

# Digital Maturity Models for SMEs: A Systematic Literature Review

Niccolò Ulderico Re, Antonio Ghezzi, Raffaello Balocco and Andrea Rangone  
*Politecnico di Milano, Department of Management, Economics and Industrial Engineering,  
Via Lambruschini 4B, 20156 Milan, Italy*

**Keywords:** Digital maturity, SMEs, Business Model, Business Model Innovation, Lean Startup, Literature Review.

**Abstract:** In recent years widespread digitalization is pushing enterprises to enhance their products and services and their value propositions. Digital transition requires companies to adapt their organization. Small and medium-sized enterprises (SMEs) lag behind larger firms when it comes to digitalization. Digital maturity models are a valuable tool for policymakers and academia to understand the state of the art of digitalisation of SMEs. However, these models too often have focused on large firms and manufacturing firms and have often adopted a narrow field of investigation. This study, through a systematic analysis of the literature, highlights the main contributions to the literature on digital maturity models of SMEs and proposes a framework for the analysis and classification of the main variables analyzed, in order to allow future research to build models of holistic digital maturity for SMEs.

## 1 INTRODUCTION

Over the past years, large firms have started to transform their business strategies, business processes, firm capabilities, products and services, and key interfirm relationships by integrating digital technologies in their processes (Bharadwaj, El Sawy, Pavlou & Venkatraman, 2013). Some are pretty much at the end of their roadmap, and they are increasingly able to offer high quality specialized products and services with less cost, resulting in lower prices (Trstenjak, Cajner & Opetuk, 2019).

Instead, due to the lack of resources and know-how, small and medium-sized enterprises (SMEs) are facing more difficulties taking full advantages of the new technologies and their potential (Amaral & Peças, 2021).

However, SMEs businesses are in serious risk due to the lack of economic, social, human, and organizational capital, and these limits are evidenced by their tiresome reaction to the challenges posed by the pandemic (Mandviwalla & Flanagan, 2021).

The pandemic has revealed the potential of digital technologies and their versatility, possibly also raising the awareness of SME entrepreneurs about digital topics. However, transformational processes pose substantial challenges, for instance due to the need to develop new capabilities within the firm (Soluk & Kammerlander, 2021).

Tools such as readiness or maturity models could be useful to guide SMEs in their digital roadmap, but the existing research rarely presents the proper perspective of SMEs (Mittal, Khan, Romero & Wuest, 2018), because it often disregards firm boundaries, industry, market competition and the network in which a SME operates.

The following research question will be addressed: which is the state-of-the-art of digital maturity models for SMEs? The objective of this research is to answer this question through a systematic review of the existing academic knowledge.

## 2 METHODOLOGY

### 2.1 Research Query Definition

The analysis of the scientific literature related to the measurement of SMEs digitalization was performed mainly on the Scopus database and it was carried out following a systematic approach. First, we defined a search query following the research scope, carefully selecting of the keywords with the help of some papers, in order to ensure the maximum coverage of the extant literature on the topic. Table 1 illustrates the query strategy.

Table 1: Research Query.

Phenomenon	(TITLE-ABS-KEY ( “digital maturity” OR “digital readiness” OR “digital transformation” OR “digitali?ation” OR “digi?ation” )
Purpose	AND TITLE-ABS-KEY ( “measur*” OR “assess*” OR “defin*” OR “framework*” OR “model*” OR “evaluat*” OR “index*” OR “level*”) OR “stage*” OR “phase*” OR “survey*” OR “case stud*” OR “journey*” )
Subject of interest	AND TITLE-ABS-KEY ( “sme*” OR “smb*” OR “small enterprise*” OR “medium enterprise*” OR “small business*” OR “medium business*” OR “small firm*” OR “medium firm*” OR “small and medium-sized enterprise*” OR “small and medium-sized business*” OR “small and medium -sized firm*” OR “small-medium enterprise*” OR “small-medium business*” OR “small-medium firm*” OR “small and medium enterprise*” OR “small and medium business*” OR “small and medium firm*” )

The query was defined looking for articles and conference papers written in English, and it was structured according to the main themes which constitute the research topic intended to cover. In particular, the keyword search was performed considering title, abstract or keywords and by grouping them into three main clusters:

- Phenomenon under investigation: digitalization process;
- Goal/purpose of the work: building up a structured way of measuring the phenomenon;
- Subject of interest: small and medium-sized enterprises (SMEs).

