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Digital Transformation Framework

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Abstract

Technological pressures forced organizations to undertake digital transformation initiatives. Due to the increasing demand by business leaders, several consulting firms and researchers have developed maturity assessment models for digital transformation. However, these models, among others, do not explain the research process underlying their design and lack scientific validation. Furthermore, the process angle of the research is often overlooked in the context of digital transformation. To address this gap, we propose a staged digital transformation capability maturity model framework that enables organizations to assess their present digital capability based on processes and establish a plan of improvements to guide them towards higher digital capability level. This framework was developed using a design science research approach, building on the ISO/IEC 330xx family of standards to provide structure to a set of digital transformation processes identified using a systematic literature review. At a time when companies look for orientation to navigate their digital transformation, the contribution of this thesis is a framework, from a process perspective, rooted in solid scientific concepts, to guide practitioners on how to assess digital transformation initiatives.

Keywords

Digital Transformation; Capability Maturity Model; Framework; Process Reference Model; Process Assessment Model; Systematic Literature Review; ISO/IEC 330xx family of standards.

Resumo

Pressões tecnológicas forçaram as organizações tomar iniciativas de transformação digital. Devido à crescente procura pelos líderes empresariais de como conduzir uma transformação digital, várias empresas de consultoria e pesquisadores desenvolveram modelos de avaliação de maturidade para a transformação digital. No entanto, esses modelos, entre outros, não explicam o processo de pesquisa subjacente ao seu desenho e carecem de validação científica. Além disso, o ângulo do processo da pesquisa geralmente é ignorado no contexto da transformação digital. Para abordar essa lacuna, propomos uma estrutura de modelo de maturidade de capacidade de transformação digital em etapas que permite que as organizações avaliem sua capacidade digital atual com base em processos e estabeleçam um plano de melhorias para guiá-las em direção a um nível mais alto de capacidade digital. Foi desenvolvido usando uma abordagem de pesquisa em ciência do design, com base na família de padrões ISO/IEC 330xx para fornecer estrutura a um conjunto de processos de transformação digital identificados usando uma revisão sistemática da literatura. No momento em que as empresas buscam orientação para navegar em sua transformação digital, a contribuição desta tese é uma estrutura, de uma perspectiva de processo, enraizada em sólidos conceitos científicos, para orientar os profissionais sobre como avaliar as iniciativas de transformação digital.

Palavras Chave

Transformação digital; Modelo de capacidade de maturidade; Estrutura; Modelo de processo de referência; Modelo de avaliação de referência; Revisão sistemática da literatura; Família de padrões ISO/IEC 330xx.

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Acronyms

CEO Chief Executive Officer

DSRM Design Science Research Methodology

DT Digital Transformation

PAM Process Assessment Model

PRM Process Reference Model

SLR Systematic Literature Review

1

Introduction

Initiatives using digital technologies as an enabler have been continuously studied and implemented by organizations in recent years, mainly due to the increasing demand from customers for added-value products and services delivered in a faster and more convenient way [7]. Besides this, the persistent increase of digital technologies capabilities impacted several and different industries, leading to endless challenges. The rapid pace of innovation, the competitive dynamics within industries, and the opportunities and threats created by new digital technologies, fundamentally changed the firms' environment [8] [9].

New digital technologies have a growing impact on an organization's activities due to the significant increase of computational power, storage volume capacity, and processing, which allows the organizations to make better decisions, enrich operational excellence and provide customers with an engaging experience. Consequently, one of the biggest challenges and problems facing companies today, is the integration and exploitation of digital technologies [10]. The incorporation and consolidation of IT strategies and business strategies derive from the concept of "digital business strategy" [11] [12].

Despite the added value that a digital business strategy can represent, it only futuristically describes business opportunities and strategies for companies that are partially or completely surrounded by digital technologies, lacking the transformational insights to achieve the desired to-be states [12]. The same author defines Digital Transformation (DT) strategy as "a blueprint that supports companies in governing the transformations that arise owing to the integration of digital technologies, as well as in their operations after a transformation" [12]. Henceforth a simplistic working definition of DT – the use of new technologies that change the way companies operate, bringing significant business improvements – is adopted until we present a new, more elaborated one (in section 4.1).

Thus, appropriate DT is required as a core strategy for most organizations to compete and survive [13]. Its success represents an utmost for organizations and the implications for those who do not do it is the disruption from the competitors.

Competitive pressures and new markets rank as the main drivers of DT, revealing "the urgency within companies to optimize and innovate". "Companies surveyed in 2017 are simultaneously experiencing increased competitive pressure (54.2%) and growth opportunities in new markets (46%)". These ranks take a relevant contribution to the attention given to DT, considered as the primary concern of corporate leaders in 2019 [14]. Decision-makers seem to be aware of this situation and spend a great deal of money on DT initiatives, although without achieving a positive return on investment. In fact, "70% of all DT initiatives do not reach their goals" and "of the $1.3 trillion that was spent on DT last year, it was estimated that $900 billion went to waste" [15]. Data suggests that companies considered to be of superior digital maturity, in addition to integrating new digital technologies more effectively and efficiently in their platforms, retain a larger number of customers by offering engaging experiences to increasingly demanding customers [16] [17].

Moreover, relentlessly, disruptive innovation performed by incumbents and new entrants have caused the falling out of traditional enterprises that were not capable of reinventing themselves in this new digital ecosystem. Besides the fact that DT is a new buzzword, garnering enough attention from top management, as well as, being widely considered to be one of the CEOs' top concerns, the current state of research indicates that may still exist a shortage of scientific material to address this issue [18] [19] [20]. A literature review performed by Gerster which consisted of an analysis of 2,833 articles "published in eight leading IS journals between 2007 and 2016 reveals that a mere 0.2% addressed the impact of DT on IT while 2.3% cover topics of DT, innovation, or digital technologies" [18].

Paradoxically, regarding the lack of scientific articles addressing the subject of DT, a study conducted by Fitzgerald [21] stated that 78% of respondents advocate that "achieving DT will become critical to their organizations", but 63% "said the pace of technology change in their organizations is too slow". Furthermore, in another study, 90% of respondents "anticipate that their industries will be disrupted by digital trends to a great or moderate extent, but only 44% say their organizations are adequately preparing for the disruptions to come [22].

Hence, the focus of this thesis consists of creating a process reference model and a process assessment model which together form the DT framework. Performing a systematic literature review represents the first step in order to create a process reference model by identifying those processes that are closely related with DT. After designing the process reference model, the next step will be the process assessment model whose objective is to assess the capability maturity level of each process encountered by a specific company and then provide some actionable recommendations to support that company in achieving the next digital maturity level. Once the foundation of the framework components is built and well established, we will test the adoption of the framework in a real case scenario, in order to validate our proposal. Note that the DT framework is not to be considered as a final product, rather it should be viewed as a guide that can (and should) be customized to match the actual needs of the company in question. This proposal represents a new DT framework in a structured way following key processes identified in the literature.

2

Research Methodology

Contents

Guidance for some aspects of DT has been fulfilled through recent academic work, however, “it has not addressed a holistic approach to the development of a company-wide digital transformation strategy” [23]. Our purpose consists of carrying out a research methodology, composed by design science research (described in section 2.1) and systematic literature review (described in section 2.2), that can contribute with a holistic approach to guide companies in their DT strategy.

2.1 Design Science Research

In this ongoing process to develop the framework, we used design science research methodology (Design Science Research Methodology (DSRM)). The reason behind the adoption of this methodology over other options is related to our aim, which is to create an artefact that intends to meet the organization’s needs regarding the DT. The main objective of design science research is to offer guidelines that enrich the articulation of a scientific proposal by means of artefacts to a specific problem that is intended to be solved. The fundamental principle intrinsic to the design science research paradigm is the “knowledge and understanding of a design problem and its solution are acquired in the building and application of an artefact” [24]. Peffers et al. proposed a synthesis of the elements that DSRM should contain by creating a process model that resulted in the following 6 activities [1]:

1. Problem identification and motivation - Define the specific research problem and justify the value of a solution.

2. Define the objectives for a solution - Infer the objectives of a solution from the problem definition and knowledge of what is possible and feasible.

3. Design and development - Determine the artefact’s desired functionality and its architecture and then creating the actual artefact.

4. Demonstration - Demonstrate the use of the artefact to solve one or more instances of the problem.

5. Evaluation - Observe and measure how well the artefact supports a solution to the problem. This activity involves comparing the objectives of a solution to actual observed results from use of the artefact in the demonstration.

6. Communication - Communicate the problem and its importance, the artefact, its utility and novelty, the rigor of its design, and its effectiveness to researchers and other relevant audiences such as practicing professionals, when appropriate.

The activities described above are represented in the correct order of approach and adopted as a means of an iterative process according to a problem-centered initiation, as shown in 2.1.

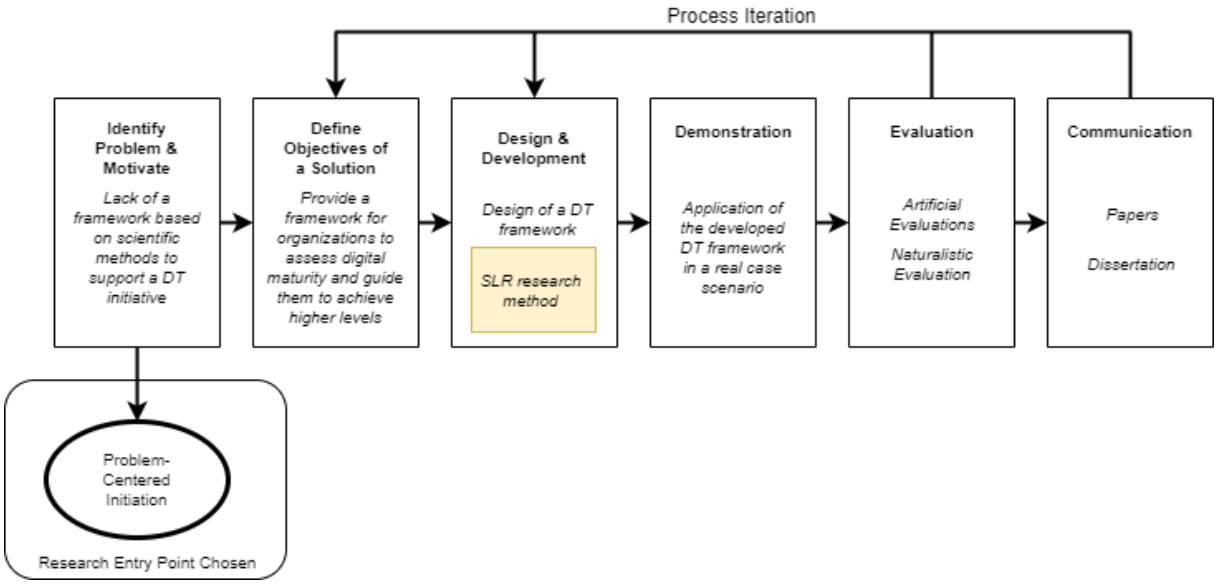

Figure 2.1: DSRM Process Model. Adapted from [1].

The additional research method inside the design development phase – Systematic Literature Review (SLR), Systematic Literature Review - was incorporated with the purpose of achieving a higher reliable result when trying to identify processes related to DT. The method and the associated procedures are described step by step in the section below.

