A meta-model for formulating digital transformation strategies for SMEs: A knowledge management-based approach

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ABSTRACT

Digital Transformation (DT) is a new socio-technical paradigm that has been reshaping society. The intensification of the use of the most recent digital technologies has triggered the need for significant changes in organizations (e.g. educational institutions, physical commerce), and in their different organizational elements (e.g. processes, technologies, culture). In this context, the problem of small and medium-sized enterprises (SMEs) stands out. They have great value for social well-being due to their ability to generate work. However, they have a long way to go on the path to digital transformation, compared to large companies. Its specific limitations, such as the scarcity of financial resources and the lack of knowledge to deal with DT, accentuate this difficulty. This implies the need to know how to design a more effective DT strategy or process, which makes better use of its scarce resources and which strategically aligns them with the potential of digital technologies. Therefore, with an approach based on knowledge management and interdisciplinary research, the following research question was investigated: how to support SMEs to face challenges and take advantage of the opportunities brought through digital transformation? Therefore, under a systemic view of TD in organizations, a meta-model was proposed, which focuses on the strategic level and initiates the adaptation of business models, through cycles of adaptation and response to new external demands. As theoretical and basic foundations, the Cesm method, the Canvas Business Model, and the organizational resilience mechanisms were used, linked to the Seci knowledge spiral. As a methodological approach, systematic reviews of scientific articles, case studies and business reports were used, combined with the Design Science Research Process (DSRP). The adopted design involved iterative and collaborative steps of conceptual review and refinement of the constructed meta-model, which was subjected to conceptual review through the submission of articles and the analysis of two domain experts in DT. As a final result, the developed artifact is presented, which structures three phases to guide the TD process, focusing on the strategic level of organizations, also recommending steps and samples of support materials (examples of tools to assist TD). As delimitations, it is highlighted that the meta-model does not address elements inherent to the tactical and operational levels of organizations. As limitations, it is pointed out that larger and more diverse samples can be used in the future. Its practical implications are to guide SMEs, indicating where and how to start DT, using phases and steps to guide this process.. As future work, its instantiation in various sectors and organizations of different sizes is recommended, as well as the use of different tools, and measurement of long-term results.

Keywords: Digital Transformation, Strategies to implement Digital Transformation, Conceptual meta-model, Organizational resilience, Knowledge Engineering and Management, SMEs.

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INTRODUCTION

According to Weiss (2019), digital transformation (DT) can be understood as a socio-technical macro-process, resulting from a significant change in technological paradigms, essentially characterized by the migration from analog to digital forms of production. Its impact permeates various sectors of society, with information technologies and their continuous evolution as key protagonists of this new reality, promoting a culture where the use of digital technologies is increasingly intensive, and which reshapes people's behavior.

The origin of DT can be traced from the emergence of electronic computers and the birth of Computer Science, to the most recent advances in the field of information and communication technologies (ICT). According to Legner *et al.* (2017), the continuous evolution of computational scientific knowledge, through the constant miniaturization of *hardware*, increased connectivity, and storage and processing capacity, has been transforming not only its academic environment of origin with new research trends, but also several sectors of society. There is no shortage of illustrations of this impact, as can be seen in industry 4.0, in e-commerce platform models, in *smartphones and their* applications, in social networks, in the big *data phenomenon* and in the advancement of artificial intelligence, for example.

As an illustrative result of this new era, it can be highlighted that digital technologies have redesigned the hierarchy of valuable brands in recent decades, creating spaces for new entrants. A survey by Interbrands (TREVAIL, 2019), which has collected data since 2001, highlighted that business models based on digital technologies for innovation allowed classic and consolidated giants such as Coca-Cola and McDonalds to be overtaken in that period (2001-2019) by four IT companies (Apple, Google, Amazon and Microsoft). Not to mention the explosion of *streaming* services and *smartphone apps* (e.g., Uber, WhatsApp, etc.).

However, far from the reality of *big tech*, SMEs struggle to adapt to this new reality. In addition to its financial scarcity compared to large or giant ones, its limitations include a lack of digitally trained human resources, digital technologies themselves, management capacity, lack of strategic vision and knowledge management, and loss of tacit knowledge due to the loss of key employees to large companies (BRUSSEVICH; DABLA-NORRIS; KHALID, 2020 DURST; WILHELM, 2011; GARENGO; BIAZZO; BITITCI, 2005).

Among the inherent weaknesses of SMEs, this work focuses on the lack of strategic vision and knowledge to address DT. To address DT, it is necessary to understand knowledge as a key resource for the organization (*knowledge-based view*), and that therefore it is not enough just to acquire digital technologies, and that other factors are necessary to extract more value from its potential. Therefore, it is emphasized in this work that engineering and knowledge management have in their framework useful methods, techniques and tools to support the DT process in organizations.

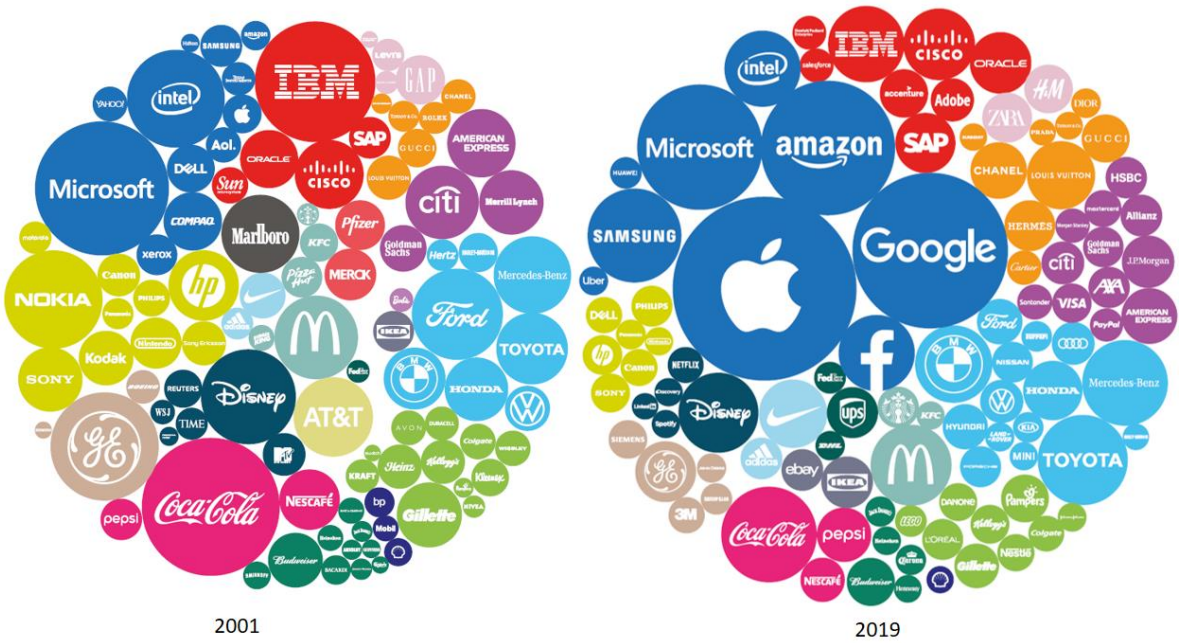
The triad of people (organizational culture), processes and technologies has been one of the pillars of the most recent KM studies (NEVES; VARVAKIS; FIALHO, 2018), and can be used as a starting point to model an artifact (meta-model) that guides the DT process, as well as studies that structure processes to better manage organizational knowledge, so that it promotes organizational innovation and resilience (NONAKA; TOYAMA; KONNO, 2000; VENZIN; KROGH; ROOS, 1998;VIAL, 2019).

Therefore, this work aims to present a meta-model, based on knowledge management, with a view to deliberating digital transformation strategies for small and medium-sized companies. A meta-model is presented that incorporates concepts and principles necessary to guide the development of strategies to guide the beginning of the digital transformation process, focusing on the specificities of SMEs. In other words, based on the vision, methods and techniques of engineering and knowledge management, it seeks to answer the following research question: how to support SMEs to face the challenges and take advantage of the opportunities brought by digital transformation?

THEORETICAL BACKGROUND

DT is a relevant and wide-ranging research topic, which arises in the technological field, but impacts society as a whole. According to Pacheco, Santos and Wahrhaftig (2020, p. 102), DT is a broad and disruptive phenomenon, characterized by a "[...] structural change in the means of production and services, caused by digital digitalization and engagement, of technological, economic, cultural, social and environmental impacts on individuals, organizations and regions". This phenomenon is a consequence of the evolution of computer sciences and their information systems (LEGNER *et al.*, 2017), which have revolutionized the *modus operandi* from various sectors of society, creating behaviors and, consequently, new demands for products and services (ARKAN, 2016; MAYNARD, 2015). For Legner *et al.*, (2017) DT can be better understood in three key moments: the popularization of personal computers, which began in the 1980s; the emergence of the internet and the future of the web as a global communication infrastructure (1990s); and the convergence of SMAC technologies – *social*, *Mobile*, *analytics* and *Cloud* In the form of Dsocial networks, the integration between machine learning (artificial intelligence) and the phenomenon *Big Data*, and in applications for mobile devices, making computing ubiquitous, and continuously and disruptively impacting important economic sectors of society (MAHRAZ; BENABBOU; BERRADO, 2019). In short, TD has been creating a new logic of consumer relations for some time, based on the most recent digital technologies of each era (PACHECO; SAINTS; WAHRHAFTIG, 2019), and it is no different now, triggering the need for studies that help to understand its nature (AIRES, 2020; LEGNER *et al.*, 2017; MAHRAZ; BENABBOU; BERRADO, 2019; PACHECO; SANTOS; WAHRHAFTIG, 2019; VIAL, 2019).

