Schäper, Foege, and Nüesch 2024)
Growing with smart products: Why customization capabilities matter for manufacturing firms	Colin Schulz; Sebastian Kortmann; Frank T. Piller; Patrick Pollok	Questionnaire study and historical information	Digital competencies can have a beneficial effect on the capacity to make individual adjustments. They can give organizations the opportunity to differentiate themselves technically from competitive offerings. This process can be promoted by providing means for the inclusion of appropriate marketing and information-relevant types of transmission, which in turn can have a positive economic effect for the organization.	(Schulz et al. 2023)
Transitioning additive manufacturing from rapid prototyping to high-volume production: A case study of complex final products	Samuel Roscoe; Paul D. Cousins; Robert Handfield	“Longitudinal case study”	With regard to additive manufacturing, it can be assumed that this type of production can initiate fundamental changes in the creation of goods. However, in order to be able to use this procedure on a broad basis, it is necessary to adapt the corresponding requirements in the emergence of goods and in the technical workflow.	(Roscoe, Cousins, and Handfield 2023)

Behavior-Centered Digital-Twin Design for Dynamic Cyber-Physical System Development	Christian Stary; Matthes Elstermann; Albert Fleischmann; Werner Schmidt	“Case study”	Two key aspects were examined on the basis of various elements of the digital twin concept and a case scenario. Firstly, the integration of digital twin technology into an existing technological infrastructure and, secondly, its inclusion in the expansion of the infrastructure were considered and analyzed. This led to the conclusion that both of these aspects are considered necessary in order to both further support existing activities and take future developments into account.	(Stary et al. 2022)
Augmented reality is eating the real-world! The substitution of physical products by holograms	Philipp A. Rauschnabel	Analysis of “AR marketing and four studies”	Whether augmented reality will become more and more important and thus partially replace parts of everyday life could not be clarified in the course of this study. However, signs were found that people are not fundamentally averse to it.	(Rauschnabel 2021)
Modularity in making: simplifying solution space for user innovation	Hari Suman Naik; Albrecht Fritzsche; Kathrin M. Moeslein	“Case studies”	The investigations have shown that operators have based their configuration on standard market goods. By using affordable electronic components and production processes based on digitality, it was also possible to create connection options if required that can be used for manual interventions or to retrieve data. This approach also made it possible to gradually adapt and improve the shape. This changed the configuration approach so that the overall shape consists of fewer different individual components, but rather an ever-increasing overall concept, which also benefits the efficiency of the resources required.	(Naik, Fritzsche, and Moeslein 2021)

Own elaboration on the basis of (Schäper, Foege, and Nüesch 2024; Schulz et al. 2023; Roscoe, Cousins, and Handfield 2023; Stary et al. 2022; Rauschnabel 2021; Naik, Fritzsche, and Moeslein 2021)

4 Findings of the Literature Analysis

The knowledge gained from the sources is mainly aimed at answering the research questions, as they reflect the central themes or tasks of this study. The following chapter is therefore structured in such a way that the research questions are addressed in chronological order. This means that the first research question will be answered first in the following section, followed by the second research question in the second section.

4.1 Influence of Digital Technologies on Material Product Innovations

In the following section, the significance of digital technologies in the development of material product innovations is discussed with reference to the first research question on the basis of the results from the literature review. In this context, the phases in the product development process that can be influenced by the use of digital technologies according to the findings of the literature review are highlighted.

One option for companies that innovate material products is to involve potential customers more closely in the workflow when creating novelties. This approach is particularly favored by the support of digital technologies. Another way in which the use of digital technologies can have a beneficial effect on the creation of material products is by using them to create initial product samples. Their advantage is that they make it possible, for example, to transfer initial design proposals into physical samples without losing a great deal of time. In addition, digital technologies can help to reduce process steps by giving potential customers the opportunity to implement their suggestions and visions directly and to create corresponding product samples with the help of these technological solutions (Schäper, Foege, and Nüesch 2024).

However, digital technologies can not only be used to change the processes surrounding the creation of material product innovations. They can also become part of the products themselves and be integrated into them. As a result, the formerly purely material product can also acquire digital features. One of the main benefits of the digital properties of material products can be that companies can gain valuable insights into how they are utilized in everyday life. This in turn can give them the opportunity to update their product according to market demand (Schulz et al. 2023).