The phenomenon in Table 1 was described using five different but complementary keywords, identified through a preliminary scoping review. Concerning the first two, digital maturity and digital readiness, “readiness” and “maturity” are generally used interchangeably to represent the same set of concepts (Pirola, Cimini & Pinto, 2019). However, readiness is defined as “the state of being both psychologically and behaviorally prepared to take action (i.e., willing and able)” (Weiner, 2009), while maturity refers to “the state of being complete, perfect or ready” (Soanes & Stevenson, 2006). Hence, the two definitions are equivalent. Mettler (2011), instead, introduces the concept of evolution and states that, to reach a state of maturity, it is required a

progressive evolution in demonstrating a specific ability or in achieving a target, from an initial to a desired end. Singh, Kaur, Kaur and College (2015) argue that maturity relates to “the degree of formality and optimization of processes, from ad-hoc practices to formally defined steps, to managed result metrics, to active optimization of the processes”, introducing a third perspective.

However, the authors converge when discussing readiness assessment and maturity assessment.

Benedict, Smithburger, Donihi, Empey, Kobulinsky, Seybert, Waters, Drab, Farkas and Meyer (2017) state that readiness assessments are “evaluation tools to analyze and determine the level of preparedness of the conditions, attitudes, and resources, at all levels of a system, needed for achieving its goal(s)”. Using Holt, Armenakis, Field and Harris (2007) definition, “a readiness assessment aims to identify any risks, opportunities and potential challenges that might arise when change processes are implemented within an actual organizational context”. Furthermore, a readiness assessment provides an opportunity to address any gaps in the

existing organization either before or as part of the process of implementing planned changes (Holt et al., 2007) and it also “aims to identify any potential barriers to success, thereby allowing the organization to address them before beginning the change project” (Pirola et al., 2019). Instead, according to Mettler (2011), maturity models for maturity assessment are “models that help an individual or entity to reach a more sophisticated maturity level (i.e., ability) in people/culture, processes/structures and/or objects/technologies following a step-by-step continuous improvement process”.

Therefore, maturity models, like readiness assessment models, also help address the objective and impartial evaluation of a company’s position, as well as answer questions such as what needs to be measured and how to assign a specific stage or degree of maturity (Becker, Knackstedt & Pöppelbuß, 2009).

For this reason, the research considered both digital readiness and digital maturity models. As for the second triplet of terms – digitization, digitalization, and digital transformation –, according to the literature they describe different facets/phases of the same phenomenon. Although often used interchangeably, they account for interdependent but different phenomena.

Digitization: “It is the transformation of information into a digital representation” (Legner, Eymann, Hess, Matt, Böhmman, Drews, Mädche, Urbach & Ahlemann, 2017). “The technical process of converting analogue data into digital ones creating