Illustrating the impact that TD has been having on society, it highlights its potential to recreate market hierarchies, displacing traditional brands and creating space for new entrants. Figure 1 summarizes this impact, through a survey of the most valuable brands in the world, comparing a cut made in 2001 to another in 2019. It shows the increased strength caused by business models based on digital technologies.



Source: Adapted from Trevail (2019, p. 6).

However, far from the reality of *big techs*, this work focuses on SMEs (Exhibit 1). Its specificities, such as its scarcity of financial resources, lack of strategy and gaps in specialized knowledge, make it difficult to respond to the challenges posed by DT. This choice is also justified due to its key role in the generation of work, and therefore of social well-being, in economies around the world, whether in industrially advanced or emerging countries (ROBU, 2013). In Brazil, they correspond to approximately 95% of the total number of companies in the industrial sector, producing approximately 42% of jobs and 22.5% of GDP (2011 average) (SEBRAE, 2014, p. 55).

Frame 1 – Classification of SMEs: size and sector

Postage	**Sectors**	
	Services and trade	**Industry**
Microenterprise	Up to 9 people occupied	Up to 19 people occupied
Small Business	From 10 to 49 people employed	From 20 to 99 people employed
Medium-sized business	From 50 to 99 people employed	From 100 to 499 employed persons
Large company	Over 100 people occupied	Over 500 people employed

Source: Sebrae (2020, p. 16).

According to Sebrae (2020, p. 6), SMEs produce about 30% of the country's wealth, which has grown in the last 35 years. The same report points out that SMEs are strategic to minimize the effects of economic crises, as they tend to lay off less. For example, between 2006 and 2019, SMEs showed a positive result in job creation, being responsible for the creation of about 13.5 million jobs, unlike medium and large companies, which closed about 1.1 million jobs in the same period.

METHODOLOGY

The present work has as its conceptual background a pragmatic view of research. According to Kinouchi (2007, p. 215), pragmatism is a philosophical view that is concerned with the practical consequences of the issues investigated. Pragmatism reflects the idea of searching for methods to address problems of practical utility (KINOUCHI, 2007, p. 215), aiming at the new systemic state, resulting from the application of previously constructed scientific knowledge.

Based on the objective of this work, it can be emphasized that it can be classified as a technological research, because it is the study of the design of technological artifacts, which generate artificial and not natural phenomena (CUPANI, 2006). In this case, it is understood that technological research is in the field of knowledge related to the planning, implementation, use, adjustments, maintenance and monitoring of artifacts in the light of scientific knowledge (BUNGE, 1985, p. 231). In this sense, technology approaches problems in a practice-oriented way, through scientific research (BUNGE, 1985, p. 237).

According to Hevner *et al.* (2004, p. 77), technological artifacts can be constructs (vocabulary and symbols), models (abstractions and representations), methods (algorithms and practices) and instantiations (the implemented systems or their prototypes). In this sense, the present research delivers a technological artifact that is close to the model definition of Hevner *et al.* (2004, p. 77), as it abstracts the results found in the literature, adding instructions for their instantiation. This artifact is classified as a meta-model, as it is built from the integration of different models of DT orientation for organizations, through an approach based on KM (knowledge management), which articulates KBV (*knowledge-based view)* and RO (organizational resilience) in the search for specific guidelines and tools for SMEs.

Therefore, it is understood that a meta-model is a model that consists of instructions modeled from other sets of models, which serve to guide the construction (instantiation) of new models themselves. For example, new business models and new management models that integrate guidelines from other sets of different reference models (JEUSFELD, 2009; CARDOSO *et al.*, 2012). In other words, just as models are abstractions of a reality, meta-models are abstractions of other models (JEUSFELD, 2009).

Therefore, as it was then an object of sociotechnical study, a pragmatic research approach was used (GOLDKHUL, 2004), applying the process model prescribed by DSRM (*Design Science Research Methodology*) (JUNIOR FREITAS *et* al.2017; PEFFERS *et al.*, 2007), which foresees ETPAS to be run in a cyclical manner, as described in Table 2:

Chart 2 – Research Process according to DSRM

Process Stage (DSRM)	**Description**	**Activities carried out to implement the step**
Problem Definition	Analyze and describe the problem, motivation, and justification, as well as emphasize the value of the solution. Know the current state of the problem and the importance of its solution (PEFFERS *et al.*, 2007).	**Exploratory research, through two systematic reviews**. **Systematic Review 1**: Digital Transformation, Society 5.0, Industry 4.0, SMEs, Challenges and Opportunities. Focus on scientific articles and reports produced by companies in the technology sector.
		Revisão Sistemática 2*: SMEs; Covid-19; response; opportunities; challenges; digital transformation; strengths; weaknesses; threats.* Improvement of the model, focusing on the development of specific DT strategies for SMEs, based on their reaction to the acceleration caused by the pandemic.
Solution Objectives	Infer the goals of the solution from the problem definition. Describe how a new artifact can support addressing the proposed problem (PEFFERS *et al.*, 2007). Incremental refinement of research objectives and problem.	**Inductive data analysis**: Meetings between the authors of this work.
Artifact design and development (part 1)	Create the artifact (meta-model) (HEVNER *et al.*, 2004). This activity includes determining the desired functionality for the artifact, its architecture, and then its implementation.	**Modeling (abstraction)** of the key elements to compose the meta-model. Inductive logic, based on the materials previously raised, through cyclical meetings with the advisor(s), producing an incremental advance in the artifact. **Application of the CESM method** (BUNGE, 1995) to systematize the abstraction of the key aspects of DT in SMEs.
Process Stage (DSRM)	**Description**	**Activities carried out to implement the step**
Artifact design and development (part 2)	At this stage, the conceptual review of the model under development consisted of the analysis and incorporation of *feedback* from external reviewers of the work. First, the initial abstraction of the key aspects for TD in SMEs was submitted to the congress (CiKi), which incorporated the indications for improvement given by the reviewers of the event. Then, after new evolutions of the model, with the structuring of the CESM for DT, the use of RO and the Canvas for the elaboration of strategies for SMEs, a version of the conceptual model was elaborated and submitted to the journal KPM – Qualis A2). The suggestions of the paper's international reviewers were also incorporated and improved the conceptual framework of the	**Conceptual revision** of the artifact, through submission to the CiKi congress (International Congress of Knowledge and Innovation). http://dx.doi.org/10.48090/ciki.v1i1.922 Main challenges and opportunities, first **abstraction of the key aspects for DT in SMEs**: initial digitalization, process efficiency, business intelligence, cultural resignification, business model review. **Communication of the results** through the **publication of the article** in the annals of the event.
		Conceptual review (external and international) of the evolved artifact. Submission to the journal *Knowledge Process Management* Wiley Online Library. https://doi.org/10.1002/kpm.1660 Application of CESM to the aspects abstracted in the previous step. After further readings, a conceptual model for a DT strategy was redesigned, focusing **on knowledge as the main element and on the review** of elements of the ***Canvas*** *Business model*. Use of engineering and knowledge management (**Seci**) and **organizational resilience mechanisms** (**monitoring, anticipation, learning and response**) as a basis. Notes from the journal's reviewers incorporated into the