2.2 Systematic Literature Review

A systematic literature review incorporates several procedures that seek to ensure a rigorous and accurate research in order to obtain relevant information through empirical studies produced in a certain domain. A straightforward definition of systematic literature is provided by [25] - “a systematic review is a means of evaluating and interpreting all available research relevant to a particular research question, topic area, or phenomenon of interest. Systematic reviews aim to present a fair evaluation of a research topic by using a trustworthy, rigorous, and auditable methodology”. Systematic literature reviews “are primarily concerned with the problem of aggregating empirical evidence which may have been obtained using a variety of techniques, and in (potentially) widely differing contexts” [2]. In contrast to a simple and traditional review of the literature, systematic literature review presents some differentiating features such as [25]:

- Systematic reviews start by defining a review protocol that specifies the research question being addressed and the methods that will be used to perform the review.
- Systematic reviews are based on a defined search strategy that aims to detect as much of the

relevant literature as possible.

- Systematic reviews document their search strategy so that readers can access its rigour and completeness.
- Systematic reviews require explicit inclusion and exclusion criteria to assess each potential primary study.
- Systematic reviews specify the information to be obtained from each primary study including quality criteria by which to evaluate each primary study.
- A systematic review is a prerequisite for quantitative meta-analysis.

When performing a systematic literature review, an element that takes a fundamental role is a review protocol. This protocol aims to minimize bias in the study by establishing in advance how the systematic review should be conducted [2]. The three phases that correspond to the process of systematic literature review must be executed in order - Plan Review, Conduct Review and Document Review. The steps that constitute each phase are shown in 2.2.

The choice of SLR as the research methodology is based on our purpose to identify the processes related to DT already mentioned in existing literature.

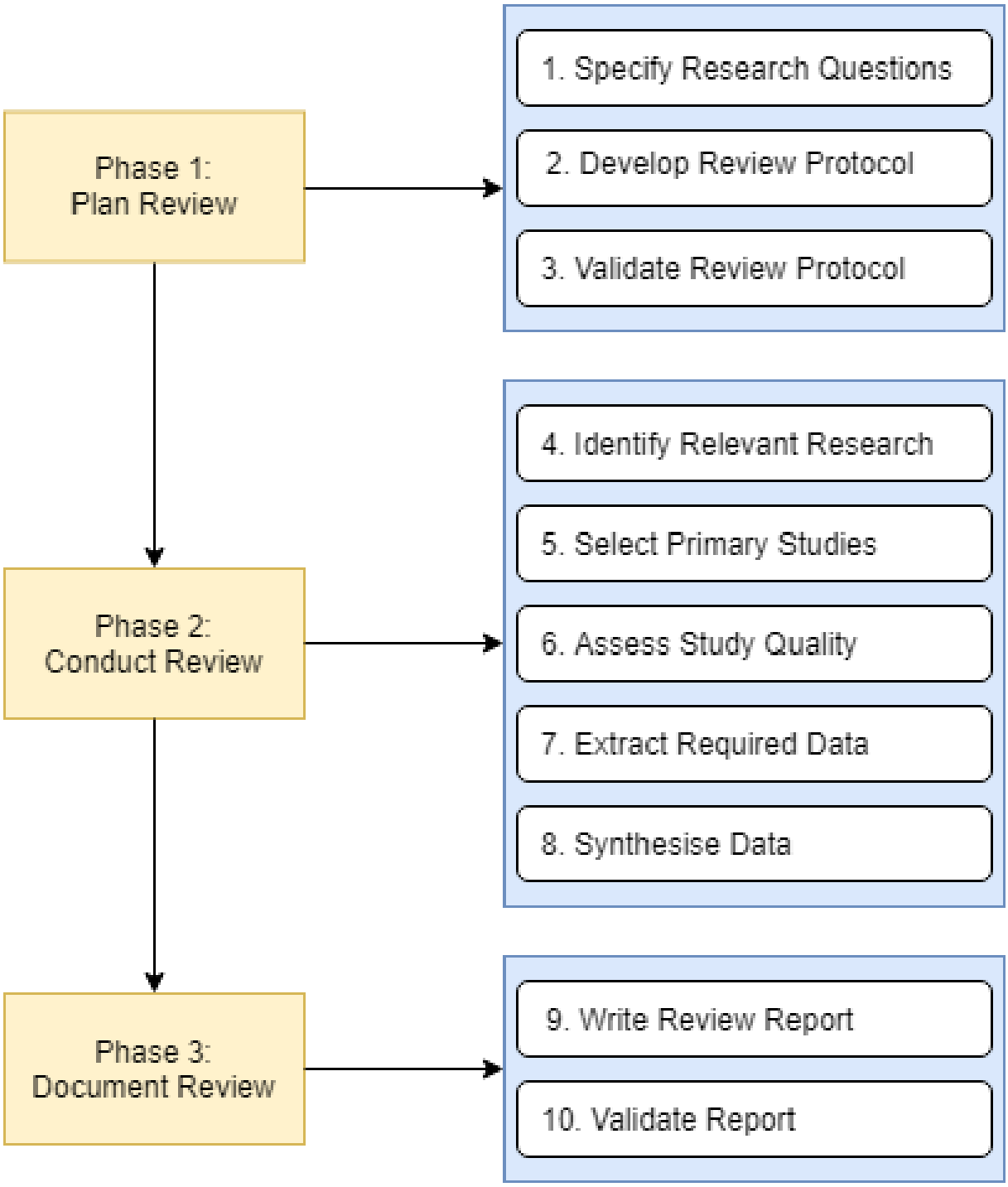

Figure 2.2: Systematic Literature review process. From [2].

3

Research Problem

Following the DSRM approach this section represents the first step to the identification of the problem and motivation. Nowadays, the integration and exploitation of new digital technologies is one of the biggest challenges that companies face and no sector or organization is immune to the effects of DT [23]. Indeed, business leaders in general are more concerned with the implications that new technologies have for the current and future state of the work environment, as well as the important role they play in the everyday activities of consumers, championing for DT within their enterprises. "Senior leaders realize what the stakes are (. . .) just 33% of executives in our 2007 survey said their CEO was a champion for digital; that number has doubled to more than 68% today." [26]. Nonetheless, some companies are left behind despite of their efforts to undertake a DT. In turn, companies want to act according to their business strategy convictions, but several obstacles sometimes block the intended path to perform a digital innovation. "Several obstacles stand in the way of digital maturity; lack of strategy and competing priorities lead the list of speed bumps. Lack of digital strategy is the biggest barrier to digital maturity for companies in the early stages according to more than 50% of respondents from early-stage organizations" [27]. There are times when the constraints are not necessarily dealing with the availability of financial resources, but with the lack of direction and orientation to start the journey of DT. The question is no longer when do companies need to make DT a strategic priority but how to embrace it and use it as a competitive advantage [23]. Another problem that exists is the idea that DT is just the adoption and use of new emerging technologies. Due to the recent emergence of the DT concept, there are still many relationships to understand and even more differentiating approaches to discover. Additionally, through an exploratory investigation conducted by Bonnet et al., involving in-depth interviews with 157 executives from 50 companies in 15 countries, the authors were able to conclude that [28]:

- Two-thirds of the executives in the sample spoke of the pressures they feel from competitors and customers to speed up their transformation programs.
- Only a third of the companies are truly reshaping their businesses through digital transformations.
- Other companies gained some value from transforming parts of their businesses, but only a few are fulfilling their true potential.
- An important underlying cause is that many are still working to understand whether and how to change.

Due to the increasing demand by business leaders, several consulting firms and researchers have developed maturity assessment models for DT. For example, Deloitte, in collaboration with TM Forum, created a digital maturity assessment tool [29]. Another example is the Forrester Research digital maturity model that seeks "to help companies assess their overall digital readiness" [30]. However, these

models, among others, do not explain the research process underlying their design and lack scientific validation. We propose to address this gap by developing a scientifically sound DT capability maturity model framework, capable of helping organizations assess their current digital maturity and define a plan to increase it.

Succinctly, the problem that we aim to address **is the lack of a framework with a scientifically based research to guide a DT, by helping the organizations to assess their current digital maturity and move them to the next digital maturity level**.

4

Theoretical Background

Contents

The clarification of concepts and definitions, related to our topic and derived from existing theories and empirical studies available in the academic literature, is provided in this section. The scientific literature review may be considered an integral part of the theoretical background since it gathers relevant academic work. In the third phase of DSRM (Design Development) conducting a rigorous systematic literature review "has to be ensured by using all related work available" [31]. However, it is important to emphasize that this theoretical background represents a literature review carried out separately from the systematic literature review which is conducted with the objective of building the Process Reference Model (PRM) DT (section 5).

4.1 Digital Transformation (DT)

Ubiquitous digital technologies are increasingly impacting organizations' businesses. In fact, "digital is the main reason just over half of the companies on the Fortune 500 have disappeared since the year 2000", as uttered by Pierre Nanterme, Accenture Chief Executive Officer (CEO) from 2010 to 2019. Many incumbents have felt the pressure to change the way they do business. Entrant start-ups and other companies with a digital-savvy mentality have attracted customers with their digital platforms that offer higher speed and convenience in the use of products and services. In recent years we have come across the bankruptcy of large and well-established companies that were disrupted by innovative business models tightly integrated with new digital technologies supporting their infrastructures and platforms. Kodak and Blockbuster are paramount examples [32] [33]. The former, once a behemoth in analog photography, neglected the transition to digital [32], while the latter was surpassed by Netflix in the changeover from physical DVDs and video clubs to online streaming of digital content. Both suffered from digital inertia, denoting an "inability to rapidly develop and implement new digitally based business models" [23]. Across industries, companies feel the urgency to become digital in a fast pace, otherwise they know that competitors and new entrants are willing to disrupt and take their places [34]. Corroborating with this concern DT has arisen in companies' business agendas where according to a study "80% of respondents regard DT as being important for their company's overall business strategy" [35]. Moreover, the challenges essentially come from the pressure customers have placed on the companies to always come up with innovative products and services incorporating technology of high level. "As technology change accelerates and new digital solutions emerge, many companies feel the pressure to perform a DT. This pressure increases due to changing preferences and expectations of customers and users." [36]. Additionally, employees also expect companies to be at the forefront of new digital technologies, evidencing, as well, the importance of DT. As can indicate the MIT Sloan Management Review and Capgemini Consulting online survey completed by 1,559 people in 106 countries which found that "fully 93% of employees agreed that DT was the right thing right now for their companies to do, and 73%

strongly agreed." [21]. According to Google Trends, the term DT started to gain momentum and be used more frequently in 2004. This topic is seen with such importance that the World Economic Forum (WEF) has developed a white paper on Digital Transformation of Industries [37] and in its last conferences in Davos promoted debates with a panel where CEOs of multiple industries discussed the future of their companies and the role of DT. The head of WEF's digital transformation stated that "digitalization is the cause of large-scale and sweeping transformations across multiple aspects of business, providing unparalleled opportunities for value creation and capture, while also representing a major source of risk." [37]. DT has been considered a buzzword which has attracted the attention of researchers and practitioners. Likewise, Fig. 4.1 suggests that, in recent years, the topic has gained importance for researchers and practitioners. The need to adopt DT in organizations and the interest of executive leaders in the subject reinforced the interest of the researchers in providing informational knowledge and solutions.