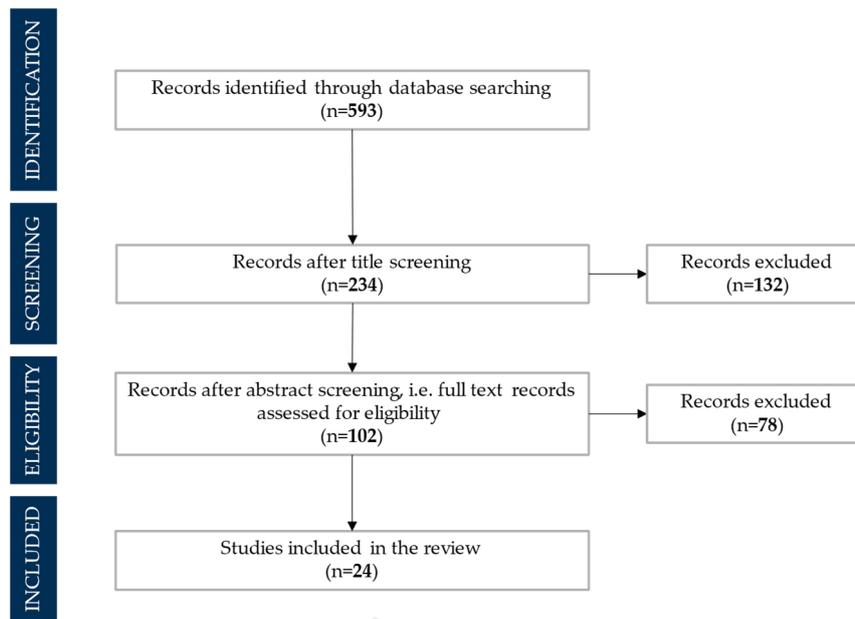


Figure 1: PRISMA flow diagram (Higgins, Thomas, Chandler, Cumpston, Li, Page & Welch, 2019).

data for information system and processing” (Autio, Nambisan, Thomas & Wright, 2018; Tilson, Lyytinen, & Sørensen, 2010; Verhoef, Broekhuizen, Bart, Bhattacharya, Dong, Fabian & Haenlein, 2021). Slightly different but still coherent is the definition of Park, Pavlou and Saraf (2020), which describe the phenomenon as the “firm’s effort and process to digitize its business processes by implementing, assimilating, and using information systems”.

Digitalization: “A paradigm, which has made information technology (IT) pivotal for competitiveness and customer satisfaction” (Mithas, Ali & Will, 2013). Fischer, Imgrund, Janiesch and Winkelmann (2020), Autio et al. (2018) and Tilson et al. (2010) define digitalization as a “socio-technical process” that sees the adoption of information and communication technology (ICT) as complementary to knowledge based-assets such as organizational and human capital (OECD, 2017).

Digital transformation: “As digital technologies connect people, things, and locations to generate and analyze large amounts of data, digitization and digitalization merge to become digital transformation” (Legner et al., 2017), which “alters communication and interactions between all stakeholders and reshapes the current economic, social, and political landscape” (Hansen & Sia, 2015; Holotiuk & Beimbom, 2017). In fact, Verhoef et al. (2021) acknowledge digital transformation as “the most pervasive and complex phase due to its multidisciplinary nature which involves changes in strategy, organization, information technology,

supply chains and marketing”. Rogers (2016) agrees stating that it “is fundamentally not about technology, but about strategy”. In summary, it can be defined as “the process of reshaping the business model of a company due to, and through, the adoption and use of digital technologies, in order to create a setting where new possibilities are enabled and value created” (Jeansson & Bredmar, 2019).

Even if it is difficult to identify a unique and common ground definition for each of these three phenomena, it is nevertheless possible to extrapolate a concept from the literature. They represent consequential phases of a path that, going forward, requires involving and taking into consideration more and more factors and stakeholders. This concept is well explained by Eller, Alford, Kallmünzer and Peters, (2020) which, referring specifically to the transition from digitalization to digital transformation, states that this adheres to the “adage of walking before you run”. However, once again, with the purpose of covering the whole research field was deemed necessary to insert all three terms within the query. For the sake of this research, we will adopt the digital transformation perspective.

## 2.2 Screening Process

Once extracted, the list obtained underwent a screening process (Figure 1) aimed at collecting the relevant articles strictly inherent to the topic. The selection was performed according to a three-step procedure. First, we carried out a title screening in

order to discard the results that were clearly not aligned with the research objective. 359 records were excluded. Example of papers not included are: “The Quality of Infectious Disease Hospital Websites in Poland in Light of the COVID-19 Pandemic” (Król & Zdonek, 2021), with a clear connection to health management, and “The Implications of Social Media on Local Media Business: Case Studies in Palembang, Manado and Bandung” (Maryani, Rahmawan & Karlinah, 2020) since there is a clear connection to marketing and communications.

The second step was to filter the records based on the abstract reading. 132 records were excluded, since they were not targeted to the objective of the research.

The remaining documents were subjected to a full-text reading for an eligibility assessment.

In order to support the screening process, we also assessed the relevance of each record in terms of:

- relevance of the source, looking at the H-index (SCImago);
- relevance of the article, considering three indicators: number of citations – collected from Scopus, Google Scholar, and Semantic Scholar, since these databases have different algorithms to count citations –, Field-Weighted Citation Impact (Scopus), and highly-influential citations (Semantic Scholar).