	artifact.	model. Communication of results through the publication of articles and books.
Process Stage (DSRM)	**Description**	**Activities carried out to implement the step**
Artifact design and development (part 3)	This part continues the previous one, adding a conceptual review of the artifact under development, together with different domain experts. It involved presenting the artifact to two domain experts, for the incorporation of different contributions.	**Incorporation** of phases, steps and tools to guide future instantiation of the meta-model. **Conceptual Review via Doctoral Qualification Board**. **Conceptual review with two major domain experts** (in TD), who contributed their evaluations of the developed artifact. **Systematic Review 3**: search for practical guidelines for instantiation of the meta-model. Keywords*: 'digital transformation', 'SMEs', 'roadmap', 'steps', 'models',* 'meta-models', 'strategies', 'guidelines' and 'process model'.
Consistency and feasibility analysis with SMEs	Illustrate how the artifact can be used. It may involve its use in a real-world scenario, simulation, a case study, or another appropriate method. Important to describe the knowledge (resource) of how to use the artifact to address the problem. Results are detailed in the Consistency *Analysis chapter*.	**Demonstration of the phases and stages proposed for SMEs**. Verification carried out with a sample of four entrepreneurs from different sectors, who evaluated the possible contributions of the artifact. Limited sample size due to the difficult access and availability of entrepreneurs, given the post-pandemic and recession scenario. More details in the third chapter.
Communication (Publication of results)	Communicate in article publications the problem and its importance, the artifact, its usefulness and originality, as well as the rigor of the methods adopted and their effectiveness to researchers and other relevant audiences, such as professionals in the sector.	**Stage carried out after each of the two previous cycles, of design and development of the artifact**.
		Publication of an article in CiKi 2020. *Digital Transformation: challenges and opportunities for SMEs*, on the relevance of the problem and key aspects of DT in SMEs.
Process Stage (DSRM)	**Description**	**Activities carried out to implement the step**
Communication (Publication of results)	Communicate in article publications the problem and its importance, the artifact, its usefulness and originality, as well as the rigor of the methods adopted and their effectiveness to researchers and other relevant audiences, such as professionals in the sector. Results described in this chapter.	**Publication of an International Article (A2)** in the journal *Knowledge and Process Management*, v. 28, n. 2, p. 117-133, 2021, from the Wiley Online Library, "*COVID-19 crisis and SMEs responses: The role of digital transformation*", on the **articulation between engineering and knowledge management, organizational resilience and digital** transformation, along with a solution outline for developing an SME strategy (initial conceptual model). Currently with **395 citations**, the article appears on the **first page** of the Google Scholar search engine for the keywords: ***digital transformation, SMEs, organizational resilience***.
		Final publication (article/book) . Includes phases and steps for TD, review with domain experts, SMB demonstration, and final recommendations.

Source: adapted by the author from Peffers *et al.* (2007) and Júnior Freitas *et al* (2017)

As can be seen in Chart 2, different research procedures were implemented to instantiate the steps recommended by the DSRM. Systematic literature reviews and interviews with domain experts were conducted. Each phase was visited more than once, in a cyclical manner, according to the need for improvement, producing an incremental evolution of the meta-model.

Finally, the partial result of the work was submitted for publication in the International Congress of Knowledge and Innovation – ciki (KLEIN and TODESCO, 2020) and in the international journal of Qualis A2, *Knowledge and Process Management* (KLEIN and TODESCO,

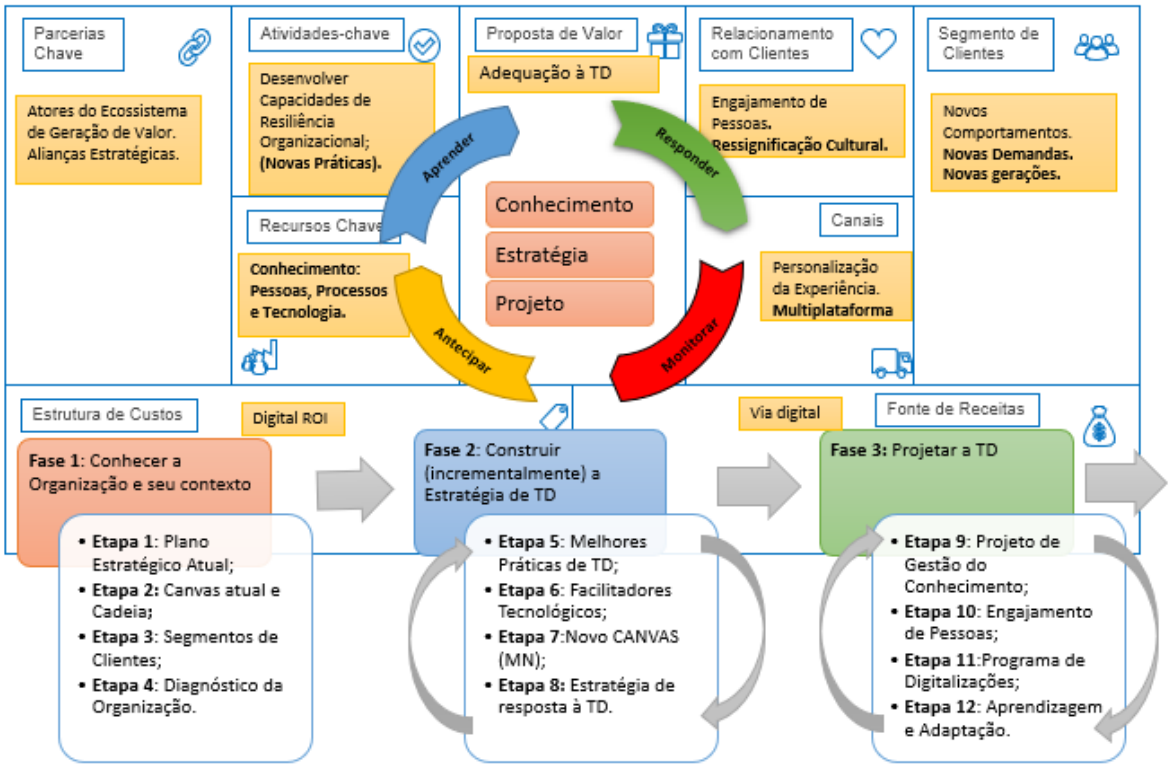
2021), whose reviews provided by the reviewers of the event and the journal were incorporated into the artifact, as well as the recommendations provided by the two domain experts interviewed, until it reaches its final version, presented below.

RESULTS

First, the general functioning of the artifact is explained, and then each of the three phases, of four stages each, is detailed.

OVERVIEW

The meta-model presented articulates the knowledge raised in the previous one, and seeks to present it in a more visual and clear way (Figua 2), and oriented to practice, to facilitate its implementation and absorption by SMEs. Three phases were structured, each recommending four (optional) steps, to be selected and implemented by its user, according to the context in which it is inserted.

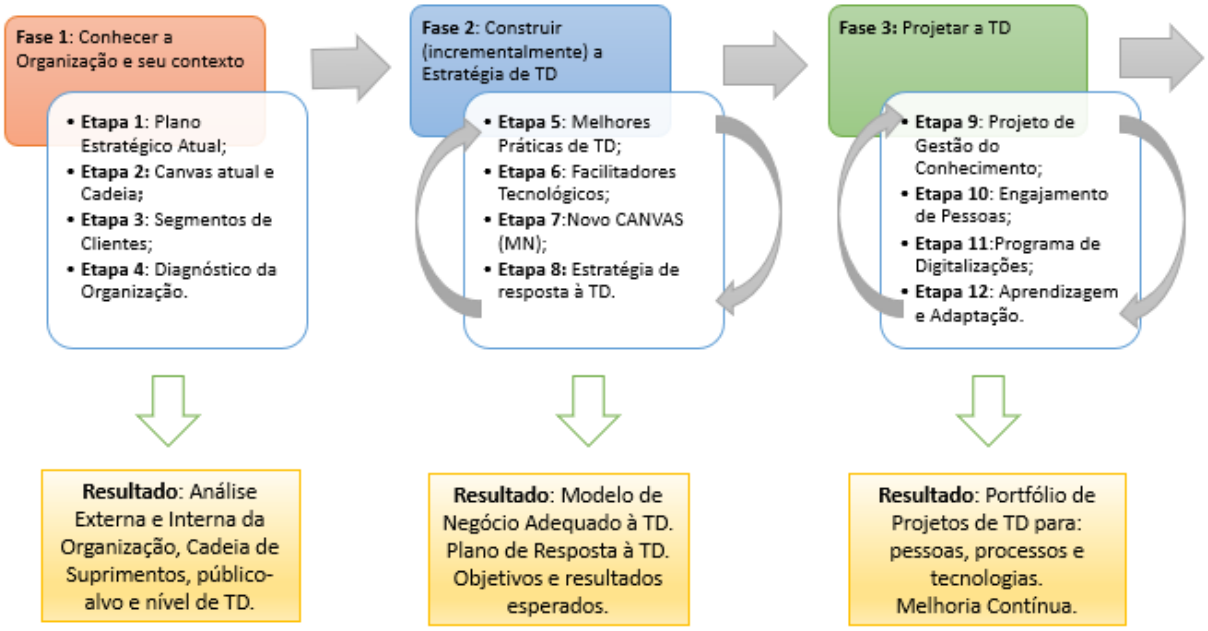


Source: prepared by the author.

As can be seen in figure 2, the guiding elements for the proposed meta-model are represented, using the structure of the *Canvas Business Model* (OSTERWALDER, 2004), with knowledge as a key resource for innovation (*knowledge-based view*) (CURADO, 2006 ; NONAKA; TOYAMA;

KONNO, 2000), which is the core of the organizational resilience mechanism (HOLLNAGEL, 2010).

To facilitate the understanding of this proposal, Figure 3 focuses on the sequential structure of the recommended phases and steps. Its structure is organized into three major phases, each with four stages, recommended support materials (tools), and expected results:



Source: prepared by the authors.