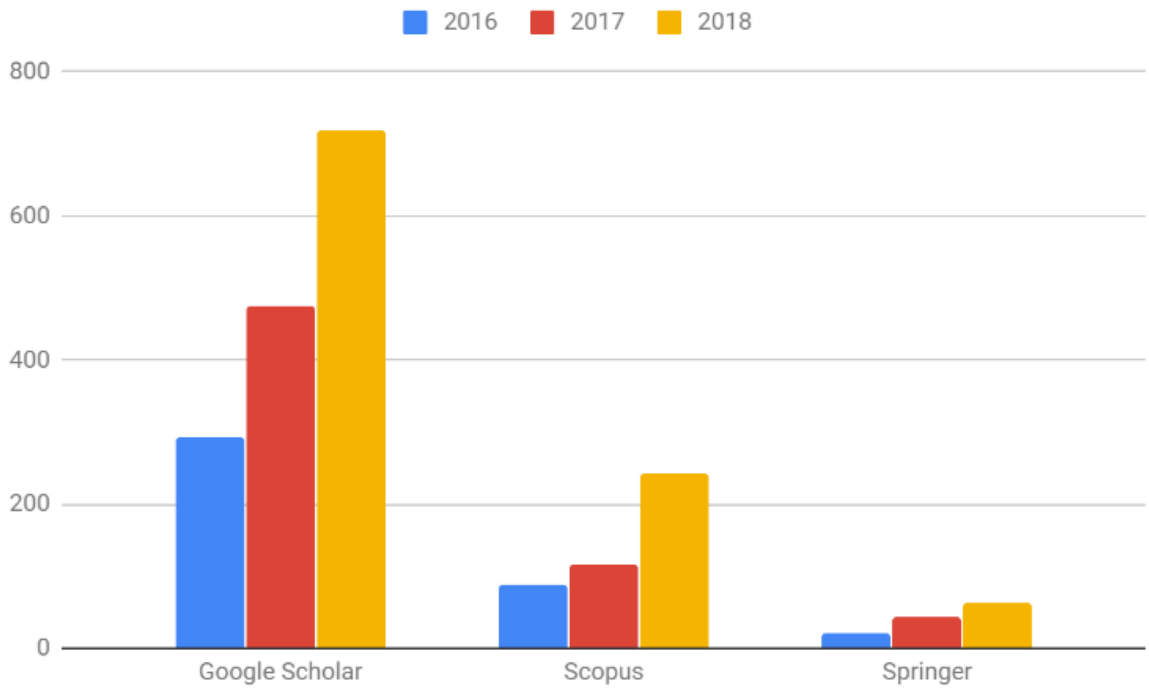

Figure 4.1: Number of articles containing "Digital Transformation" in title's publication by year and database.

Despite garnering special attention, there continues to be little consensus regarding DT explicit meaning.

Although a consensual definition of digital transformation is elusive, with multiple variations presented in Table 4.1, it is certainly possible to identify overlaps. The main differences relate to the spectrum of application of changes and the beneficial implications for the organization. Gathering the definitions of varied authors within digital transformation it is conceivable to have a sense of distinctions and overlaps.

Table 4.1: An overview of the definition of digital transformation by different authors.

Author	Definition
[27]	"The best understanding of digital transformation is adopting business processes and practices to help the organization compete effectively in an increasingly digital world."
[21]	"We define as the use of new digital technologies (social media, mobile, analytics or embedded devices) to enable major business improvements (such as enhancing customer experience, streamlining operations or creating new business models)."
[38]	"Digital transformation (DT) – the use of technology to radically improve performance or reach of enterprises – is becoming a hot topic for companies across the globe. Executives in all industries are using digital advances such as analytics, mobility, social media and smart embedded devices – and improving their use of traditional technologies such as ERP – to change customer relationships, internal processes, and value propositions."
[39]	"The digital transformation can be understood as the changes that the digital technology causes or influences in all aspects of human life."
[40]	"We consider digital transformation to be a significant change in the basic pattern of how organizations create value. In most instances digital transformation represents a fundamental change in the organization's underlying mindset, systems, and tools needed to reposition parts of, or the entire business design."
[41]	"Digital transformation is an ongoing process of changing the way you do business. It requires foundational investments in skills, projects, infrastructure, and, often, in cleaning up IT systems. It requires mixing people, machines, and business processes, with all of the messiness that entails. It also requires continuous monitoring and intervention, from the top, to ensure that both digital leaders and non-digital leaders are making good decisions about their transformation efforts."

As a consequence of analysing each digital transformation definition from (Table 4.1), we combine these ideas and arise at the following conclusions:

- DT is a strategic initiative in order to have a fundamental cross functional change using digital technologies such as social media, analytics, mobile and embedded devices to achieve major business benefits (for instance a better customer experience, operational excellence and competitive advantage) in an increasingly digitized world.
- New or redesigned business processes are needed to accomplish those benefits by creating innovative value propositions as well as leveraging digital channels to enhance customer intimacy.

4.1.1 The organizational context

However, while senior managers are putting a lot of effort into realizing a true DT, the results are not close to meeting the expectations and ambitions of top leaders. DT risk was ranked as the number one concern in 2019 from CEOs and senior executives but "yet 70% of all DT initiatives do not reach their goals" and "of the $1.3 trillion that was spent on DT last year, it was estimated that $900 billion went to waste" [15]. The significant percentage of failures in conducting a DT accounts for many obstacles faced by enterprises. Regarding the DT property of cross-functional process it is likely that encompasses a wide spread of barriers such as the following in Table 4.2.

Table 4.2: Barriers faced in digital transformation

Barriers/References	[8]	[21]	[35]	[42]
Lack of urgency		X		
Lack in digital talent			X	X
Gaps in cross-functional knowledge			X	
Lack of digital culture	X	X		X
Poor communication				X
Constant competition				X
Not enough funding		X		
Roles and responsabilities are not clear		X		
Regulatory concerns		X		
Unrealistic expectations				X
Business units implementing independently in silos		X		
Limitations of IT systems		X		
Lack of vision		X		
Unclear business case		X		

In this list of obstacles, we can have a sense of the complexity involved in DT and why so many companies struggle to take advantage of digital opportunities. Nevertheless, other companies achieve the benefits of emergent technologies and accomplished what we call high levels of digital maturity. According to research carried out with the objective of identifying the similarities between the companies

considered more digitally mature, it is possible to highlight some points of convergence compared to less mature companies, such as those represented in Table 4.3.

Table 4.3: Characteristics of enterprises with higher digital maturity

Characteristics/References	[17]	[10]	[43]	[44]
A digital strategy that defines a SMACIT (social, mobile, analytics, cloud and internet of things [IoT])-inspired value proposition.	X			
An operational backbone that facilitates operational excellence.	X			
A digital services platform that enables rapid innovation and responsiveness to new market opportunities.	X			
A better understanding of digital consumer behavior, preferences and choices.			X	
A greater digital intensity, i.e., these companies invest more in technology-enabled initiatives.				X
A more integrated digital strategy.				X
A higher proportion of top management team members with a background in digital, technology and innovation.				X
A more decentralized management structure.				X
A greater investment in skillset building.				X
A stronger risk-taking culture				X
A stronger communications skill		X		

As expected, many of the characteristics of companies undergoing a successful DT are those that go through the above-mentioned obstacles. These common attributes are a good source of information regarding a framework that can help and guide companies through a DT. The benefits of DT are very much related to the advantages that digital technologies present to companies. Somehow, companies perform a DT in order to achieve cost reduction, productivity improvement, and innovation [23].

4.2 Process Reference Model (PRM)

When it comes to introducing the concept of Process Reference Model (PRM), it is pertinent to also cover the clarification of reference model. Regarding its explanation, “a reference model is an abstract framework for understanding significant relationships among the entities of some environment that enables the development of specific architectures using consistent standards or specifications supporting that environment. A reference model consists of a minimal set of unifying concepts, axioms and relationships within a particular problem domain, and is independent of specific standards, technologies, implementations, or other concrete details.” [45]. Academics have been using the ISO 15504/330xx family definition of PRM, which consists of “a model comprising definitions of processes described in terms of process purpose and outcomes, together with an architecture describing the relationships between the processes” [5]. Furthermore, the standard emphasizes the descriptive elements that each process

in the PRM follows [5]:

- Process ID: Each process belonging to a Group (Common Integrated Management Processes, Organizational Processes or Technical Processes) is identified with a Process Identifier [ID] consisting of the Group abbreviated name (COM, ORG, TEC) and a sequential number of the process in that Group.
- Name: The name of a process is a short phrase that summarizes the scope of the process, identifying the principal concern of the process, and distinguishes it from other processes within the scope of the process reference model.
- Context: For each process, a brief overview describes the intended context of the application of the process.
- Purpose: The purpose of the process is a high-level, overall goal for performing the process.
- Outcomes: An outcome is an observable result of the successful achievement of the process purpose. Outcomes are measurable, tangible, technical or business results that are achieved by a process. Outcomes are observable and assessable.

With regards to the state of the art, PRM has been attracting increased interest in the literature, specifically in its design. Many PRMs were designed for multiple and varied domains such as automotive sector, enterprise processes and regulation compliance, as it is referred to in [46]. Beyond these, an important international standard for process reference model and process assessment model were developed in the field of information security management which was used as the basis for many PRMs designed later. Unfortunately, although there are already several artefacts of PRM, including a standard, we were unable to identify any article that has a guideline on how to build a PRM from the ground up. Therefore, we had to determine which processes are relevant, independently of the domain application. For example, the ISO/IEC 33052 “defines a process reference model (PRM) for the domain of information security management.” [5], thus, presents beforehand the processes that they identified as determinants for this domain, without mentioning which criteria determined the choice for those processes. As far as we are concerned, in the absence of a framework to identify the key processes, whatever the domain under consideration, we decided to perform a systematic literature review when dealing with this issue (the results and approaches are detailed in section 5).

4.3 Process Assessment Model (PAM)

Judging by the amount of publications by academics and practitioners, maturity models have been growing in considerable numbers [47] [48]. The business world has also adopted maturity models to improve

its business processes considering the quality management required by stakeholders and for reasons of competitiveness. Since the development of Capability Maturity Model (CMM) from the Software Engineering Institute (SEI) – Carnegie Mellon [49], many other maturity models have been proposed across various domains, such as IT management [50], Business Process Management (BPM) [48] [51] [52], Knowledge Management (KM) [53], and Digital Government [54]. In accordance with CMM's first version, "the CMM was designed to guide software organizations in selecting process improvement strategies by determining current process maturity and identifying the few issues most critical to software quality and process improvement." [49]. When it comes to standards, ISO/IEC 15504 was apparently the first consensual standard that proposed a reference model for maturity models. The associated and updated standard now for ISO/IEC 15504 is the ISO/IEC 330xx family. Within the objective of performing an assessment, the document ISO/IEC 33002 defines the minimum set of requirements that form a structure for the assessment of process and the application of process assessment. These are [55]:

- Facilitates self-assessment.
- Provides a basis for use in process improvement and capability determination.
- Takes into account the context in which the assessed process is implemented.
- Produces a process rating.
- Addresses the ability of the process to achieve its purpose.
- Is applicable across all application domains and sizes of organizations.
- Can provide an objective benchmark between organizations.

The Process Assessment Model (PAM) "supports the performance of an assessment of process capability by providing indicators for guidance on the interpretation of the process purposes and outcomes as defined in ISO/IEC TS 33052 and the process attributes as defined in ISO/IEC 33020" [6]. In short, "a PAM comprises a set of indicators of process performance and process capability. These serve as a basis for collecting the objective evidence that enables an assessor to assign ratings." [6]. The ISO/IEC 33072 established structure, as well as the COBIT 5, includes two dimensions [6]:

- A process dimension: the processes are defined, and, more specifically, the PAM expands the PRM process definitions by including a set of process performance indicators called base practices for each process. The PAM also defines a second set of indicators of process performance by associating inputs and outputs with each process.
- A capability dimension: the capability level and process attributes are used and expanded through the inclusion of a set of generic practices. Hence, a set of process attributes grouped into capability

levels is defined. The processes attributes provide the measurable characteristics of the process quality characteristic of process capabilities.