Furthermore, another area in which companies can benefit from digitally supported technologies is the external appearance of material product novelties. In this process step, the aforementioned technologies in particular can help to enhance the visual aspects of products (Roscoe, Cousins, and Handfield 2023). Another special feature of digital technologies arises from their ability to copy material products, for example, and to continue the duplicates of products in digitalized form in a digital reality. New paths can thus be opened up in the development of future products. This is because although the real product has long since been discontinued and is no longer marketed, it could be possible, for example, to use the values and data collected via the digital copy as part of a successor model or a new, material product. Under certain circumstances, this can help to save a lot of time, as future new product development projects can be based on a previous status and does not have to start from scratch (Stary et al. 2022).

The possible combinations between material products and digital technologies can be very diverse. A further way of bringing digital technologies and material products together, which can also promote the emergence of material product innovations, is to integrate digital technologies into the design or surface of new material products. For example, it could be possible to digitally change the external look of the otherwise material product to a certain extent. In this way, for instance, certain functions can be supported by giving the product surface an appearance or image that corresponds to the function (Rauschnabel 2021).

Linking digital technologies is another way in which the form of new material products, for example, can be influenced. For instance, the combination of different digital technologies can support operators

regarding the shape of material products by giving them response and thus enabling their progress. Overall, this development can help to facilitate the novelty process in shape and form (Naik, Fritzsche, and Moeslein 2021).

The results for the first research question are compiled in Table 2 below.

Table 2: Summary of findings on how digital technologies can influence the emergence of material product innovations

Sources:	Potential influence of digital technologies on the emergence of material product innovations:
(Schäper, Foege, and Nüesch 2024)	Product idea generation Creation of product samples
(Schulz et al. 2023)	Extension of the product functions Product relaunch activities
(Roscoe, Cousins, and Handfield 2023)	Expansion of the scope for creativity
(Stary et al. 2022)	Product successor measures
(Rauschnabel 2021)	Extension of the product functions Expansion of the scope for creativity
(Naik, Fritzsche, and Moeslein 2021)	Expansion of the scope for creativity

Own elaboration on the basis of (Schäper, Foege, and Nüesch 2024; Schulz et al. 2023; Roscoe, Cousins, and Handfield 2023; Stary et al. 2022; Rauschnabel 2021; Naik, Fritzsche, and Moeslein 2021)

4.2 Digital Technologies with an Impact on the Generation of Material Product Innovations

The digital technologies presented in the coming section can influence the creation of innovations according to the literature sources examined. They therefore represent a possible set of instruments that can also be used to modify and possibly also promote the emergence of material product innovations in particular. The digital technologies identified are summarized accordingly in the following Table 3, stating the respective literature source, and are intended to answer the second research question in the context of this study.

Table 3: Summary of digital technologies for impacting material product innovations

Sources:	Areas of application:	Types of digital technologies:
(Schäper, Foege, and Nüesch 2024)	In the area of implementation, as for example in the creation of novelties within the frame of product samples or alternatively in the involvement of potential customers regarding the novelty workflow of material products.	“additive manufacturing”; “computer-aided Design (CAD)”; “toolkits”
(Schulz et al. 2023)	In the field of customer demand identification and implementation. For example, in the development of hybrid products that have a material body and digital properties at the same time, or by gaining better insights into the use of products through the support of digital components in order to generate new impulses for the improvement or development of new products.	“smart products”; “cloud computing”

(Roscoe, Cousins, and Handfield 2023)	Applicability in the process of determining the external appearance of material product novelties.	“AI”; “big data”; “machine learning”; “additive manufacturing (AM)”
(Stary et al. 2022)	The development of new or improved products based on existing knowledge could be another possible area of application.	“digital twins”
(Rauschnabel 2021)	The creation of new or improved features of the product in conjunction with the product exterior could also represent a potential utilization scenario.	“augmented reality”
(Naik, Fritzsche, and Moeslein 2021)	The field of deployment can also extend to the shaping of new or improved forms in connection with the development of novel types of material products.	“3D printing”; “toolkits”; “online platforms”

Own elaboration on the basis of (Schäper, Foege, and Nüesch 2024; Schulz et al. 2023; Roscoe, Cousins, and Handfield 2023; Stary et al. 2022; Rauschnabel 2021; Naik, Fritzsche, and Moeslein 2021)

5 Conclusions and Recommendations

The results of the literature analysis indicate that the process of creating material product innovations can probably also benefit from the development of digital technologies. Though the influence of digitalization on material products is often associated in the literature with a loss of the physicality of material products (Magaudda 2011).