Below, each phase is detailed, as well as its stages.

PHASE 1: GET TO KNOW THE ORGANIZATION AND CONTEXT

The objective of this phase is to explain the knowledge related to strategic elements of the organization. The aim is to carry out a diagnosis of the strategic level that allows to know the organization and its key elements, as well as to have an influence on the construction of a specific strategy for DT. It seeks to analyze elements internal and external to the organization, such as the requirements of customer segments and partners in the supply chain, actors in the supply chain and the ecosystem as a whole (e.g., service providers, financing agents). The approximate level of digitalization is also estimated here, in order to identify the difficulties or the starting point for the DT project to be developed.

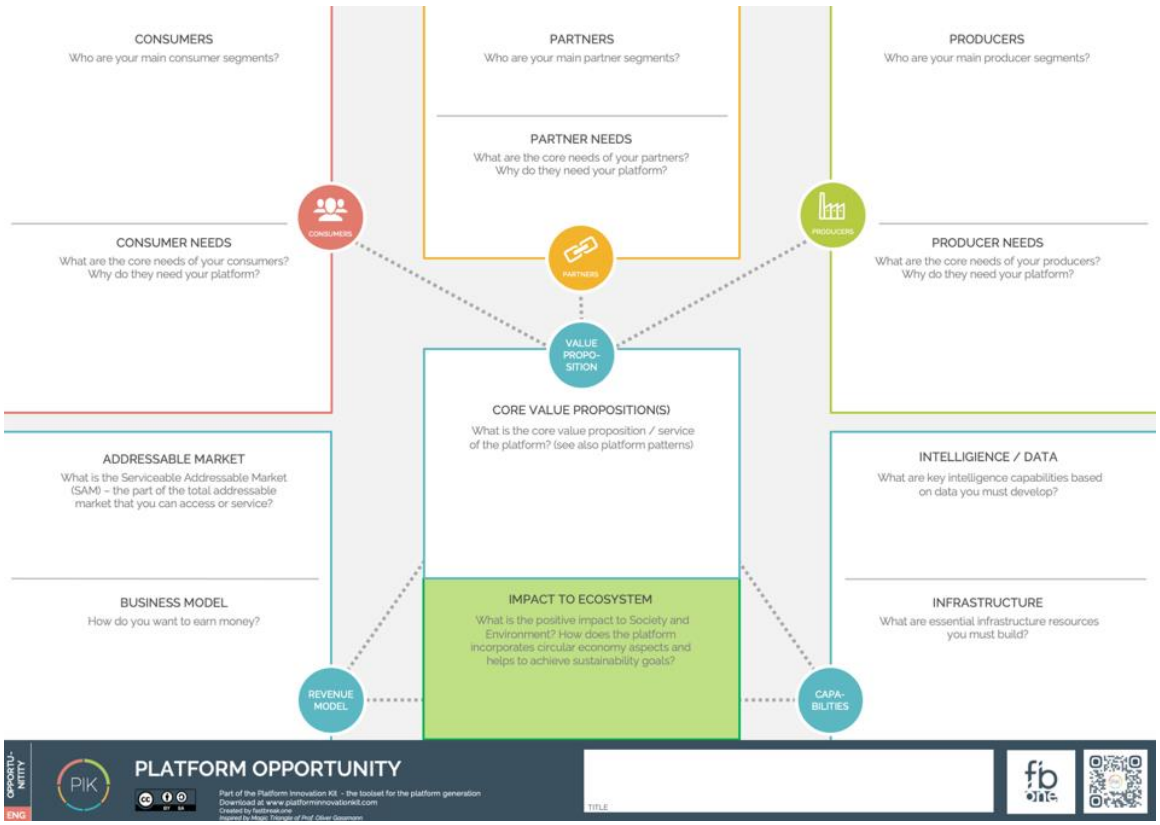
Phase 1 - Step 1: Know the current Strategic Plan

This stage aims to know the current (or absent) Strategic Plan in the organization in order to identify key attributes that may influence the ongoing DT project, inherent to the strategic level. It is

recommended to explain knowledge about the organization's current strategic planning. Its vision, mission, and values, its internal strengths and weaknesses, external opportunities and threats, as well as its strategic objectives, if any. In the absence of this last element, an initial outline is recommended that can provide a greater understanding of the organization, especially to elucidate the ideas and expectations for TD. As an illustrative sample of support materials, it is recommended to use strategic plan structures (artifacts), for example, that contain the definitions of vision, mission, values, SWOT analysis, and strategic objectives (SEBRAE, 2022).

Phase 1 - Step 2: Current Canvas and Chain

This stage aims to generate knowledge about the current business model as well as about the actors in the organization's value chain, expanding knowledge about the organization and its external context, about the mechanisms of value generation and the relationships between the components of the socio-technical system, which are the organization and its external environment. That is, more in-depth knowledge about each element of the business model and its environment must be generated. Extra-organizational (external actors, partners, suppliers) and intra-organizational (process management, value proposition) aspects should also be explained. In short, the internal production line (internal value chain) and the entire external value chain must be analyzed, mapping the main actors of the value-generating ecosystem, such as, for example, suppliers, development agents, service providers, technology suppliers and other actors in the innovation ecosystem in question. As support materials, it is recommended to use the Business *Model Canvas*. Another tool that facilitates the understanding of external elements can be the *Platform Opportunity* (Figure 3) (PLATFORM INNOVATION KIT, 2021), which has other canvases to facilitate the identification of the entire ecosystem involved.



Source: Platform Innovation Kit (2021).

As can be seen in figure 3, it is recommended to generate knowledge about elements of the environment external to the SME, such as the needs of partners (strategic alliances), their impact on society and the environment (natural resources used), how their value proposition relates to the other value propositions existing in the network of partners chain, and so on, always in the sense of rethinking the business model and its context, before choosing the technological solution.

Phase 1 - Stage 3: Customer Segments

This step focuses on emphasizing the importance of explaining the requirements of the customer segments, to understand what benefits are sought from the organization (personalization of the value proposition). From this initial stage, it is expected to guide the entire DT process in a customer-centric way, starting from an external perspective to carry out the internal transformation. Different classifications of customer requirements and studies in the marketing area can be used as support materials, such as: functional requirements (functionalities sought), economic (cost-benefit), logistical (ease of acquisition), emotional (experience offered) and social (social *status* obtained after acquisition) requirements (SCHALLMO; WILLIAMS, 2018).

Phase 1 - Stage 4: Diagnosis of the organization (level of scanning)

This step aims to carry out a diagnosis of the level of the organization in relation to DT. It seeks to estimate approximately the current level in relation to TD, so that it is possible to better know how to approach the project under development. Therefore, as an example of a tool to estimate the levels of digitalization, it is possible to use the Digital Quotient, from the *Care Framework* (ELANGOVAN; SESHADRI, SEETHARAMAN 2021), which classifies an organization's digital capabilities into:

- **Beginner**: basic digital capabilities, few new products, high cost of basic operations, and declining sales;
- **Optimizing**: digital capabilities optimize processes and the customer base is stable;
- **Accelerator**: digital capabilities improve the customer experience, products are improved, and there is revenue growth;
- **Disruptive**: Digital capabilities customize (personalize) and innovate products, the cost of operations is low, and future revenue projections are positive.

In addition, Chonsawat and Sopadang (2020) illustrate 23 SME-specific DT readiness indicators, which can serve as a complementary baseline. Here's a sample:

- Level of skill to deal with digital platforms;
- Percentage of customers reached via digital *marketing*;
- Level of cooperation with other partners in the SME network (e.g. number of partners, stages of the chain already integrated);
- Percentages of data collected, integrated, and analyzed in real time;
- Levels of knowledge possessed *versus* required to achieve each goal.

TD maturity models can also support this step. It is important to highlight that it is also recommended to raise the level of digitalization of partners (e.g., suppliers, service providers), as it may influence the TD result of the organization as a whole, as it tries to achieve interoperability between systems and logistics between partners in the chain (SCHALLMO; WILLIAMS, 2018).

PHASE 2: BUILD (INCREMENTALLY) THE TD STRATEGY

The goal of this phase is to build (incrementally) the TD strategy by improving the user experience and the new business model, suitable for TD. For this, the inputs generated in phase 1 (current strategy, current business model, analysis of the value generation ecosystem, customer segmentation, estimated level of TD), the functionalities of the technological enablers for DT (digital technologies) and recommendations of new practices for DT, to be made explicit, in order to think of new possibilities for the business model, are considered as a basis. as set out below.

Phase 2 - Stage 5: New DT Practices

This stage aims to identify new existing practices for DT, both in the scientific and business literature, that can have a positive impact on the business model (SCHALLMO; WILLIAMS, 2018). It raises what the SME needs to learn, to incorporate into its routines, after internally identifying the obsolete practices and routines to be discontinued **(organizational unlearning)** (NAVARRO; MOYA, 2005). The new practices raised in this stage serve as input for stage 7 (new Canvas). The specificities of each sector of activity of the organization in question, as well as its specific characteristics (SMEs), should also be considered.