Regarding the capability dimension, the levels are defined on a six-point ordinal scale in a range of 0 to 5, and the process attributes associated with each process capability level are structured as follows [6]:

- Process capability Level 0: Incomplete process
- Process capability Level 1: Performed process
  - 1.1 Process performance process attribute
- Process capability Level 2: Managed process
  - 2.1 Performance management process attribute
  - 2.2 Work product management process attribute
- Process capability Level 3: Established process
  - 3.1 Process definition process attribute
  - 3.2 Process deployment process attribute
- Process capability Level 4: Predictable process
  - 4.1 Quantitative analysis process attribute
  - 4.2 Quantitative control process attribute
- Process capability Level 5: Innovating process
  - 5.1 Process innovation process attribute
  - 5.2 Process innovation implementation process attribute

The process attribute is a “measurable property of a process quality characteristic” [56]. Each process attribute is the mechanism to judge the degree of achievement for the assessed process.

5

Research Proposal

Contents

Moving to the second and third phases of DSRM, we will now respectively discuss the objectives of the solution and its design and development.

5.1 Objectives

The main objective of our proposal solution is to provide a framework to assess the current state of DT in an organization and provide guidance to achieve higher levels of digital maturity. In order to accomplish this objective two major tasks must be completed:

- The creation of a Process Reference Model (PRM), and
- The creation of a Process Assessment Model (PAM)

Therefore, by integrating these two models, our framework should be able to become a useful artefact for organizations to use as a guide for DT. This would enable them to deliver extensive internal benefits, for instance in a form of customer engagement, competitive advantage, and digital capabilities. In order to substantiate the validity of the artefacts produced, they will have the support of standards, procedures and methods accepted by the community.

5.2 Systematic Literature Review: Planning the Review

In this section, associated with the first phase of SLR methodology, we present the objectives of conducting this review, the research question, and the protocol review.

5.2.1 Objectives

DT is seen as a complex issue that considerably affects and modifies the companies' business and operation. [11] [23]. Through an exploratory investigation conducted by Bonnet et al., involving in-depth interviews with 157 executives from 50 companies in 15 countries, the authors were able to conclude that [28]:

- Other companies gain some value from transforming parts of their businesses, but only a few are fulfilling their true potential.
- An important underlying cause is that many are still working to understand whether and how to change.

Subsequently, our aim regarding the SLR is to simplify the DT that organizations operate through the identification of reference processes related to DT.

5.2.2 Research Question

The research question addressed by this study is:

- RQ1: What are the reference processes for digital transformation?

5.2.3 Protocol Review

The search process was performed through a manual search that consisted of the use of a search string in multiple data sets. The respective search string and data sets are mentioned below:

- Search string: Title("Digital Transformation" AND (Process OR Method OR Framework OR Methodology OR Activity))
- Data sets: ACM Digital Library, Google Scholar, IEEE Digital Library, Science@Direct, Scopus and Springer Link

The search intended to select relevant articles since 2004 up to March 2019. Our search string just takes into consideration the title of the articles, considering we wanted to especially focus only on relevant literature, avoiding waste, as much as possible.

5.3 Systematic Literature Review: Conducting the Review

This section covers the second phase of the SLR methodology in which we will address the study selection, according to the protocol review defined above, and provide the data extracted from the respective selected studies.

5.3.1 Study Selection

Once we applied our search string, the number of articles collected corresponded to 138 through the whole data sets in use. Although, from those 138 articles, 45 were duplicated. Then by applying the inclusion and exclusion criteria the number of articles decrease considerable until a final number of 37 articles. Regarding the inclusion and exclusion criteria, articles written in English published between 2004 and March 2019, and containing the following topics were included:

- Meta-analyses
- DT practical area i.e. literature that approaches a DT in a specific domain.

Articles whose topics do not show content related to DT were excluded. From the initial collected articles, 56 of them were put on the rejected category for not accomplishing the inclusion and exclusion criteria.

5.3.2 Data Extraction

The publication of articles was considerably larger in conferences than in journals and the years of the publications on the selected articles has grown in size in recent years, suggesting a greater interest in the topic. Regarding the sources of the papers in our pool, within the Conferences, Journals and Books, those who contributed the most were the book “Digitalization Cases” with 3 papers, the International Journal of Corporate Learning, and the following conferences, Hawaii International Conference and International Conference MLSD contributed with 2 papers. Note that the category of 2019 just covers articles publish until March 2019.

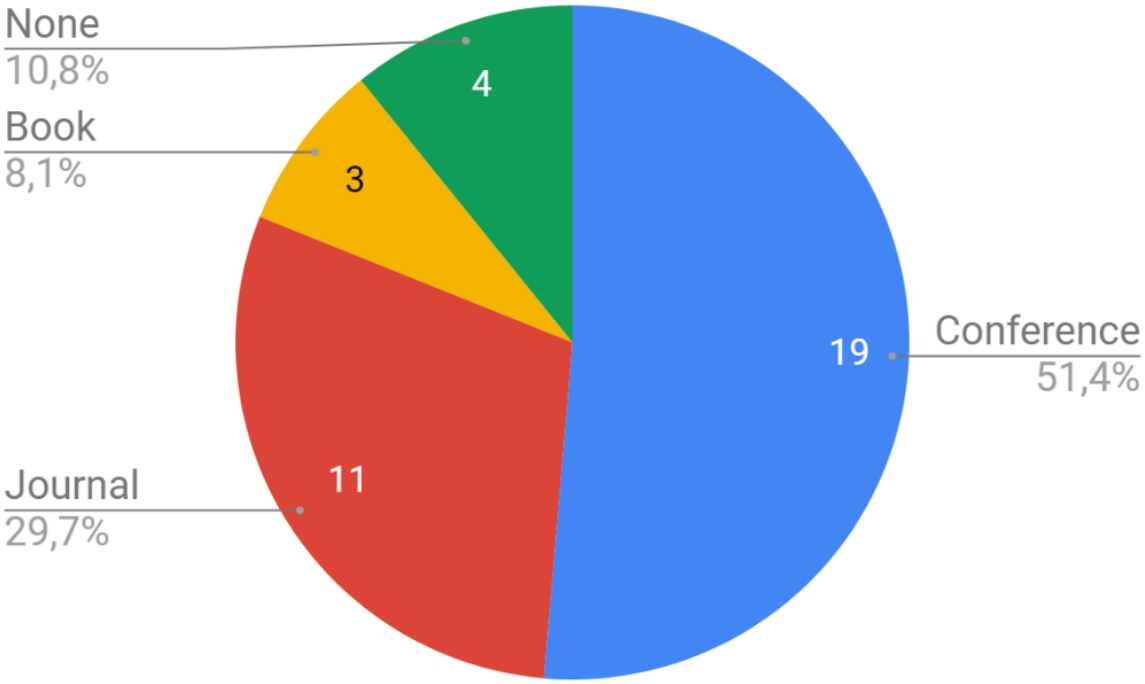

Figure 5.1: The articles type distribution

5.4 Systematic Literature Review: Reporting the Review

In this section, which covers the last phase of SLR methodology, we will present the results from the analysis of the articles selected and answer the approached research question. In order to better understand the basis for the identification of the processes we are going to provide the quotations that support the basis for the selection of processes, and thus, defending the important contribution factor of a specific process in the context of a DT initiative. Moreover, Table 5.2 show a matrix that makes the intersection between the articles with the processes, allowing us to know which processes were

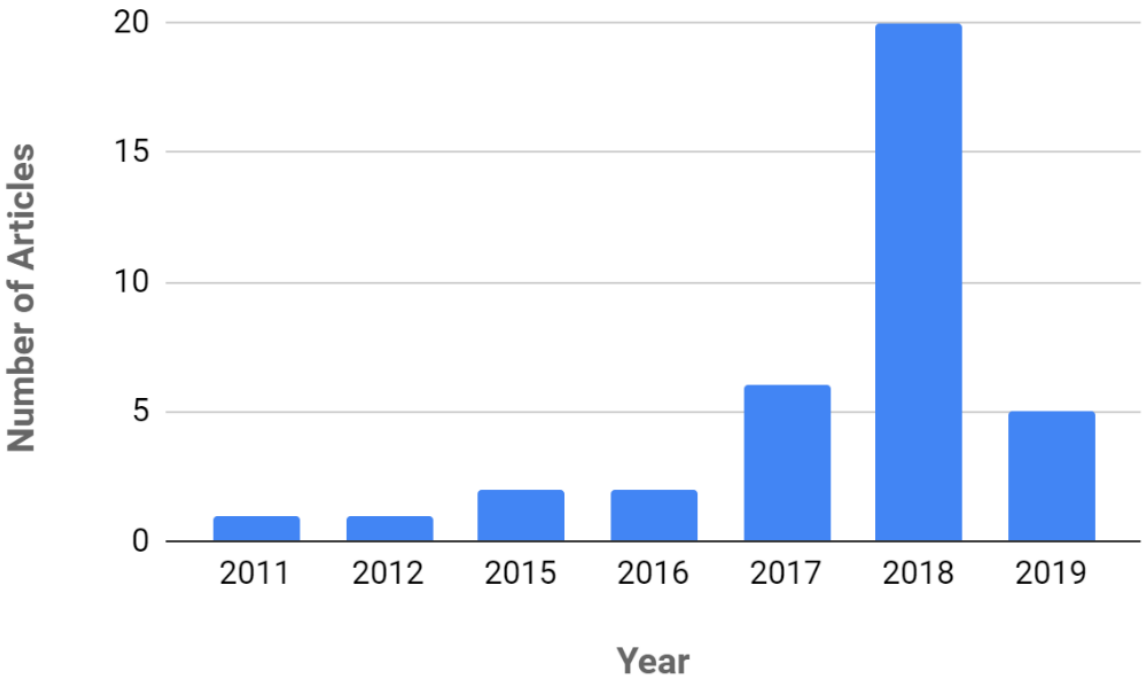

Figure 5.2: The number of articles by year of publication

addressed in a particular article.

5.4.1 Processes

The processes documented in the selected articles were identified based on some quotations uttered by the authors. In Table 5.1 some of these quotations are described for each article.

5.4.2 Analysis

The identified processes present a broad scope of what could involve a DT. When analysing the identified processes, it is possible to conclude that the execution of these processes will have to involve several departments, as well as numerous stakeholders, connoting a trans-functional property of the DT. The interconnection between processes can also be predicted through the analysis of the list of processes. The dependence of results between processes may possibly exist, and the output of some processes can be considered as the input of other processes. However, there are processes that appear to be feasible to be carried out in parallel, not demonstrating dependence on its completion. Figure 5.3 shows the number of articles that mention each identified process, allowing a better perception of the focus that has been channelled in terms of processes in the context of DT. The selected literature thus suggest a

Table 5.1: Justification for the selected processes

Processes	Justification
Manage digital strategy	"DT success will only occur when a digital strategy that follows realistic goals leads to an appropriate integration considering the impact." [57] "Prior research has come to the conclusion that organizations need to approach their digital transformations by designing a digital business strategy" [58]
Manage business processes	"Processes are fundamentally reconsidered in the digital transformation of organizations." [59] "Digital transformation cannot be done without rethinking existing business processes." [60]
Manage innovation	"Continuous innovation is a unique quality of digitalization, and it can change a business model". [61] "Digitally mature organizations, are characterized by the following: Product innovation – they employ digital technologies in order to provide innovative products and services." [62]
Manage changes	"Change management in which specific changes related to people, processes, and technologies, due to the adoption of digital transformation are managed." [63] "The implementation of digital transformation leads to the change of internal conditions in an organisation including the change in decision making, financial conditions and business performance." [63]
Manage human resources	"For digital transformation, an organization relies on smart, creative employees with a digital, boundary spanning skillset, including skills such as striving for the latest technical development or mastering data analytics." [3]
Manage customer experience	"As noted by many researchers a customer centric approach is vital for successful digital transformation in a company". [61] "Successful digital transformation begins with an understanding of digital consumer behaviour, preferences and choices". [62]