### 3 FINDINGS

According to Wendler (2012), maturity models are frequently multi-dimensional. From the qualitative assessment of the literature, it was possible to define some academic papers which have a relevant impact in this field. Starting from these papers it was possible to identify the major themes addressed by researchers in defining a maturity model or a readiness model from both quantitative and qualitative models. For this reason, we have reclassified the relevant dimensions and have summarized them in eight clusters.

Each theme is a cluster of several relationships between two dimensions that researchers have validated with their studies.

With the review of Eller et al. (2020), Jeansson & Bredmar (2019), Pirola et al. (2019) Zangiacomi, Pessot, Fornasiero, Bertetti and Sacco (2020), Del Giudice, Scuotto, Papa, Tarba, Bresciani & Warkentint (2021), Park et al. (2020), the purpose is to give a better description of the consolidated dimensions, from which it could be possible to

expand the existing knowledge and achieve a deeper comprehension of SMEs.

#### 3.1 Digital Strategy and Roadmap

Inside the cluster of digital strategy/roadmap we group relationships among digitalization and other dimensions related to the strategy of a SME. Jeansson and Bredmar (2019), Pirola et al. (2019), Eller et al. (2020), and Zangiacomi et al. (2020) agree to define the positive relationship between digital strategy and digitalization. Also the opposite is true: the lack of alignment between digital and business strategy gives a negative impact on digitalization and digital transformation (Jeansson & Bredmar, 2019), highlighting the absolute necessity of an established strategy for a successful digital roadmap.

From the studies, it emerges also that the capability of understanding which technologies suit best the business needs exert a positive influence on digitalization (Zangiacomi et al., 2020). The only way to identify the best solution is being aware of the goals that the SME want to achieve, therefore this subtheme is obviously anchored to the previous one.

A well-established roadmap could be implemented only with a well-established management, and Zangiacomi et al. (2020) also strongly underline this issue: the positive effect on digitalization that pilot projects bring to the company.

According to Zangiacomi et al. (2020), this approach to the digital roadmap is highly beneficial for the digitalization of companies, allowing the possibility of experimenting. Working with a test-by-doing approach is considered a best practice to develop a SME digital path, in a highly dynamic digital environment.

#### 3.2 Employee Skills and Culture

Also, this theme is pervasive: four out of six seminal papers (Jeansson & Bredmar, 2019; Pirola et al., 2019; Eller et al., 2020; Zangiacomi et al., 2020) analyzed the relationship among employee skill, company culture, and digitalization.

As for the previous theme, authors agree that the lack of management and knowledge, the lack of a shared organizational identity and culture exert a negative impact on the digitalization of a SME (Eller et al., 2020; Jeansson & Bredmar, 2019), highlighting the central role that information and know-how play for firms.

The human factor, through employee skills, is a priority for SMEs as organizations, and human resources play a key role for the implementation and

the achievement of a higher level of digitalization (Eller et al., 2020). Digital maturity requires employee skill and competences (Pirola et al., 2019), and firms could achieve a better level of digitalization investing in people and culture and sharing knowledge and best practice inside the organization (Zangiacomi et al., 2020).

People are the first users of the new technologies, and therefore they are the first source of feedback for SMEs. For this reason, helping employees to develop a critical approach is necessary to effectively implement digital projects and consequently, improving digital maturity (Pirola et al. 2019).

### 3.3 Organizational Flexibility and Adaptability

The third theme in the literature refers to the organization's ability to adapt. MNEs have always had an advantage over SMEs due to the greater resources they can devote to the introduction of enabling digital technologies (Del Giudice et al., 2021). However, the growing ascent of software-as-a-service allows firms to switch between technologies as needed, while remaining within a reasonable range of resources and time (OECD, 2017). This provides SMEs with an unprecedented opportunity to drive digitalization by developing scalable, high-quality IT infrastructures (Eller et al., 2020).

Nonetheless, organizational adaptability is required to reap the benefits of cost-effective implementation of digital options (Del Giudice et al., 2021). It affects the learning curve of the company (Del Giudice et al., 2021), requiring the organization to develop a dynamic and ever-changing set of capabilities in order to ensure business-IT alignment to rapidly sensing and responding to changing environments (Eller et al., 2020; Park et al., 2020). In accordance with the previous paragraph, this should happen through a progressive proactive involvement of human resources, aimed at gathering different perspectives and developing an integrated approach (Zangiacomi et al., 2020).