According to Maire, Bronet and Pillet (2005), the term "best practices" or "good practices" can be associated with the choice of practices previously known and carried out by the organization itself, in order to make it more efficient. The term "new practices", on the other hand, is related to the possibility of externally identifying ways to more radically transform its key activities and value proposition.

For Schreier (2006), best practices are well known by a given community, with well-defined reference standards serving as a practical reference guide. However, new practices may already exist within the same community, usually being still poorly standardized and known, making the most well-known practices obsolete.

Practices may vary depending on the context of metamodel instantiation. There are generic practices, such as, for example, enhancing collective trust (organizational culture) (ELANGOVAN; SESHADRI; SEETHARAMAN, 2021) and create a *data-driven* culture (ARKAN, 2016), and more specific practices for SMEs in the industrial sector, for example, focusing on *lean manufacturing* and cyber-physical systems (SUFIAN *et al.*, 2021), use digital *marketplace platforms* (PLATFORM INNOVATION KIT, 2021) and cloud tools (LIU *et al.*, 2021), among others. Table 5 presents a recommendation of specific practices for SMEs, but which can be generalized to other organizations.

Table 5 – Sample of principles for TD in SMEs

Aspect	Principles	Authors
Initial Digitalization and Operational Optimization	Digitization and automation of key processes or parts of them is a prerequisite for initiating TD in organizations. This will allow routine tasks to be performed more efficiently and to generate data at the operational level, producing information about products, suppliers and customers for future analysis.	Legner *et al.* (2017); Erbert e Duarte (2018); Mahraz, Benabbou e Berrado (2019); Pelletie e Cloutier (2019); Levkovskyi *et al.* (2020); Pacheco, Santos e Wahrhaftig (2020); Sufian *et al.* (2021).
Security & Compliance	Develop a clear policy (transparency) for the use of individual/organizational data (e.g., customers and suppliers do not want their data shared with third parties or competitors, respectively). The protection of the **collected data** against cybercrime must be ensured to prevent leaks. Implement **legal compliance** (General Data Protection Law - LGPD). Seek technical standards and norms for the use of the data collected.	Choi and Sethi (2020); Legner *et al.* (2017); Erbert and Duarte (2018).

Business Intelligence	Extract information from the operational level to support decisions from the tactical/strategic level. Mine data to identify patterns and new demands. Gathering *insights* from the customer's experience with product/service. Seek personalization of the user experience (physical and digital).	Hoong (2013); Legner *et al*. (2017); Erbert e Duarte (2018); Göt'z e Jankowska (2018).
Cultural reframing: *data-driven*	Incorporate a culture of **data-driven** decisions *to* enhance the improvement or reinvention of products and services, as well as the business model as a whole. Seek digitalization and integration with other actors in the innovation ecosystem, the value chain (CHOI; SETHI, 2020).	Barann *et al.* (2019); Legner *et al.* (2017); Mahraz, Benabbou e Berrado (2019); Pelletie e Cloutier, (2019); Elangovan, Seshadri e Seetharaman (2021).
Cultural resignification: a culture that enhances innovation and engagement.	Complementing the previous item and seeking **ambidexterity** in addition to efficiency, creativity should be promoted through more flexible and friendly work environments (e.g., increased telecommuting, *happy hours),* which promote engagement and creativity. We should look for elements that enhance innovation, such as a culture of strong socialization and collective trust. Products and services must be **co-created** (PACHECO; SAINTS; WAHRHAFTIG, 2020) in an **open innovation** approach (CHESBROUGH (2017), through strategic alliances between SMEs (CEGARRA-NAVARRO, 2005).	E.g.: creating an emotional intelligence structure to enable organizational change (ELANGOVAN; SESHADRI; SEETHARAMAN, 2021).
Aspect	Principles	Authors
Focus on resources (SMEs) and Risk Management.	SMEs must carefully balance the resources spent on carrying out each action required for TD against their value creation proposition (LIU *et al.*, 2021). There is a risk of not obtaining the expected financial returns in time (Droi delay) (ERBERT; DUARTE, 2018). In addition, their scarcity of financial resources should lead them to seek the Risk **Management** area and the specific guidelines for SMEs (dependence on external financing, volatility in the prices of raw materials that hit them hardest, cyberattacks on local systems, dependence on the chain with few suppliers, growth risk and consequent increase in costs) (FALKNER; HIEBL, 2015).	Liu *et al.* (2021). Falkner and Hiebl (2015).
Cloud-first (PMEs)	Due to the lack of IT infrastructure and technological expertise, one possibility for SMBs is to pursue a cloud approach. Benefits: high reliability, availability, scalability and relatively low cost. Cloud computing and storage services can be subscribed to on a monthly basis, for example, and scaled according to needs, eliminating the costs of maintaining *hardware* and *software* infrastructure. However, there may be divergences between the requirements of the SMB and the services offered by the cloud provider. The following challenges stand out: dependence on internet connection (continuity of services), privacy and security (company data is stored by another) (QIAN *et al.*, 2009), external technical dependency, and the problem of ***vendor lock-in***, which means that if the SMB wishes to change cloud service providers, this task has proven to be extremely difficult (time and cost), due to the lack of compatibility between the different solutions of different cloud providers, proprietary architectures, lack of open standards and interoperability, and proprietary *software* licenses used (OPARA-MARTINS; SAHAND; TIAN, 2014).	Liu *et al.* (2021). Pelletie e Cloutier (2019). Quian *et al*., (2009). Opara-Martins, Sahandi e Tian (2014).
Social media	Consider the flow of **C2B communication** (from the customer to the organization). Social networks are an opportunity to mine *insights* from customers, as they create a new meaning in the communication process between consumers and companies, which can be beneficial. However, online viral reviews (eWOM) can cause serious reputational damage to businesses.	Göt'z e Jankowska (2018).
Emerging Technologies and Agile Methods	Continuously monitor emerging technologies, **review the business model** in light of this evolution and act in an agile manner. Rapid prototyping can facilitate constant improvement of the product or service through local testing and *user feedback*.	Erbert and Duarte (2018).
Aspect	Principles	Authors

Focus on the customer (*Customer-Centric*)	Orient the DT process with the customer as the protagonist, rethinking three elements: the transformation of customer experiences, the transformation of business processes and the reinvention of business models. The **transformation of** the customer experience must take into account the ability of digital technologies to collect *feedback* and personalize the product/service (PACHECO; SAINTS; WAHRHAFTIG, 2020), as well as the high demand of the new generations, who are increasingly digitized (digital natives) (MAHRAZ; BENABBOU; BERRADO, 2019).	"Customers are more demanding and expect companies to listen, understand and be flexible about their evolving needs." Mahraz, Benabbou and Berrado (2019).
Model Based on Digital Platforms	Consider the advantages of insertion in digital platforms or *marketplaces.* According to Pacheco, Santos, and Wahrhaftig, (2020, p. 98), business models based on digital platforms have generated phenomena such as dematerialization (i.e., exchange of acquisition for the use of goods) and disintermediation (i.e., reduction of intermediaries between products and beneficiaries). Although they have a more evident impact on the services sector (e.g., Uber, Airbnb), they have multisectoral potential.	***Marketplaces*** are being used to digitally transform entire industries and develop new sources of competitive advantage through the convergence of cloud, *big data, mobile,* and integrated partner networks (IDC, 2013). E.g. personalized advertisements, recommendation systems, better delivery logistics.

Source: prepared by the author.

For Maire, Bronet and Pillet (2005), among the approaches that can help a company improve its performance, *benchmarking* is one of the most used, as it can serve as an approach to obtaining and sharing knowledge, by analyzing the best practices in an industry and evolving them internally.

Also at this stage, it is highlighted that, in addition to learning new practices, it is necessary to consider the disposal of old ones. According to Navarro and Moya (2005), ineffective and obsolete organizational knowledge and routines block the absorption of new knowledge and opportunities. This is because, in general, when looking for KM processes, organizations focus on increasing their organizational learning, but not on the process of organizational unlearning (NAVARRO; MOYA, 2005; TSANG, 2008). Thus, organizational unlearning can be understood as a process in which outdated knowledge and routines are abandoned, with the aim of facilitating the absorption and development of better and new practices and cultures (NAVARRO; MOYA, 2005; ZHAO, 2013).

Phase 2 - Stage 6: Technology Enablers

This stage complements the previous one, as it aims to identify the technological enablers (digital technologies) of TD that can transform the business model. In the same logic as in the previous step, when instantiating this meta-model, a search for case studies, reports of technological trends and benchmarking should be carried out that can help to create an overview of the main technologies and compare them to the current business model (SCHALLMO; WILLIAMS, 2018). As supporting materials, examples can be seen in Erbert and Duarte (2018) or Sufian *et al.* (2021), which recommend and detail the possibilities of using current technologies for industry 4.0, such as:

machine learning (artificial intelligence) and *big data,* cyber-physical systems, internet (and industrial) of things, cloud and virtual reality. The idea of this step is to select a sample of possible technologies, and evaluate how they impact the organization's business model. For example, Artificial Intelligence (AI) is a variety of intelligent human behaviors, such as perception, memory, judgment, reasoning, communication, learning, forgetting, creating, and so on, that can be artificially performed by machines (LI; DU, 2017). Therefore, it is necessary to raise the impacts of AI considering the organization's current business model, as well as its value chain.