Manage culture	"Digitally mature organizations are characterized by the following: Culture – they are open to and command an understanding of digital technologies; relevant skills are deeply rooted in the organization." [62] "DT should evolve as the philosophy of our life and part of the new digital culture that affects all personal, corporate, industrial, government, commercial and social orders. The internal digital culture of the organization must be constantly evolving." [64]
Manage enterprise architecture	"The literature has also argued for enterprise architecture (EA) being a precondition to successful digital transformation." [65]
Manage governance	"To sustain transformation results and keep the related business processes on track, an appropriate process governance approach is required. It needs to be clear how the performance of a process and the success of a digital transformation is measured. Required responsibilities and accountabilities need to be defined." [66]
Manage information and data	"The ability to collect data and use of information derived from data are unique attributes to digital transformation." [61] "Most of our interviewees believed that data is the foundation of success in the digital economy because it affects many actions fields related to digital transformation." [3]
Manage collaboration	"Efficient collaboration between business and IT units is an enabler of organizational digitalization." [65]
Manage Business models	"Digital transformation requires profound changes in the business models of the organization." [65] "Digital transformation changes the business model of an organisation by re-designing the cost and revenue structure in an organisation." [63]

Manage knowledge	“The goal of this paper is to present the role of knowledge as a source of digital transformation process, especially the importance of sharing knowledge when communicating and networking between organizations in marketing channels.” [67]
Manage digitization and automation	“The basis for all levels of digital transformation is the digitization of analog sources, for example, the conversion of paper documents into digital documents or the measurement of environmental conditions translated into digital signals using sensors.” [68] “Digitalization also includes robotization and automatization of actions, better ergonomics – ease and speed of access and propagation, possibility to receive and transfer data and information from many and to many subjects.” [69]
Manage communication	“Generally, the communication is an essentially relevant topic for its transformation in both dimensions: internal (“the more transparent and open communication is, the quicker and more effective the transformation.”) and external in terms of the exchange with other banks and the client-bank relationship.” [70]
Manage monitoring and control	“Monitor and correct the course: The introduction of new technologies can cause a great interruption of the work flow, it is necessary to ”monitor its implementation” it is important to listen to the opinions and concerns of the interested parties and adjust their implementation as necessary to achieve its adoption.” [71]
Manage business agility	“Agile design and implementation are important for a successful digital transformation. Fast changing market requirements are an essential driver of digital transformations.” [72]

Manage products and services	“Digital transformation affects the offerings of products and services by embedding innovation and improving their features.” [63] “DT leads to the development of more digital products and services which use network-effects for the creation of value.” [57]
Manage portfolio	“Transformation projects are defined and prioritized based on the impact of the involved processes and their overall impact on the goals of the company. (. . .) The resulting dynamic project portfolio management allows to deliver most value through process digital transformations and adjust the project portfolio based on changing company and market requirements.” [66]
Manage structure	“Structural changes have also been highlighted as a key dimension of every digital transformation endeavour.” [44] “Some of the challenges linked to failure to attain successful DT revolve around: appropriate organizational structures suitable for DT.” [73]
Manage digital channels	“In relation to the business of digital transformation, the customer touch points and the customer engagement usually need to be considered.” [63] “Internal and external omni-channel communication is an essential element for DT but it must be rich in its contents.” [64]
Manage security	“Accordingly, our interviewees ranked data security among the major challenges of digital transformation. Strict regulations and unpredictable consequences in case of data loss or leakage require organizations to deliver superior data security as a brand promise and to minimize downside risks.” [3]
Manage partnership	“Digital ecosystems help organizations quickly offer new products and services to a global customer base.” [3]

special emphasis on the processes of manage digital strategy, manage business processes and manage innovation, giving the high frequency of different articles that mentioned these processes. The importance of the manage digital strategy process is acknowledged by several authors and recommended as one of the first actions to be taken in a DT. For the successful implementation of a DT, the definition and planning of a digital strategy shows, according to the extensive research, a decisive role above all other processes. As far as business process management is concerned, this process suggests in some way the monitoring and control of the activities and results that are obtained at the end of the business processes. Eventually, it is expected that with business process management, organizations can modify and improve processes to become more efficient, as well as achieve greater resource utilization. Other processes can probably influence and have a decisive impact on the improvement of business processes, such as digitization and automation. Considering the management of innovation, which is considered the third most approached process, it is possible to extrapolate that innovation prefaces an essential criterion in the perspective of a DT, where it is intended to denote a competitive advantage achieved through differentiation in the use of new digital technologies. In addition, the considerable discussion of the management of customer experience in the DT articles that were collected in this work can also indicate the importance of a customer-centric approach in which the focus is on providing an engaging experience to ensure a loyal and consistent relationship with customers. On the other hand, the process of manage partnership was mentioned in lesser frequency, gathering reduced attention from the researchers in the selected articles. This may indicate a lack of study regarding this specific process in the field of DT. However, it may also simply mean less importance of this process in DT initiatives. The articles that address this process reveal that some companies that do not have enough resources or knowledge acquired to implement and manage the infrastructure required for the use of digital technologies, need partnerships. These companies need (and are encouraged) to establish partnerships with companies that present digital solutions and technological capabilities that enable them to digitize operations and business processes. Consequently, making a strategic partnership agreement enables companies to achieve greater efficiency, quality and customer satisfaction. When thinking about companies that are considered to have a superior digital maturity, they seem to retain human resources of high digital in-house value , capable of managing effectively and in a notorious way the digital assets. By some means, perhaps these companies do not take partnership as a crucial factor for DT since they possess mostly reliable and scalable digital platforms. In fact, it may be the traditional enterprises the ones searching for those digital mature companies in order to make alliances with the objective of becoming digital as well.

Despite our reliance on the usefulness and applicability of this set of reference processes for DT, identified through the SLR, these should not be seen as the only and exclusive processes for achieving a successful DT. Potentially, companies can reach a relevant digital maturity by committing themselves

Table 5.2: The matrix intersection between processes and articles

Processes / Articles	[59]	[74]	[75]	[61]	[68]	[3]	[62]
Manage digital strategy	X	X	X	X	X	X	X
Manage business processes	X			X	X	X	X
Manage innovation	X	X		X	X	X	X
Manage changes				X	X	X	X
Manage human resources		X	X		X	X	X
Manage customer experience	X			X		X	X
Manage culture				X	X	X	X
Manage enterprise architecture					X	X	
Manage governance		X	X		X	X	
Manage information and data				X	X	X	
Manage collaboration					X	X	X
Manage business model				X		X	X
Manage knowledge					X		
Manage digitization and automation	X				X		
Manage communication							
Manage monitoring and control					X	X	
Manage business agility						X	X
Manage products and services	X			X	X	X	X
Manage portfolio			X			X	
Manage structure							
Manage digital channels				X		X	X
Manage security				X			
Manage partnership					X	X	

Processes / Articles	[70]	[76]	[77]	[78]	[67]	[79]	[80]
Manage digital strategy	X	X	X	X	X	X	X
Manage business processes		X	X	X		X	X
Manage innovation	X	X		X		X	X
Manage changes	X			X		X	X
Manage human resources	X	X	X			X	
Manage customer experience	X	X			X		X
Manage culture	X	X	X	X	X		X
Manage enterprise architecture	X	X	X			X	
Manage governance		X		X		X	
Manage information and data	X	X	X	X		X	X
Manage collaboration	X			X		X	
Manage business model		X					
Manage knowledge	X			X	X		
Manage digitization and automation		X		X		X	
Manage communication	X			X			
Manage monitoring and control		X	X		X	X	
Manage business agility		X		X			
Manage products and services							X
Manage portfolio	X		X				
Manage structure			X	X			X
Manage digital channels	X				X		X
Manage security						X	X
Manage partnership		X					

Processes / Articles	[81]	[71]	[82]	[60]	[83]	[16]
Manage digital strategy	X	X	X	X	X	X
Manage business processes	X	X	X	X	X	X
Manage innovation	X		X	X	X	
Manage changes	X	X	X		X	X
Manage human resources		X	X			X
Manage customer experience		X	X	X		X
Manage culture	X	X				X
Manage enterprise architecture	X	X				
Manage governance	X	X			X	X
Manage information and data		X			X	X
Manage collaboration			X		X	X
Manage business model	X	X		X	X	
Manage knowledge	X			X		X
Manage digitization and automation	X			X		
Manage communication	X	X	X		X	
Manage monitoring and control	X	X	X			
Manage business agility						
Manage products and services			X			
Manage portfolio						X
Manage structure						
Manage digital channels						
Manage security	X					
Manage partnership						

Processes / Articles	[69]	[84]	[65]	[85]	[86]	[72]
Manage digital strategy	X	X	X	X		X
Manage business processes	X	X	X	X	X	X
Manage innovation	X		X			X
Manage changes	X	X	X			X
Manage human resources	X	X	X	X		X
Manage customer experience	X	X	X			
Manage culture		X	X			
Manage enterprise architecture	X	X	X	X		
Manage governance		X				
Manage information and data	X	X				
Manage collaboration		X	X	X		
Manage business model	X	X				
Manage knowledge	X		X	X		
Manage digitization and automation	X			X	X	
Manage communication	X			X		X
Manage monitoring and control		X				
Manage business agility			X			X
Manage products and services						
Manage portfolio						
Manage structure			X			
Manage digital channels						
Manage security	X					
Manage partnership						

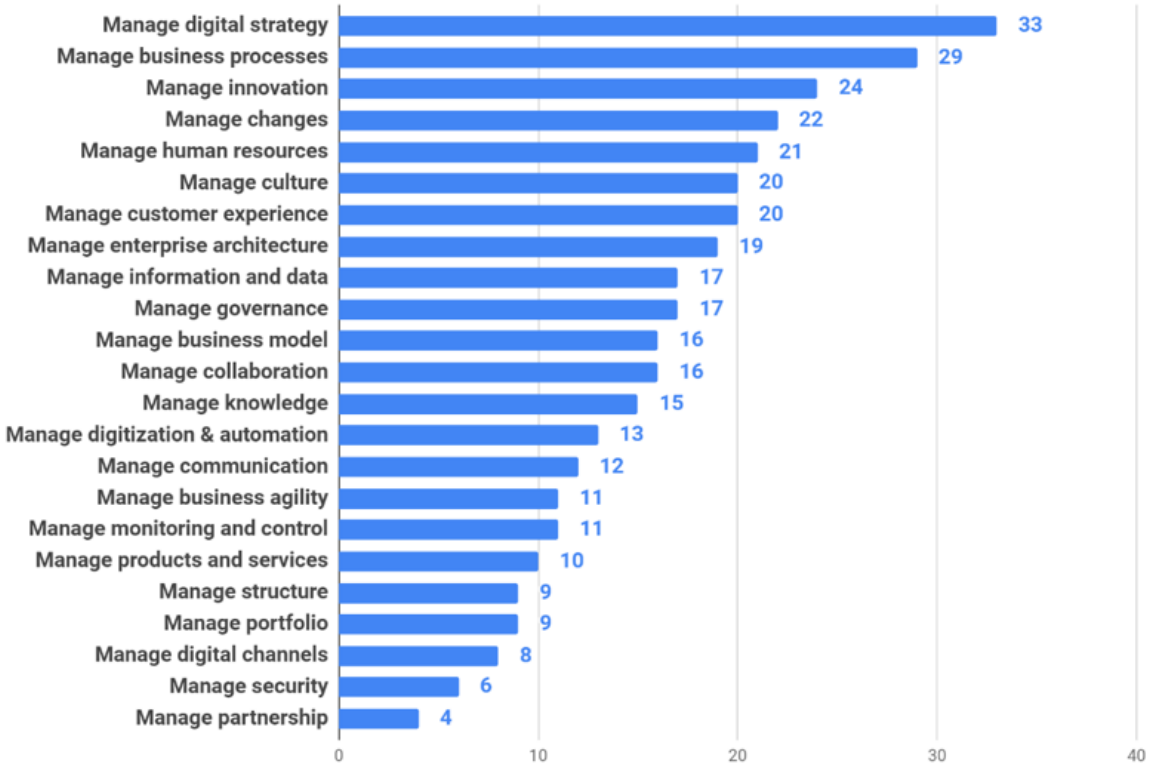

Figure 5.3: Number of articles that mention each process

to change only a limited number of processes that are identified here, or by adopting other processes that allow them to achieve the same goals.