In summary, SMEs (and companies in a broader sense) should be able to pursue ambidexterity intended as “the ability to pursue both efficiency and flexibility while balancing exploitation and exploration” (Park et al., 2020). In fact, Del Giudice et al. (2021) consider it as a “measure of organizational agility and adaptability”.

The relatively small size and flexible structure could facilitate the creation of a shared code of positive values and norms that foster digitalization (Eller et al., 2020). Whereas large companies struggle

because of their structural complexity, inertia of existing processes, and bureaucratic formalities (Del Giudice et al., 2021).

It is evident that the relationship described so far is bidirectional and can create virtuous cycles. In fact, as stated by Park et al. (2020), IT systems enable seamless knowledge flows by facilitating the active participation and collaboration of employees, which in turn enhance the flexibility and speed of adaptation of an enterprise in volatile and ever-changing environments (Del Giudice et al., 2021).

As companies must continually adapt their business realities to deal with ever-changing market requirements, the models for evaluating them should also change accordingly. In fact, according to Pirola et al. (2019) modularity, understood as the ability to adapt to the needs and context of the company, has proved to be a key feature for providing a tailored assessment of SMEs digitalization.

### 3.4 Information Technology

Even if only few authors (Eller et al., 2020; Jeansson & Bredmar, 2019; Pirola et al., 2019) discussed the implication of the IT inside the SMEs, it is fundamental to underline that digitalization is initiated by specific technologies. According to Pirola et al. (2019), IT carries relevant weight in the digital transformation, and a critical analysis of the actual IT infrastructure of a SME should be the starting point of a digitalization roadmap. “IT is an umbrella term summarizing technological devices with computing capabilities that support decision making and organizational information processing” (Eller et al., 2020). This means that Information Technology is the heart of the digitalization, it is a key resource, it is an enabler that should be exploited from small and medium-sized enterprises to improve communication, collaboration and facilitate the development of digital infrastructure (Eller et al., 2020).

Hence both authors agree in stating that IT influences digitalization positively.

### 3.5 Integration

This cluster gives to digitalization a strong processes-oriented point of view. With the Integration theme, Pirola et al. (2019) and Jeansson & Bredmar (2019) define the relationship between digital maturity and process integration.

The researchers did not limit the discussion only to the simple positive correlation between these two dimensions but define process integration is a requirement of digital maturity (Pirola et al., 2019).

In this way, an implementation of a new technology or a new software inside the company cannot be considered the only goal to pursue in order to achieve better results related digital readiness, but SMEs should consider the horizontal implication among all the processes affected by the new technology and should try to exploit all the benefits that integration can bring to the firm (Jeansson & Bredmar, 2019; Pirola et al., 2019). Digitalization, considered as technology integration, influences positively information sharing and communication among different areas within the organization and other actors inside the supply chain (Pirola et al. 2019). It is for this reason that sharing information and data among processes is crucial to improve SMEs digital readiness, and companies could gain benefit in further digital projects.

### 3.6 Customers

This cluster contains all the evidence related the beneficial effect that digitalization gives to the customers. On the other hand, it is well known by SMEs that their customer is more and more digitally oriented, and they are ready to use and interact with digital system and tools; hence, customer orientation is a requirement for digital maturity (Pirola et al., 2019).

Digital tools open to a new way of communicating with customers and, thanks to this, SMEs are stimulated to develop digital project to better communicate their value proposition (Jeansson & Bredmar, 2019). Moreover, digitalization binged the competition to another level, and customers are becoming more and more demanding; this unstable context pushes SMEs to improve their processes and their capabilities, and, as stated by Jeansson & Bredmar (2019), this could positively influence the implementation of digital projects.

To achieve digital maturity, SMEs need to become customer oriented (Pirola et al, 2019), and digitalization could help to improve the communication with the downstream of companies supply chain (Eller et al. 2020).

### 3.7 External Environment

Firms which operate in highly competitive environments needs to take as much as possible advantages from all the resources available, hence Jeansson & Bredmar (2019) state that an unstable market and external pressures are positively correlated to the development of digital projects.