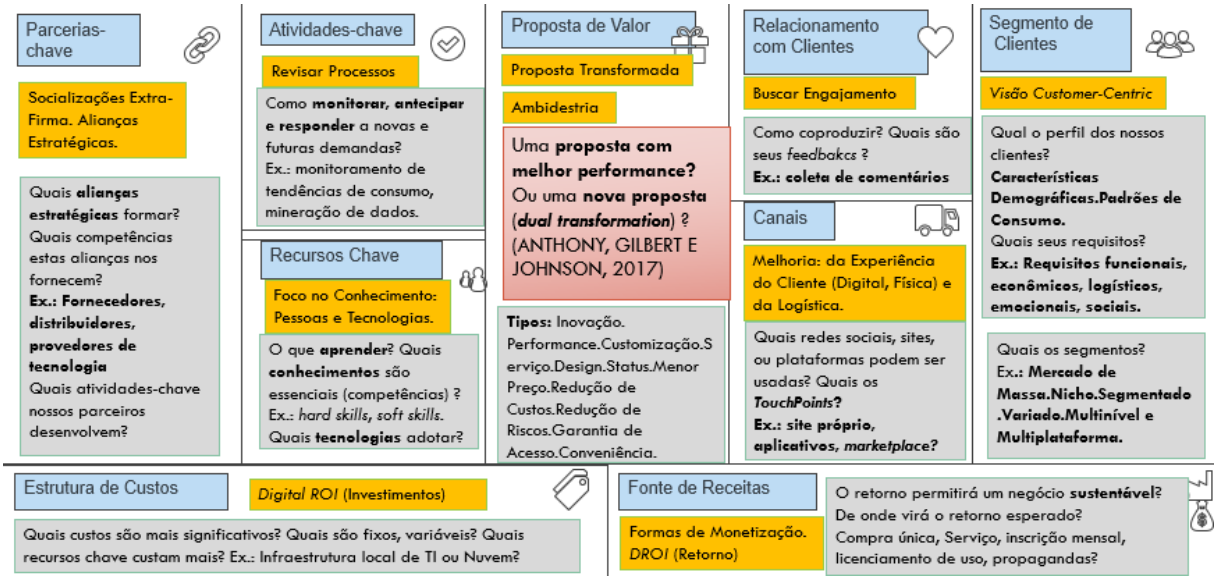
Phase 2 - Stage 7: New Canvas (MN)

This step aims to build a Canvas for TD (MN – business model), which reconfigures the organization's resources and key activities, to seek RO (organizational resilience), through a continuous flow of anticipation, monitoring, response and learning. It is recommended to consider the potential of the new practices and technologies raised in the previous stages, in such a way that the organization transforms its paths of value creation while managing structural changes and organizational barriers due to the impact of the latest digital technologies (VIAL, 2019).

It is recommended to monitor the environment external to the organization, that is, variables such as new customer behaviors, emerging digital technologies, and new best practices for DT, already raised above. Other variables can be added, such as new trade regulations (state) and market trends. Still in the external environment, especially for SMEs, due to their greater need to form alliances, partners should be monitored, in order to seek key partnerships (strategic alliances) to assist in internal knowledge gaps and form integrated logistics for the delivery of the value proposition (e.g., suppliers and delivery logistics).

Next, one must learn (internalize) the data and information collected about the external environment, transforming elements of the business model, such as processes (key activities), people (training, competencies), cost structures (e.g., considering training costs), and environment (e.g., customer-centric culture). These transformations will enhance an anticipation of significant changes in the external environment and will allow the organization's response, in the form of a new value proposition appropriate to DT, through new, more efficient and personalized delivery channels (effectiveness).

As a support tool, it is recommended to instantiate the *Business Model Canvas* for TD (Figure 6):



Thus, the purpose of this stage is to use all the knowledge raised in the previous stages about the value chain and its actors, about the requirements of the customer segments, the strategies and the business model of the organization, about the key concepts related to DT, its digital enablers (technologies) and the recommended principles, in order to then adapt the business model to this new reality. In particular, the functionalities and features of digital enablers and DT principles can be used to simulate new business model options (SCHALLMO; WILLIANS, 2018, p. 53), allowing performance improvement for the implementation of the value proposition or the creation of an entirely new proposal (ANTHONY; GILBERT; JOHNSON, 2017). For example, implementing self-service via *chatbot* on WhatsApp, inserting yourself in *marketplace* platforms, investing in augmented reality, among others.

As a complement to the support materials for this stage, we also recommend the RAD Model (*Run, Accelerate, Disrupt*), *Paths* (ELANGOVAN, SESHADRI and SEETHARAMAN, 2021) and the characteristics of digital business models (SCHALLMO and WILLIANS, 2018).

Phase 2 - Step 8: TD Response Strategy

This stage aims to develop specific strategic objectives for TD based on the new *Business Model Canvas*. Specific strategic objectives for TD should be made explicit, detailing the expected results. As seen above, one can separately or simultaneously (*dual transformation)* design business models that use digital technologies for two purposes: to improve the organization's performance (for a short-term response) or to create entirely new products and services, estimating long-term results. In other words, it is recommended at this stage to look for organizational ambidexterity as a culture to be sought. This concept rescues the importance of the balance between operational efficiency, through rigid and efficient processes; and creativity, through a flexible and exploratory culture (in the

sense of research and development, experimentation), which allows for the discovery of new knowledge and innovation (O'REILLY; TUSHMAN, 2008).

As support material, the agile OKR (*Objectives and Key Results*) method is recommended, aimed at promoting quick adaptations to constant changes, in shorter time intervals (CASTRO; MONTGOMERY; KARRER, 2018). The perspectives of the bsc (*balanced socred cards*) can also help to think about kpis (*key performance indicators*) for TD (Chart 3) (STALMACHOVA, CHINORACKY and STRENITZEROVA, 2018).

Chart 3 – Examples of strategic objectives for TD planning

Organizational Perspective	**Strategic Objective (TD)**	**Measure**
Financial Perspective	Reduce operating costs by utilizing technological advancements.	Share of ICT costs in total costs. Return on investment in ICTs.
	Increase revenue by offering new digital products and services.	Share of revenues from digital products and services in relation to total revenues.
Consumer/user perspective	Improve the availability of user service (cross-platform).	Number of mobile app downloads. Number of authentication *tokens* generated. Customer satisfaction with the mobile app. API response time.
	Attract new customers.	Rate (percentage) of attracting new customers through the use of ICTs. Customer satisfaction with new products and services.
	Reter existing customers.	Retention rate of existing customers.
	Improve the organization's interaction with the customer.	Customer satisfaction with service levels. Usability metrics, customer effort score (e.g., *Customer Effort Score*).
	Increase user engagement.	Engagement metrics (social media interactions, likes, shares, comments).
Organizational Perspective	**Strategic Objective (TD)**	**Measure**
Process Perspective	Digitize and Optimize processes.	Increase in the percentage of digitized processes. Total number of artifacts (e.g., official documents) articulated in digital format. Processes replaced by more efficient ones, using digital technologies.
	Improve the safety of processes and activities.	Number of attacks fried/blocked. Number of fraudulent transactions that occurred. Number of occurrence of leaked data.
	Introduce new digitized products and services.	Number of new digitized products and services introduced per year. New time to launch the product/service to the target audience.
Learning Perspective.	Provide continuing education to employees (face-to-face or remote).	Number of trainings completed per employee per year. Investment in employee training per year.
	Improve Employee Productivity.	Percentage of profit sharing. Bonus for solved tasks. Greater incentive for more complex, higher-impact tasks. Encouragement for sharing technical knowledge.
	Modernization of ICTs.	Increased investment in more modern ICT equipment.
	Increase employees' digital skills (e.g. digital literacy, new	Level of digital skills of employees. Complementarity between digital and non-

	programming languages).	digital skills (e.g., training in *hard* and *soft skills*.
	Create a digital culture and flexible work environment.	Level of employee satisfaction with ICTs used at work. Employee satisfaction with working hours and work shifts. Rate of use of modern communication tools (e.g. Slack, MS Teams, Google Meeting). Use of flexible ways of working (teleworking, reduction of hours). Degree of self-control and ability of employees to self-organize.

Source: adapted and translated from Stalmachova, Chinoracky and Strenitzerova (2018).

It is noteworthy that, when developing the strategic plan for DT in SMEs, it is necessary to consider its specificities, such as scarcity of resources and knowledge gaps (KLEIN; TODESCO, 2020).