5.5 PAM for Digital Transformation

In this section, we will cover some processes detailed regarding the process assessment model adopted and what are the conditions to achieve a certain capability level for each process.

Our proposal to assess the DT processes in organizations is based on ISO/IEC 330xx. We chose this family of standards because it is a global reference for process capability assessments, containing, for example, specific requirements for process reference models and process assessment models. It is an accepted international standard and because of its greater adaptability for the purpose of determining the current capability of organizations' processes, as well as establishing priorities for process improvement. Additionally, a design science research project conducted by [87] advocates that "the external validity of an artefact can be improved with the use of International Standards" and concludes that the project in question "demonstrated the significant role of International Standards to confirm research relevance during artefact design, development and evaluation". Our process assessment model follows the example of ISO/IEC 33072, the process capability assessment model for information security

management, and is structured in accordance with the requirements of ISO/IEC 33004, also used by ISO/IEC 33072.

Toward the aim of building a DT process assessment model, it is first necessary to identify relevant processes in this context. This was done previously using a systematic literature review. That study resulted in the following list of processes that are here grouped in action fields (Fig. 5.4).

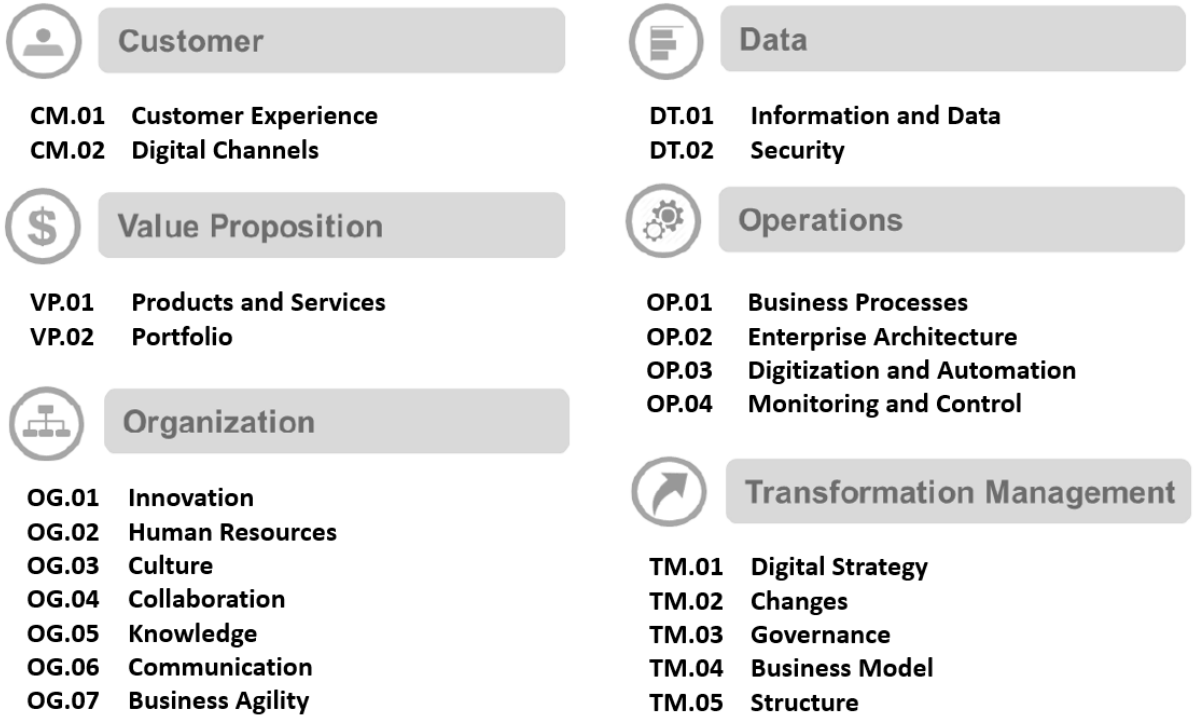

Figure 5.4: Process Reference Model (PRM) including the DT processes identified from our previous research effort and grouped by action fields. Adapted from [3].

As mentioned before, the PAM is a two-dimensional model concerning the process dimension and capability dimension. The representation of what constitutes the process dimension of the PAM for five specific processes are presented in Tables 5.3, 5.4, 5.5, 5.6 and 5.7.

Table 5.3: Manage Customer Experience (original content from the authors using the ISO/IEC 33072 structure [5]).

Process ID	CM.01
Name	Customer experience
Context	Manage the emotional component of experiences using experience audit as a tool to get close to customers. Communicate, implement and monitor a customer experience management system in a never end constant improving overall experience process.
Purpose	Leverage customer loyalty, create a competitive advantage, understand customers' needs and desires.
Outcomes	As a result of successful implementation of this process: 1. Current and future customer experience performance requirements are identified. 2. Customer experience data are collected, monitored and analysed. 3. Customer experience data are used to forecast future demands.
Base Practices	OP.01.1 – Identify customer experience requirements [Outcome 1] OP.01.2 – Monitor customer experience [Outcome 2] OP.01.3 – Prepare future customer experience [Outcome 3]
Inputs	
Recommendations reports [Outcome 1] Regulatory requirements [Outcome 1] [Outcome 2] [Outcome 3] Platform tracking system [Outcome 2] [Outcome 3] Search engines reports [Outcome 2] [Outcome 3] Social networks analytical reports [Outcome 2] [Outcome 3]	
Outputs	
Customer experience requirements [Outcome 1] Customer experience assessment report [Outcome 2] Customer experience plan [Outcome 2] Customer experience forecast analysis report [Outcome 3]	

Table 5.4: Manage Digital Strategy (original content from the authors using the ISO/IEC 33072 structure [6])

Process ID	TM.01
Name	Manage digital strategy
Context	A strategy that encompasses and involves an introspection of how to leverage new digital technologies to create business value. A comprehensive vision aligned with the various functional strategies, fostering collaboration and nurturing a digital mindset in search of disruptive innovation are important elements regarding digital strategy.
Purpose	In implementing this process, organizations must adopt a digital strategy according to their needs and capabilities, to provide a direction, knowledge development and internal understanding of the vision, goals and opportunities for digital technologies. Organizations must take advantage of digital technologies to achieve a competitive advantage, following a strategic dynamic plan and communicate it throughout the organization.

Outcomes	As a result of successful implementation of this process: 1. Digital vision, goals and opportunities identified. 2. Digital strategy aligned with digital transformation objectives. 3. Digital capabilities and IT infrastructure faculties analysed. 4. Approach to new digital technologies defined and implemented. 5. Adequate and clear responsibilities for the definition and implementation of digital strategy allocated. 6. Top management support ensured. 7. Alignment with functional and operational strategies. 8. Stakeholders commitment reinforced. 9. Continuous reassessment of digital strategy.
Base Practices	OP.01.1 – Define what kind of digital strategy should be taken and how to implement (customer engagement strategy or digitizes solutions strategy) [Outcome 1] OP.01.2 – The formulation of digital strategy that is consistent and integrated with the entire coordination, prioritization, and implementation of digital transformation [Outcome 2] OP.01.3 – Determine the digital capabilities present in organization to know what skills needed to be acquire, and acknowledge the IT infrastructure state of the art [Outcome 3] OP.01.4 – Plan an approach do deal with emergent technologies, such as adopting a conservative, aggressive or innovator approach [Outcome 4] OP.01.5 – Determine the roles and responsibilities for digital strategy definition and implementation [Outcome 5] OP.01.6 – Ensure a consensual adoption and engagement for a digital mindset throughout the organization. [Outcome 6] OP.01.7 – Identify the locally strategies for each function and operation, merging them into a global digital strategy [Outcome 7] OP.01.8 – Implement an ecosystem of ideas based on innovation, developing everyone's participation and collaboration in transformation initiatives. [Outcome 8]
Inputs	
Emergent technologies report [Outcome 1] Benchmarking report [Outcome 1] Digital Transformation objective [Outcome 2] Workforce skillsets report [Outcome3] IT infrastructure as-is analysis [Outcome3]	
Outputs	
Digital strategy procedure [Outcome 1] Digital technologies approach plan [Outcome4] Digital strategy assessment [Outcome 9] Digital strategy roles and responsibilities [Outcome 5] Digital capabilities and IT infrastructure requirements [Outcome 3]	

When it comes to capability dimension, the process capability levels and process attributes are an important factor to a process capability assessment. The process attributes are grouped into capability levels providing a scale of achievement and a measure of the capability of the process [6]. To look at the bigger picture see Fig. 5.5.

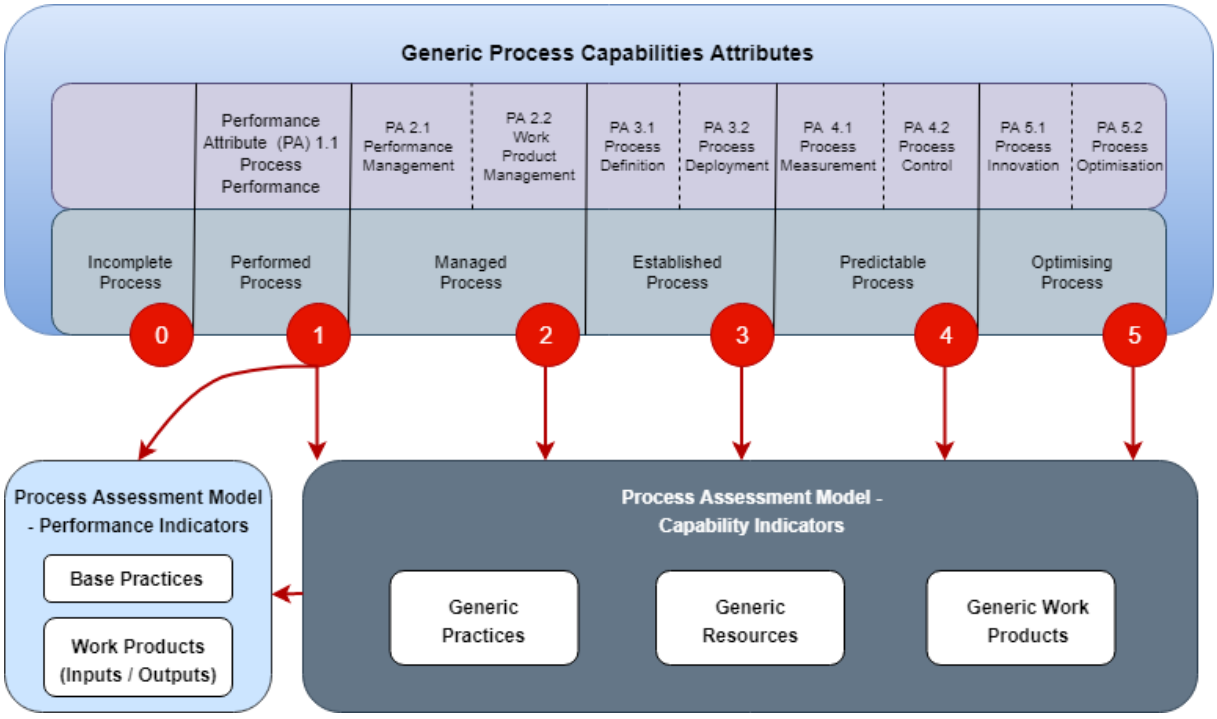

Figure 5.5: Process Capability Model. Adapted from [4]

In order to understand Fig. 5.5 it is important to highlight the following properties:

- The performance attributes are aligned with the correspondent column representing the capability level that they are at.
- The capability levels follow the numerical order labelled with the red node.
- The first capability level (Performed Process) uses performance indicators as well as capability indicators for its assessment.
- All the others capability levels from 2 to 5 are based on capability indicators for their assessment.