Nevertheless, it also became clear that there is a lack of a holistic approach to incorporating digital technologies in the improvement or new development of material products. The areas of application and digital technologies identified in the literature give the impression that they are rather fragmentary observations that have been developed either from the perspective of a specific application or from the perspective of one or more digital technologies.

In the course of the literary analysis, it rather emerged that the influence of digital technologies on material product innovations can take very different forms. The influence of digital solutions can have an indirect impact on the innovation sequence for material products, for example by enabling the company's customers to participate in the formation phase (Schäper, Foege, and Nüesch 2024). Alternatively, digital technologies can also have a direct impact on the development of new material products, for example by helping to shape their physical form (Roscoe, Cousins, and Handfield 2023; Naik, Fritzsche, and Moeslein 2021), affecting the partial design of the surface (Rauschnabel 2021), adding digital attributes to an analog product (Schulz et al. 2023) or enabling the digital preservation of knowledge about a product in order to make it easier to manufacture possible successor models (Stary et al. 2022).

In terms of the influence of digital technologies, a distinction can also be made as to whether it is only a single digital technology that is needed to bring about a certain change or whether certain digital solutions should be combined with each other so that innovative influences on the product can be realized in the best possible way (Naik, Fritzsche, and Moeslein 2021).

Understanding the task of product innovations in particular to mean that their creation also pursues the goal of successful marketing on the market and that they should also contribute to the company's success in this way (Agustia et al. 2022), it is noticeable that the relevance of digital technologies with regard to this understanding of product innovation tasks in the field of marketing is rather underrepresented in the literature sources examined. The results of the literature analysis indicate that the focus of scientific studies is more on the areas of product development and design than on their successful marketing.

These results of the literature analysis have suggested that the process of creating material product innovations can also benefit from the application and use of digital technologies in many ways. It would therefore be advisable for companies to take a closer look at the possibilities and potential benefits of

digital technologies in the development and marketing of material product innovations in particular, in order to seize opportunities that may not have been exploited to date. Companies from the manufacturing industry in particular should try to exploit these potential opportunities, as the provision of innovation solutions in the context of products can be an important aspect of shaping their own future (Na and Kang 2019).

The other advantages that digital technologies can offer companies lie in particular in improvements to existing business as well as production processes. An additional success factor of digital technologies can be found in the fact that they can help to make the process of obtaining market information less cost-intensive (Liu et al. 2023).

6 Limitations of the Study and Upcoming Research Areas

In conclusion, it should be noted that also this study is not free of restrictions. This is mainly due to the choice of method applied in this study, the way in which the literature sources were selected and the exclusive use of the selected literature database. Further constraints in this paper include, for example, the fact that no differentiation was made in this paper with regard to geographical characteristics, company size, markets or sectors. Furthermore, aspects relating to the requirements, hurdles and potential uncertainties of companies that could be associated with the introduction and use of digital technologies, as discussed for example in Tamvada et al. (2022), were not considered.

However, this study can provide valuable impulses for further research in the domains of digital technologies and material product innovations. This is because an in-depth examination of the literature revealed, for example, evidence that may indicate that the literature probably lacks a holistic view of digital technologies with regard to the generation of material product innovations. In this respect, future scientific research could help to shed more light on this process and take a closer look at it.

In view of the growing difficulties in generating innovative products, the use of digital solutions could possibly enable companies to exploit previously untapped potential in the creation of product innovations (Elverum and Welo 2015). In this sense, however, it would also be welcome if scientific research in this area were to deal more intensively with the support of digital technologies with regard to the marketing of material product innovations in the future, as the results of the investigation within this work have indicated that this area could be underrepresented in the scientific literature. In addition to the individual consideration of digital technologies, the interaction of different digital technologies should also be examined more closely and specifically with regard to their influence on innovation output.

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