PHASE 3: DESIGNING THE TD

The goal of this phase is to design the transformation based on the strategic objectives elaborated, and the new *Business Model Canvas* for TD.

In this phase, the optionality of each stage stands out, since each organization arrives at this stage with a different level of TD and strategic objectives.

For example, for TD projects aiming to pursue rapid digitalization, one can stick to a simpler digitization project, and engage the people needed to implement it. Now, for projects with larger objectives, it is recommended to also instantiate the "KM (Knowledge Management) Project" stage, to create a de facto ambidextrous culture, which seeks to generate innovation based on organizational knowledge.

Phase 3 - Stage 9: Knowledge Management (KM) Project

Organizational knowledge is an intangible asset that can be managed, and is essential to respond appropriately to changes in the business environment (SELL; FREIRE; TODESCO, 2020). Therefore, this stage aims to structure a KM program in order to create processes that allow the maintenance and expansion of competitive advantage. Therefore, KM processes must be implemented with a view to identifying, creating, storing, sharing and applying (accessing) knowledge in the different areas of the organization. For example, knowledge gaps should be mapped (e.g., training in the necessary technologies); preserve and minimize knowledge loss (e.g., key employees leaving); create elements that enhance innovation (flexible culture, *home office*); among other KM recommendations. As a support material, the *APO (*ASIAN PRODUCTIVITY

ORGANIZATION) *KM framework is recommended*. It indicates processes, methods, techniques, and tools for each of the five steps of its KM model (APO, 2020).

Phase 3 - Step 10: People Engagement

This stage aims to prepare the organization to understand the internal changes (cultural resignification) that enhance the implementation of DT. According to Burchardt and Maisch (2019, p. 113), in order to achieve the necessary engagement for DT, a cultural resignification must be sought in the organization. Organizations need to have a high degree of predisposition to change, great flexibility and self-management capacity of their employees, to respond to highly volatile and competitive environments, such as the labor market. In this regard, it is emphasized to seek continuous improvements in the *customer experience* and *employee experience*. According to Jain, Aagja and Bagdare (2017), CX has emerged in recent decades as an important *marketing* concept, being defined as a unique, pleasurable and memorable experience, the result of a strategic process to create value through differentiation and competitive advantage of products/services. On the other hand, employee engagement (*Employee Engagement* – EE), in addition to reducing turnover (and loss of tacit knowledge), increases the possibility of contributing ideas to innovation or improving process performance, which are important for competitive differential, as it is people who create such differential, since the same technology may be available to other organizations (CHANDANI *et al.,* 2016).

Teichert (2019, p. 1682) describes attributes that characterize an organizational culture focused on DT, using the term "digital culture", such as an organizational environment tolerant to failures, incorporation of new work methods, with leadership transparency, decentralized decision-making, and a focus on continuous improvement of the user experience, among others.

Phase 3 - Stage 11: Scans Program

This step recommends projecting an incremental advance in the use of digital technologies, from the operational to the strategic level, and among the actors in the supply chain, thus promoting the implementation of a culture of data-driven decisions. Therefore, an alignment between the strategic objectives, functionalities and characteristics offered by the different digital technologies should be sought, and the different levels of digitalization among the actors in the chain should be considered. It also involves identifying any knowledge gaps to deal with the technologies to be deployed, and developing a plan of competencies required. As support material, the following steps are recommended, based on Sufian et al. (2021) and Verhoef et al. (2021): 1 - basic connectivity (initial IT infrastructure); 2 - Information Systems for Vertical Integration (intra-organizational, between operational, tactical and strategic levels); 3 - Information Systems for Horizontal Integration

(extra-organizational, where partner systems, data from social networks and other possible external sources are integrated); 4 - Analytical Capacity (develop the competence to mine data to generate *insights*); 5 - Experimentation with emerging technologies (exploring new possibilities offered by new digital technologies).

Phase 3 – Stage 12: Learning and Adaptation (Organizational Resilience)

This last step aims to design a process of continuous improvement of the use of digital technologies in the organization. Thus, it aims to implement mechanisms for monitoring and adapting DT strategies, as well as learning about the deployment of the strategy, in order to ensure the adaptation of the organization to the new context.

According to Rosing and Etzel (2020), DT is a process whose life cycle needs to contain a phase of continuous improvement, to constantly meet new demands and possible new technological advances and different ways of using digital technologies. Such an approach should focus on innovation management, whose process needs to be continuous and integrated with other organizational processes, promoting the creativity of professionals, stimulating socialization and obtaining extra-firm knowledge (OLIVEIRA; OLIVE TREE; ZIVIANI, 2019).

As support material for the implementation of the post-TD continuous improvement phase, the guidelines for RO (organizational resilience) applied to TD are recommended, as follows:

- **Constantly monitor** critical changes in the internal and external environment. E.g., measuring the organization's performance indicators; monitor market demands, technological trends, digital technologies used by competitors;
- **Learn** the knowledge needed to deal with changes in the environment. E.g., develop the ability to understand customer segments based on their data, understand new demographics and their behaviors. Incorporate managerial and technological competencies inherent to the data-driven decision-making process: collecting, treating, analyzing, estimating consumption patterns and trends. E.g.: based on the use of the latest products, better estimate production quantities, avoiding waste and losses;
- **Anticipate** or prepare in advance for potential changes. Facilitate future response. E.g.: based on learning about the customer segment and constant monitoring of their demands, estimate new products/services that can be reinvented into totally new parts or products, starting as soon as possible the training with employees in the necessary technologies;
- **Respond** to changes in the medium. Actually implement the necessary adaptations, reacting to new demands. E.g.: optimization of processes and logistics, continuous improvement of products and services.

In addition to the continuous improvement based on the RO explained above, this step also recommends guidelines pointed out by other authors in studies on DT in society that may be important for maintaining long-term competitive advantage for organizations. As can be seen in the term 'Industry 5.0', as defined in the report for the future direction of European industry (EUROPEAN COMMISSION, 2021), 'Industry 5.0' is a complement to the existing 'Industry 4.0' approach, specifically putting research and innovation at the service of the transition to a sustainable, human-centred and resilient industry. For Deguchi *et al.* (2020), DT can be thought of as not only generating data for analysis and decision-making, but also serving the implementation of values that seek the difficult balance between individual and collective benefits, in the constant challenge of improving the quality of life, making use of technologies.

In addition to these recommendations, it is highlighted that DT is an opportunity to bring to light the environmental and social concerns inherent to the surroundings of the organizations in question. The triple ESG (*Environmental*, *Social* and *Governance*) indicators has gained attention in the industrial environment and in academic research (BASSEN; KOVÁCS, 2020; UMAR; KENOURGIES; PAPATHANASIOU, 2020), as it is a way to attract investments to organizations, and which can be desired by SMEs. The incorporation of the ESG concept implies the creation of data with relevant information about a company's performance in non-financial values (environment, social responsibility and governance), offering inputs to investors, who can thus better assess investment risks. As an example that can make investors aware of the risk that the absence of environmental concerns can cause, the literature in the area mentions the scarcity of raw material for manufacturing industries as a possibility of investment losses (BASSEN; KOVÁCS, 2020), just to illustrate one case among many.

CONCLUSIONS

The proposed meta-model is based on several notes in the academic literature and technical reports, which indicated the need for a strong strategic orientation to implement the DT process in any organization, as a step prior to mere technological adoption. Thus, in order to effectively pursue DT, the artifact proposed to support the transformation of different organizational elements, based on the triple processes, people (organizational culture) and technologies. In other words, DT was understood as a non-trivial process, which requires an interdisciplinary look for its better understanding. Through organizational ambidexterity, we seek to increase the resilience of organizations in the face of DT, which is a strong change in their external environment. Thus, with knowledge as a key element, the proposed meta-model helps to create strategies based on obtaining and applying the necessary knowledge to carry out the internal DT of organizations. With a focus on SMEs, it was possible to idealize a scenario of greater difficulty to implement DT, due to the scarcity

of resources, lack of strategic vision and managerial and technological knowledge. However, such adversities can be overcome with the recommendations of the proposed artifact, which is its main contribution. In the short term, the meta-model can serve for rapid digitalization, given the need for adaptation and response of each organization, recommending a strategic review and search for a digitalization project, for example. In the long term, its contribution is to monitor and promote a continuous improvement of the organization, focusing on a strategy based on the management of the knowledge necessary for better use of digital technologies, redefining the organizational culture, engaging people and generating positive implications both for the organization and for its surroundings, society and the environment.

REFERENCES

1. Arkan, Ç. (2016). *Digital transformation: seven steps to success*. [S. l.]: Microsoft. Disponível em: https://bit.ly/3MLwz04. Acesso em: 20 mar. 2020.

2. Brussevich, M., Dabla-Norris, E., & Khalid, S. (2020). Who will bear the brunt of lockdown policies? Evidence from Tele-workability Measures Across Countries. *IMF Working Paper*, (2020/088), 1-24. Disponível em: https://bit.ly/3Ro9mV7. Acesso em: 20 mar. 2020.