At the stage of this work, as seen in the process dimension of those five processes previously detailed, we describe process performance indicators for five processes which enable us to be assess those processes of the PRM and classify them in the respective capability level in accordance with an organization process capability assessment.

Table 5.5: Manage Digital Channels (original content from the authors using the ISO/IEC 33072 structure [6]).

Process ID	CM.02
Name	Manage digital channels
Context	This process ensures the capacity to establish multiple channels for sales, customer service and for all interactions with organizations. Ensuring consistent customer experience across all channels and touch points.
Purpose	The purpose of manage digital channels is to provide multiple customer touchpoints in order to enhance customer engagement and boost sales.
Outcomes	As a result of successful implementation of this process: 1. Digital channels designed and implemented (Websites, online-shops, mobile apps). 2. Deeper connections with customers established using social medias effectively. 3. Digital and physical channels combined (Omni-channel). 4. Digital channels evaluation of both opportunities and threads. 5. Digital channels in compliance with existing strategies and with security guidelines. 6. Monitoring analytics and social media channels feedback.
Base Practices	OP.01.1 – Provide multiple touchpoints where customers can interact with [Outcome 1] OP.01.2 – Manage social media interactions and engagement. Establish a relationship base on trust with customers [Outcome 2] OP.01.3 – Integrated and consistent use of multiples channels [Outcome 3] OP.01.4 – Continuous evaluation of existing digital channels and new ones to ponder the opportunities and threats [Outcome 4] OP.01.5 – Digital channels in line with digital strategies and the securities guidelines are in accordance with the standards [Outcome 5] OP.01.6 – Understand better the customers options and preferences by leveraging the data gather from digital channels. [Outcome 6]
Inputs	
Social Media Contact Points Plan [Outcome 1] Social Media Engagement Plan [Outcome 2] Digital Channels Integration Plan [Outcome 3] Digital Channels Business Cases [Outcome 4] Digital Channels Security Plan [Outcome 5] Digital Channels Information Plan [Outcome 6]	
Outputs	
Social Media Approach [Outcome 1] Social Media Engagement Approach [Outcome 2] Digital Channels Integration Report [Outcome 3] Digital Channels Business Cases [Outcome 4] Digital Channels Security Approach [Outcome 5] Digital Channels Information Report [Outcome 6]	

Table 5.6: Manage Business Processes (original content from the authors using the ISO/IEC 33072 structure [6]).

Process ID	OP.01
Name	Manage business processes
Context	This process is responsible to manage the innovation and performance of processes. In that regard it is expected that all business processes are aligned with organization's digital strategy, they are as much autonomous as possible to achieve high levels of optimization. The work that normally must be done in this matter are the analysis of the current state of business processes, identify what are the problems or bottlenecks in practice, modelling as-is and to-be processes where the to-be processes have the improvements proposed to solve those problems identified previously.
Purpose	The purpose consists of redefining the business processes using digitalisation in order to employ automatization, improve quality, optimise processes by means of standardisation of processes, increase productivity, reduce costs, find procedural bottlenecks and increase the level of innovation.
Outcomes	As a result of successful implementation of this process: 1. Process discovery performed properly (as-is business process models). 2. Process redesign performed (to-be business process models). 3. Process monitoring mechanisms and performance measures (time, cost, quality, and flexibility) established throughout the enterprise. 4. Policies and procedures for continuous improvement of processes established throughout the enterprise.
Base Practices	OP.01.1 – Define and manage the process identification definition, understanding the complete flow of working activities and tasks in order to achieve the outcome expected. Prioritize the handling improvement of processes based on importance, complexity and impact [Outcome 1] OP.01.2 – The implementation and deployment of a business process redesigned based on qualitative process analysis and quantitative process analysis [Outcome 2] OP.01.3 – Monitor and review the workflow of processes, handling non-conformities in order to correct them as soon as possible [Outcome 3] OP.01.4 – Plan and analyse regularly the redesign of processes to ensure the continual improvement and align them to match with current requirements [Outcome 4]
Inputs	
Interviews with stakeholders [Outcome 1] Documented business processes survey [Outcome 1] Classified and prioritised processes [Outcome 1] BPMN AS-IS Processes [Outcome 2] Contact points established [Outcome 3] Processes current states report [Outcome 4]	
Outputs	
Business Process Improvement document [Outcome 1] Full documented business processes [Outcome 2] Processes audit reports [Outcome3] Processes improvement policy [Outcome 4]	

Table 5.7: Manage Business Model (original content from the authors using the ISO/IEC 33072 structure [6]).

Process ID	TM.04
Name	Manage business model
Context	The implementation of this process enables the transformation, monitoring and control of firm's business model. Support the changes in key components such as customer value preposition, channels, cost and revenue structure.
Purpose	The purpose of manage business model is to establish an innovative business model with the ability to take a competitive advantage preventing the firm from becoming obsolete.
Outcomes	As a result of successful implementation of this process: 1. As-is business model analysis performed effectively. 2. New business model has been established, accepted and communicated throughout the enterprise. 3. The new business model and digital strategy plan are aligned as agreed. 4. Policies and procedures for continuous improvement of business model established throughout the enterprise.
Base Practices	OP.01.1 – Analyse and define the current established business model by identifying and write down all components of business model canvas [Outcome 1] OP.01.2 – Define and manage a new business model that describe the business operations completely [Outcome 2] OP.01.3 – Ensure that the new business model is consistent with the digital strategy plan and their objectives [Outcome 3] OP.01.4 – Monitor and ensure the effectiveness of business model in the context of the business environment digital transformation [Outcome 4]
Inputs	
AS-IS Business Model Analysis [Outcome 1] New Business Model Behaviour Approach [Outcome 2] Business Model – Digital Strategy Alignment Definition [Outcome 3] Business Model Improvement Policy Plan [Outcome 4]	
Outputs	
AS-IS Business Model Report [Outcome 1] New Business Model Behaviour Enhanced Statement [Outcome 2] Business Model – Digital Strategy Alignment Report [Outcome 3] Business Model Improvement Policy Approach [Outcome 4]	

6

Demonstration

Contents

This section covers the description of the completion of the demonstration stage of DSRM.

The solution presented should be called into question in order to prove its effectiveness in solving the problem mentioned in the research problem section. The objective behind demonstrating the validity and usefulness of our proposal is to lead the adoption of the DT framework in a real-case scenario.

Following procedure, we will present the results of applying our framework, specifically to the assessment of manage digital strategy process, in Company A (for privacy reasons we cannot give the exact name of the company, so we will simply refer to it as ”Company A”).

6.1 Context

The framework was applied with the manage digital strategy process assessment at Company A. This company is present in countries such as the United Kingdom, Germany, France, Spain and Portugal.

As in all other industries, the Company A industry has increasingly been more competitive, where companies must be creative and flexible to succeed. Company A to this end has been successfully implementing DT initiatives.

Regarding the assessment, we met with the Company A’s IT director in order to perform the assessment following our PAM with the focus on the manage digital strategy process.

Our demonstration counted on the assessment of manage digital strategy process performed to conclude whether the company was at capability level 0 or 1. At this stage of the study, superior levels were considered out of the scope of this assessment.

To determine whether this manage digital strategy process was implemented or not, the classification used by the ISO/IEC 330XX family of standards was adopted. That is, with the Company A IT Director’s self-assessment within the respective standard scale (Not Achieved, Partially Achieved, Largely Achieved and Fully Achieved) for the process purpose and outcomes supported by the base practices, inputs and outputs. It works as follows:

- If the Process Purpose rating is lower than Largely Achieved, i.e. Not Achieved or Partially Achieved, the capability level is immediately considered 0 (however the rating continues for outcomes).

- For outcomes, each is independently evaluated. After all are evaluated, a median of the results is made to arrive at a representative value of the outcomes.

- Finally, we compare the process purpose classification with the outcomes classification where the inferior classification is the one that persists. If the final rating is Largely Achieved or Fully Achieved it means that capability level 1 has been reached. Otherwise, the capability level is 0.

For the purpose of making the framework assessment experience simple and more interactive, we developed a web-based software tool to assess the capability maturity level of DT processes.

The following images shows a wizard with the necessary questions to perform the assessment. After filling in all fields present for the process purpose (Fig. 6.1) and outcomes (example of an outcome assessment Fig. 6.2) the capability level for the current state of the process is disclosed (Fig. 6.3).

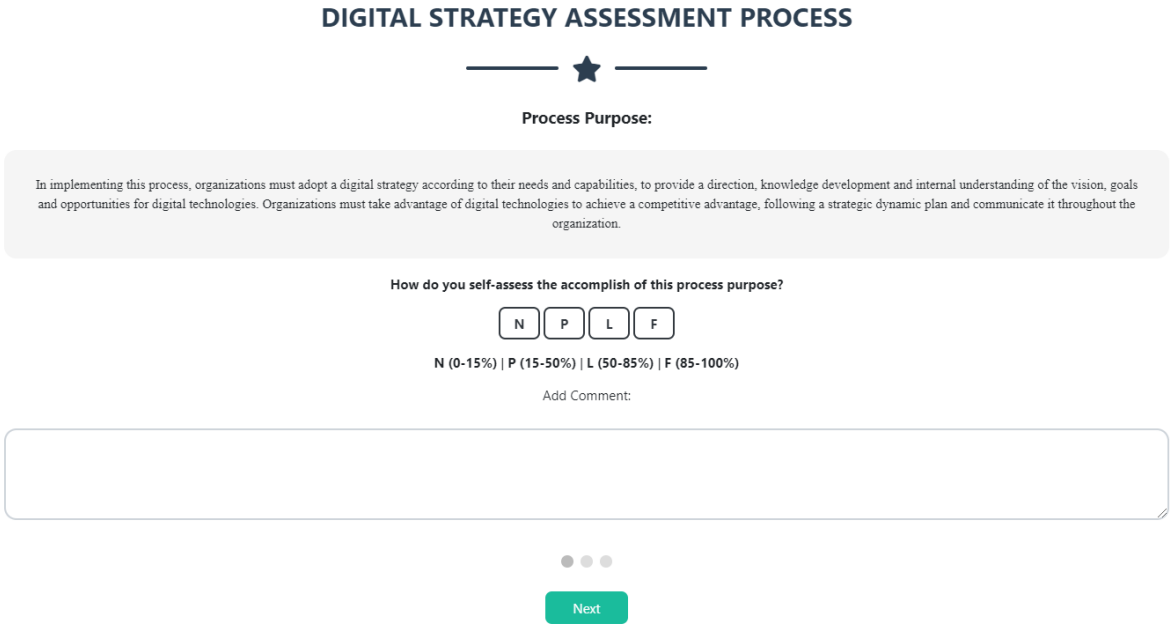

Figure 6.1: Manage digital strategy process- Process purpose, assessment of accomplishment.