Digitalization is positively correlated to the achievement of better results in term of market competitiveness, market position, strategic advantages, and the development of new products and services (Jeansson & Bredmar, 2019).

Changes brought by exogenous events are another driver which influences positively the digitalization roadmap of SMEs (Pirola et al., 2019). The COVID-19 pandemic is the most recent case of such external push OECD (2020).

The external environment theme also includes a set of dimensions that are strictly related to digital maturity. Del Giudice et al. (2021) found that networking is crucial for SMEs to cover internal lack and knowledge gaps. SMEs with partners and strong networks should be considered better prepared to introduce a new technology rather than isolated SMEs. This is because a good network could help a small or medium-sized enterprise to overcome some of its constraints (e.g financial constrain and information asymmetries as in Mittal et al, 2018) bringing the company to another level of competitiveness. This relation is also confirmed in the work of Zangiacomì (2020).

### 3.8 Performance and Benefits

Performance and benefits are the last theme that has been extracted and reinterpreted by our review.

Potentially, this could enclose the drivers that SMEs firstly consider while they are assessing the introduction of a new technology inside the company.

Authors agreed that the impact on cost and efficiency are some of the most relevant benefits that small and medium-sized enterprises could achieve from digitalization (Eller et. al., 2020; Jeansson & Bredmar, 2019).

However, digitalization can bring several improvements also for the company measurement system – as observed by Eller (2020), allowing the introduction of real time data collection, and enabling better process optimization and better financial analysis. Authors found that data collection is a fundamental driver in a digitalized word (Pirola et al, 2019).

## 4 CONCLUSION, LIMITATION AND FURTHER RESEARCH AVENUES

The consequences of the preponderance of Industry 4.0 are reflected in the models extant in the literature.

In fact, most of the existing Industry 4.0 and Smart manufacturing models focus on internal dimensions while keeping less attention on external dimensions.

Furthermore, due to this approach focused on manufacturing, very often in the literature there is a too vertical approach in digital maturity models, which does not allow the development of all-inclusive models to study digital maturity.

Starting from the results presented in this article, future research works should try to validate the use of an all-encompassing digital maturity model through an empirical approach. Furthermore, in order to develop digital maturity models created ad hoc for SMEs, it is of fundamental importance for future research to analyze the specific context, internal and external, in which manufacturing and service SMEs operate, trying to grasp their peculiarities.

Finally, this work has some limitations. Firstly, the analysis was based on an extraction of papers from the Scopus database alone, secondly, only conference articles and newspaper articles written in English were analysed.