3. Bunge, M. (2003). *Emergence and convergence: qualitative novelty and the unity of knowledge*. Toronto: University of Toronto Press.

4. Cardoso, R., et al. (2012). O uso da ferramenta "metamodelo de gestão" na integração de múltiplos modelos de referência na modelagem da gestão organizacional. In *Simpósio de Engenharia de Produção Sustentabilidade na Cadeia de Suprimentos, 19*, Bauru. Anais [...]. Bauru: Sinpep. Não paginado. Disponível em: https://www.researchgate.net/publication/334520459_O_USO_DA_FERRAMENTA_METAMODELO_DE_GESTAO_NA_INTEGRACAO_DE_MULTIPLOS_MODELOS_DE_REFERENCIA_NA_MODELAGEM_DA_GESTAO_ORGANIZACIONAL. Acesso em: 20 mar. 2022.

5. Chonsawat, N., & Sopadang, A. (2020). Defining SMEs' 4.0 readiness indicators. *Applied Sciences, 10*(24), 8998. Disponível em: https://www.mdpi.com/2076-3417/10/24/8998. Acesso em: 20 mar. 2022.

6. Cupani, A. (2006). La peculiaridad del conocimiento tecnológico. *Scientiae Studia, 4*(3), 353-371. Disponível em: https://www.scielo.br/j/ss/a/STXgdYmmHXL4Qjcb5xYqrDm/?format=pdf&lang=es. Acesso em: 20 mar. 2020.

7. Curado, C. (2006). The knowledge based-view of the firm: from theoretical origins to future implications. *ISEG*, (1), jan. 2006. Disponível em: https://bit.ly/3P2GbW0. Acesso em: 20 mar. 2020.

8. Garengo, P., Biazzo, S., & Bititci, U. S. (2005). Performance measurement systems in SMEs: A review for a research agenda. *Wiley International Journal of Management Reviews, 7*(1), 25-47. Disponível em: https://bit.ly/3nVKBCk. Acesso em: 20 mar. 2020.

9. Goldkuhl, G. (2004). Meanings of pragmatism: Ways to conduct information systems research. *Action in Language, Organisations and Information Systems*, 13-26. Disponível em: https://bit.ly/3yYqeKR. Acesso em: 20 mar. 2020.

10. Hollnagel, E. (2010). How resilient is your organisation? An introduction to the resilience analysis grid (RAG). *Introduction to the RAG, DRAFT*, 1-7. Disponível em: https://bit.ly/3Rt5h1Z. Acesso em: 20 mar. 2020.

11. Durst, S., & Wilhelm, S. (2011). Knowledge management in practice: insights into a medium-sized enterprise's exposure to knowledge loss. *Prometheus, 29*(1), 23-38. Disponível em: https://bit.ly/3yZvE8M. Acesso em: 20 mar. 2020.

12. Elangovan, P., Seshadri, S., & Seetharaman, P. (2021). 6B Model for Business-Aligned Digital Transformation. *IT Professional, 23*(5), 17-22. Disponível em: https://www.researchgate.net/publication/355257596_6B_Model_for_Business-Aligned_Digital_Transformation. Acesso em: 20 mar. 2022.

13. Hevner, A. R., et al. (2004). Design science in information systems research. *MIS Quarterly, 28*(1), 75-105. Disponível em: https://www.jstor.org/stable/25148625. Acesso em: 20 mar. 2020.

14. Jeusfeld, M. A. (2009). Metamodel. In *Encyclopedia of Database Systems* (pp. 1727-1730). Springer. Disponível em: https://link.springer.com/referencework/10.1007/978-0-387-39940-9. Acesso em: 20 mar. 2022.

15. Junior, V. F., et al. (2017). Design Science Research Methodology Enquanto Estratégia Metodológica para a Pesquisa Tecnológica. *Revistas Espacios, 38*(6), 25.

16. Kinouchi, R. R. (2007). Notas introdutórias ao pragmatismo clássico. *Scientiae Studia, 5*(2), 215-226. Disponível em: https://bit.ly/3RskCQt. Acesso em: 11 jul. 2022.

17. Klein, V. B., & Todesco, J. L. (2020). Transformação digital: Desafios e oportunidades para PMEs. In *Congresso Internacional de Conhecimento e Inovação, 10*, Ciudad del Saber. Anais [...]. Florianópolis: UFSC. Não paginado. Disponível em: https://proceeding.ciki.ufsc.br/index.php/ciki/article/view/922/493. Acesso em: 20 mar. 2022.

18. Klein, V. B., & Todesco, J. L. (2021). COVID-19 crisis and SMEs responses: The role of digital transformation. *Knowledge and Process Management, 28*(2), 117-133. Disponível em: https://onlinelibrary.wiley.com/doi/full/10.1002/kpm.1660. Acesso em: 20 mar. 2022.

19. Legner, C., et al. (2017). Digitalization: Opportunity and challenge for the business and information systems engineering community. *Business & Information Systems Engineering, 59*(4), 301-308. https://doi.org/10.1007/s12599-017-0484-2. Disponível em: https://bit.ly/3yZWRrF. Acesso em: 20 mar. 2020.

20. Mahraz, M., Benabbou, L., & Berrado, A. (2019). A systematic literature review of digital transformation. In *International Conference on Industrial Engineering and Operations Management, Toronto, Proceedings [...]* (pp. 916-931). IEOM. Disponível em: https://bit.ly/3Rpuaf0. Acesso em: 20 mar. 2020.

21. Neves, M. L. C., Varvakis, G. J., & Fialho, F. A. P. (2018). Pessoas, processos e tecnologia na gestão do conhecimento: uma revisão da literatura. *Revista de Ciências da Administração, 51*(20), 152-167. Disponível em: https://periodicos.ufsc.br/index.php/adm/article/view/2175-8077.2018v20n51p152. Acesso em: 20 mar. 2022.

22. Osterwalder, A. (2004). *The business model ontology: a proposition in a design science approach* (Doctoral dissertation, Universite de Lausanne). Disponível em: https://bit.ly/3c2CFfP. Acesso em: 20 mar. 2020.

23. Pacheco, R. C., Santos, N., & Wahrhaftig, R. (2020). Transformação digital na Educação Superior: modos e impactos na universidade. *Revista NUPEM, Universidade Estadual do Paraná, Campo Mourão, 12*(27), 94-128. Disponível em: https://bit.ly/3yBYpqA. Acesso em: 20 mar. 2020.

24. Platform Toolkit Innovation. (2022). Tools & Guides. [S. l.]: Platform Innovation Kit. Disponível em: https://platforminnovationkit.com/. Acesso em: 18 set. 2022.

25. Peffers, K., et al. (2007). A design science research methodology for information systems research. *Journal of Management Information Systems, 24*(3), 45-77.

26. Schallmo, D. R. A., & Williams, C. A. (2018). History of digital transformation. In D. R. A. Schallmo & C. A. Williams (Eds.), *Digital Transformation Now!* (pp. 3-8). Cham: Springer.

27. Nonaka, I., & Takeuchi, H. (1991). The knowledge-creating company. *Harvard Business Review, 85*(7-8), 162. Disponível em: https://bit.ly/3OfKfkR. Acesso em: 20 mar. 2020.

28. Robu, M. (2013). The dynamic and importance of SMEs in economy. *The USV Annals of Economics and Public Administration, 13*(1-17), 84-89. Disponível em: https://bit.ly/3AK1k3a. Acesso em: 21 jul. 2021.

29. Sell, D., Freire, P. de S., & Todesco, J. L. (2020). Entregável 1 – Implantação do Modelo UCR na UNIPRF, PRODUTO 2 – Modelo de Gestão do Conhecimento Elaboração do Modelo de Gestão do Conhecimento da PRF (subproduto 04). Material não publicado.

30. Serviço Brasileiro de Apoio às Micro e Pequenas Empresas. (2014). *Participação das Micro e Pequenas Empresas na Economia Brasileira*. Sebrae, Brasília. Disponível em: https://www.sebrae.com.br/Sebrae/Portal%20Sebrae/Estudos%20e%20Pesquisas/Participacao%20das%20micro%20e%20pequenas%20empresas.pdf. Acesso em: 18 set. 2022.

31. Trevail, C. (2019). Top Brands of 2019. *Interbrand*. Disponível em: https://bit.ly/3PpgjDN. Acesso em: 21 jul. 2021.

32. Vial, G. (2019). Understanding digital transformation: A review and a research agenda. *Managing Digital Transformation, 28*(2), 118-144. Disponível em: https://www.sciencedirect.com/science/article/abs/pii/S0963868717302196. Acesso em: 20 mar. 2022.

33. Weiss, M. C. (2019). Sensored society: the society of digital transformation. *Advanced Studies, 33*(95), 203-214. https://doi.org/10.1590/s0103-4014.2019.3395.0013. Disponível em: https://bit.ly/3nWTcVl. Acesso em: 20 mar. 2020.