## REFERENCES

- Amaral, A., & Peças, P. (2021). SMEs and Industry 4.0: Two case studies of digitalization for a smoother integration. *Computers in Industry*, 125.
- Autio, E., Nambisan, S., Thomas, L. D. W., & Wright, M. (2018). Digital affordances, spatial affordances, and the genesis of entrepreneurial ecosystems. *Strategic Entrepreneurship Journal*, 12(1), 72–95.
- Bharadwaj, A., El Sawy, O. A., Pavlou, P. A., & Venkatraman, N. v. (2013). Digital business strategy: toward a next generation of insights. *MIS Quarterly*, 471–482.
- Becker, J., Knackstedt, R., & Pöppelbuß, J. (2009). Developing maturity models for IT management. *Business & Information Systems Engineering*, 1(3), 213–222.
- Benedict, N., Smithburger, P., Donihi, A. C., Empey, P., Kobulinsky, L., Seybert, A., Waters, T., Drab, S., Lutz, J., Farkas, D., & Meyer, S. (2017). Blended Simulation Progress Testing for Assessment of Practice Readiness. *American Journal of Pharmaceutical Education*, 81(1), 14.
- Del Giudice, M., Scuotto, V., Papa, A., Tarba, S. Y., Bresciani, S., & Warkentin, M. (2021). A Self-Tuning Model for Smart Manufacturing SMEs: Effects on Digital Innovation. *Journal of Product Innovation Management*, 38(1), 68–89.
- Eller, R., Alford, P., Kallmünzer, A., & Peters, M. (2020). Antecedents, consequences, and challenges of small and medium-sized enterprise digitalization. *Journal of Business Research*, 112(March), 119–127.
- European Union Commission. (2014). Official Journal. *Official Journal of the European Union*, 57(467), 216.
- Fischer, M., Imgrund, F., Janiesch, C., & Winkelmann, A. (2020). Strategy archetypes for digital transformation: Defining meta objectives using business process management. *Information and Management*, 57(5), 103262.
- Gavrila Gavrila, S., & de Lucas Ancillo, A. (2021). Spanish SMEs' digitalization enablers: E-Receipt applications to the offline retail market. *Technological Forecasting and Social Change*, 162(October 2020), 120381.
- Ghezzi, A., Renga, F., & Cortimiglia, M. (2009). Value networks: scenarios on the mobile content market configurations. In *2009 Eighth International Conference on Mobile Business* (pp. 35-40). IEEE.
- Ghezzi, A. (2012). Emerging business models and strategies for mobile platform providers: a reference framework. *info*, 14(5), 36-56.
- Ghezzi, A., Georgiades, M., Reichl, P., Le - Sauze, N., Di Cairano - Gilfedder, C., & Managiaracina, R. (2013). Generating innovative interconnection business models for the future internet. *info*, 15(4), 43-68.
- Ghezzi, A., Rangone, A., & Balocco, R. (2013). Technology diffusion theory revisited: a regulation, environment, strategy, technology model for technology activation analysis of mobile ICT. *Technology Analysis & Strategic Management*, 25(10), 1223-1249.
- Ghezzi, A. (2020). How Entrepreneurs make sense of Lean Startup Approaches: Business Models as cognitive lenses to generate fast and frugal Heuristics. *Technological Forecasting and Social Change*, 161, 120324.
- Hansen, R., & Sia, S. K. (2015). Hummel's digital transformation toward omnichannel retailing: key lessons learned. *MIS Quarterly Executive*, 14(2).
- Higgins, J. P., Thomas, J., Chandler, J., Cumpston, M., Li, T., Page, M. J., & Welch, V. A. (2019). *Cochrane handbook for systematic reviews of interventions*. John Wiley & Sons.
- Holotiuk, F., & Beimborn, D. (2017). *Critical success factors of digital business strategy*.
- Holt, D. T., Armenakis, A. A., Feild, H. S., & Harris, S. G. (2007). Readiness for organizational change: The systematic development of a scale. *The Journal of Applied Behavioral Science*, 43(2), 232–255.
- Jeansson, J., & Bredmar, K. (2019). Digital transformation of SMEs: Capturing complexity. *32nd Bled EConference: Humanizing Technology for a Sustainable Society*, Bled, Slovenia, June 16-19, 2019, 523–541.
- Jocevski, M., Arvidsson, N., & Ghezzi, A. (2020). Interconnected business models: present debates and future agenda. *Journal of Business & Industrial Marketing*, 35(6), 1051-1067.
- Kääriäinen, J., Kuusisto, O., Pussinen, P., Saarela, M., Saari, L., & Hänninen, K. (2020). Applying the positioning phase of the digital transformation model in practice for smes: Toward systematic development of

- digitalization. *International Journal of Information Systems and Project Management*, 8(4), 24–43.
- Klohs, K., & Sandkuhl, K. (2020). Digitalization of Small and Medium-Sized Enterprises: An Analysis of the State of Research. In *Lecture Notes in Business Information Processing* (Vol. 394). Springer International Publishing.
- Król, K., & Zdonek, D. (2021). The quality of infectious disease hospital websites in Poland in light of the COVID-19 pandemic. *International Journal of Environmental Research and Public Health*, 18(2), 642.
- Legner, C., Eymann, T., Hess, T., Matt, C., Böhm, T., Drews, P., Mädche, A., Urbach, N., & Ahlemann, F. (2017). Digitalization: opportunity and challenge for the business and information systems engineering community. *Business & Information Systems Engineering*, 59(4), 301–308.
- Mandviwalla, M., & Flanagan, R. (2021). Small business digital transformation in the context of the pandemic. *European Journal of Information Systems*, 30(4), 359–375.
- Maryani, E., Rahmawan, D. E. T. T. A., & Karlinah, S. I. T. I. (2020). The implications of social media on local media business: Case studies in Palembang, Manado and Bandung. *Jurnal Komunikasi: Malaysian Journal of Communication*, 36(1), 317–333.
- Mettler, T. (2011). Maturity assessment models: a design science research approach. *International Journal of Society Systems Science*, 3(1–2), 81–98.
- Mithas, S., Ali, T., & Will, M. (2013). How a Firm's Competitive Environment and Digital Strategy Posture Influence Digital Business Strategy. *Management Information Systems Quarterly*, 37(2), 511–536.
- Mittal, S., Khan, M. A., Romero, D., & Wuest, T. (2018). A critical review of smart manufacturing & Industry 4.0 maturity models: Implications for small and medium-sized enterprises (SMEs). *Journal of Manufacturing Systems*, 49(June), 194–214.
- Mittal, S., Khan, M. A., Romero, D., & Wuest, T. (2019). Smart manufacturing: Characteristics, technologies and enabling factors. Proceedings of the Institution of Mechanical Engineers, Part B: *Journal of Engineering Manufacture*, 233(5), 1342–1361.
- Mittal, S., Romero, D., & Wuest, T. (2018). Towards a smart manufacturing maturity model for SMEs (SM3E). In *IFIP Advances in Information and Communication Technology* (Vol. 536). Springer International Publishing.
- OECD (2020), "Coronavirus (COVID-19): SME policy responses", *OECD Policy Responses to Coronavirus (COVID-19)*, OECD Publishing, Paris.
- Park, Y. K., Pavlou, P. A., & Saraf, N. (2020). Configurations for achieving organizational ambidexterity with digitization. *Information Systems Research*, 31(4), 1376–1397.
- Pirola, F., Cimini, C., & Pinto, R. (2019). Digital readiness assessment of Italian SMEs: A case-study research. *Journal of Manufacturing Technology Management*, 31(5), 1045–1083.
- Rogers, D. (2016). *The digital transformation playbook*. Columbia University Press.
- Singh, S., Kaur, G., Kaur, P., & College, D. A. V. (2015). Importance of Testing Maturity Model.
- Sanasi, S., & Ghezzi, A. (2022). Pivots as strategic responses to crises: Evidence from Italian companies navigating COVID-19. *Strategic Organization*, 14761270221122933.
- Sanasi, S., Manotti, J., & Ghezzi, A. (2021). Achieving agility in high-reputation firms: Agile experimentation revisited. *IEEE Transactions on Engineering Management*, 69(6), 3529–3545.
- Soanes, C., & Stevenson, A. (2006). *Concise Oxford English dictionary* (Vol. 11). Oxford University Press Oxford.
- Soluk, J., & Kammerlander, N. (2021). Digital transformation in family-owned Mittelstand firms: A dynamic capabilities perspective. *European Journal of Information Systems*, 30(6), 676–711.
- Tilson, D., Lyytinen, K., & Sørensen, C. (2010). Research Commentary—Digital Infrastructures: The Missing IS Research Agenda. *Information Systems Research*, 21(4), 748–759.
- Trstenjak, M., Cajner, H., & Opetuk, T. (2019). Industry 4.0 readiness factor calculation: Criteria evaluation framework. *FME Transactions*, 47(4), 841–845.
- Verhoef, P. C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Dong, J. Q., Fabian, N., & Haenlein, M. (2021). Digital transformation: A multidisciplinary reflection and research agenda. *Journal of Business Research*, 122, 889–901.
- Weiner, B. J. (2009). A theory of organizational readiness for change. *Implementation Science*, 4(1), 67.
- Wendler, R. (2012). The maturity of maturity model research: A systematic mapping study. *Information and Software Technology*, 54(12), 1317–1339.
- Wendler, R. (2012). The maturity of maturity model research: A systematic mapping study. *Information and Software Technology*, 54(12), 1317–1339.
- Wyckoff, A., & Pilat, D. (2017). *Key issues for digital transformation in the G20*. Berlin: OECD.
- Zangiacomì, A., Pessot, E., Fornasiero, R., Bertetti, M., & Sacco, M. (2020). Moving towards digitalization: a multiple case study in manufacturing. *Production Planning and Control*, 31(2–3), 143–157.