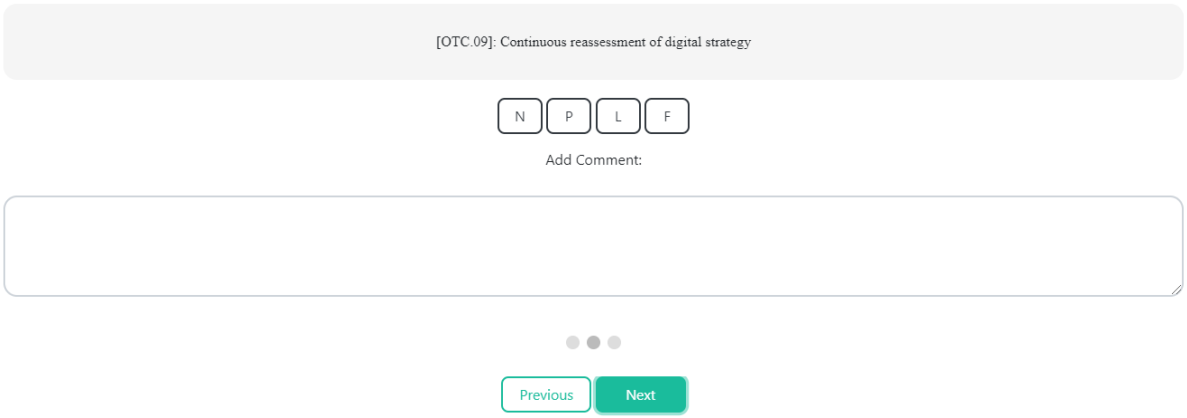

Figure 6.2: Manage digital strategy process - Outcome 9, assessment of accomplishment.

This tool allows us to collect all information in a digitized way, store the data in the cloud and keep track of the evolution of each process. Additionally, as it is a digital tool it allows for updates, new versions of the framework, to be aligned with the technological evolution and behaviour of the industries. Thus,

Figure 6.3: Example - Digital strategy capability maturity level accomplished based on answers given.

organizations can gain access to a framework that is constantly evolving and not standing still in time. Despite the importance of a digital tool that allows us more easily and more comfortably to evaluate the processes of DT, it is necessary to emphasize that this web-based software tool, in the context of this study, is just an object to deliver our framework.

6.2 Results

Our meeting took about 45 minutes, in which a brief presentation was initially made by both parties. On our side, the framework construction procedure was made known, detailing at a high level the steps taken. In the case of Company A, the company context was introduced and then focused essentially on the new Company A's digital service, with the aim of reducing waiting times.

In a second phase, the framework assessment was done by the IT Director with our proper support. The results obtained are described in the Figures 6.4, 6.5, 6.6, 6.7, that show the digital strategy assessment process performed by Company A's IT Director with the respectively rating answers according to the scale used.

Through analysis of the results, we can see that Company A already demonstrates a significant digital maturity and is already in an advanced process of DT where several solutions have been defined and implemented. The only outcome that was considered to have a lower percentage of compliance was outcome 7, which refers to the alignment between functional and operational strategies.

The third and final phase of the meeting discussed possible improvements and recommendations to the current state of the framework, where the main points to keep in mind were:

- Comparisons between companies, preferably by sector.

- Feedback at the end of the assessment. Details of next steps to be performed for processes/outcomes with lowest score.

Figure 6.4: Digital strategy process purpose assessment and process capability level achieved from last assessment results.

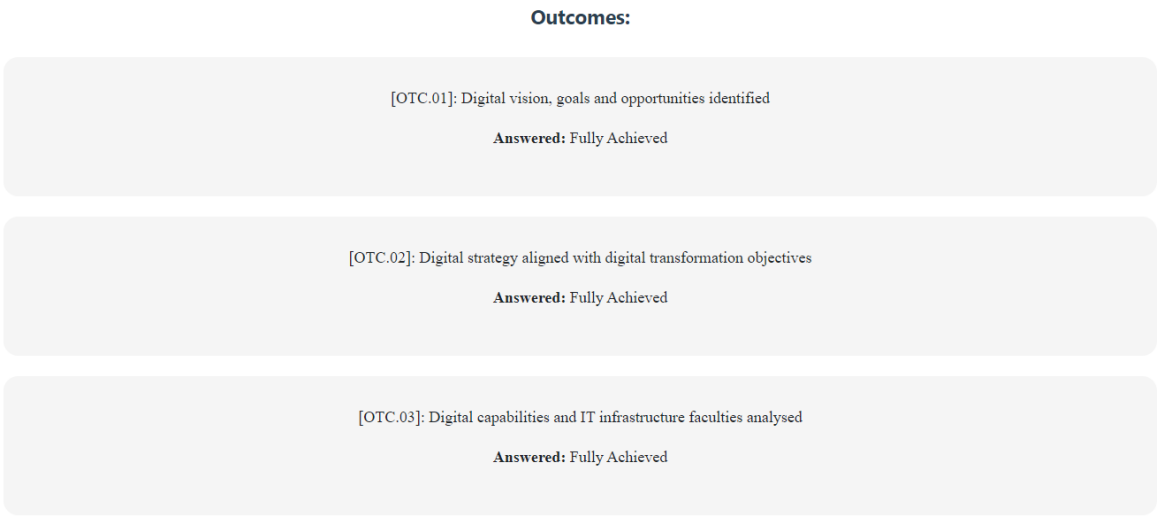

Figure 6.5: Digital strategy assessment from outcomes 1 to 3.

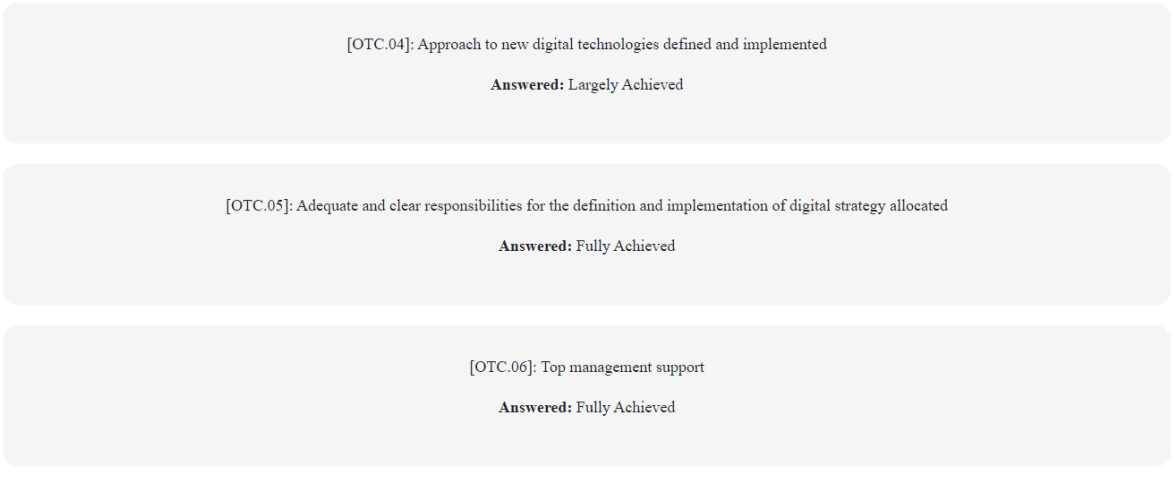

Figure 6.6: Digital strategy assessment from outcomes 4 to 6.

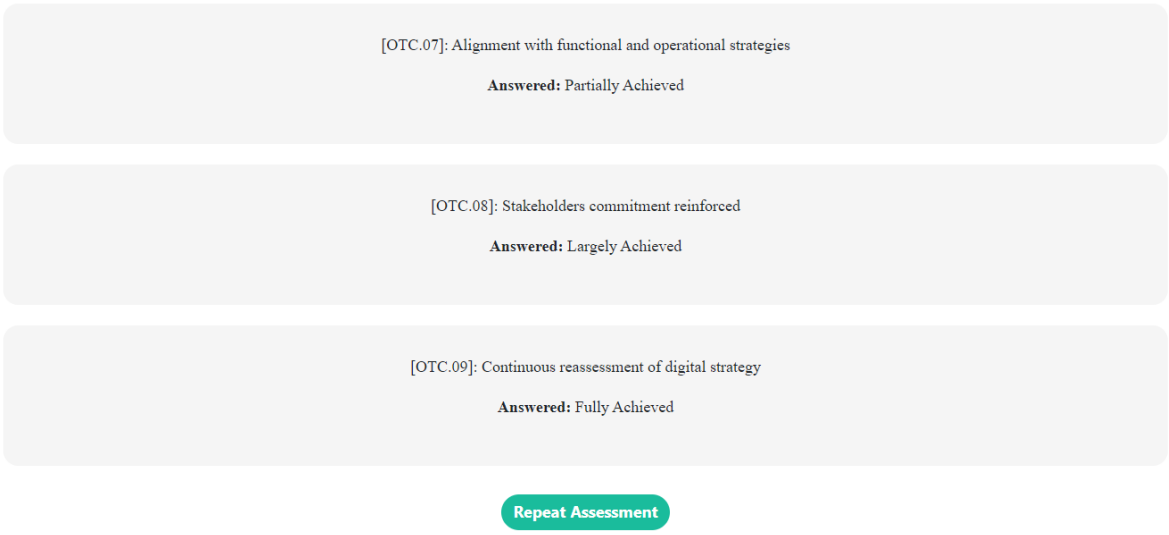

Figure 6.7: Digital strategy assessment from outcomes 7 to 9.

7

Evaluation

In accordance with the DSRM evaluation step, here we evaluate the proposed artifacts in order to prove their relevance and applicability to the research problem. For assessing and judging the proposed artifact, we followed the Pries-Hege et al. approach, in which the author presents the importance of an ex-ante perspective, with the evaluation occurring both prior to the construction of an artifact IS, and an ex-post evaluation, that is, evaluations that take place after the artifact has been built [88]. Another important reference is the classification of Venable, who identifies two main forms for the DSRM evaluation [89]:

- Artificial evaluation evaluates a solution technology in a contrived, non-real way.
- Naturalistic evaluation enables a researcher to explore how well or poorly a solution technology works in its real environment – the organization.

In our study, an artificial evaluation was performed by applying the ISO/IEC 330xx family of standards to prove that it is possible to build a capability maturity model specifically for DT, using a scientific approach based on design science research. Feasibility was demonstrated for the processes of manage digital strategy, manage digital channels, manage customer experience, manage business processes and manage business model, suggesting that it is feasible to follow the same steps for all other processes included in our PRM. A second artificial evaluation was conducted by checking the applicability of our framework into a web-based software tool.

A naturalistic evaluation was equally applied, in this case in a company, Company A, where it was possible to dispute the use of the framework in a real context, as well as its usefulness in conducting a DT program.

In a nutshell, the results prove that it is possible to build a capability maturity model for DT grounded in scientific well known standards and methodologies, in a digital form with a web based software tool, and finally can be used by organizations to help them guide their DT initiatives.

8

Communication

In harmony with the DSRM's communication proposal, we aim to communicate our artefacts to the applicable audience. For this purpose, we pursued two different ways to deliver the communication proposal described as follow:

- Publish papers through scientific journals or conferences.
- Communicate the work-study through the dissertation itself.

To reach a broader communication in our work, a paper entitled "Digital Transformation Practices based on a systematic literature review" was submitted to the ISACA Journal, which contributed to the identification of reference processes for DT. This paper still awaits confirmation of acceptance.

The second paper, "Digital Transformation Capability Maturity Model Framework", consists of the detailed realization of a specific process - manage digital strategy - which was identified in the previous article. The contribution of this paper is a framework, from a process perspective, rooted in solid scientific concepts, to guide practitioners on how to assess DT initiatives. The paper was already accepted and presented at the 2019 IEEE 23rd International Enterprise Distributed Object Computing (EDOC 2019).

A third paper is in the early stages of development, which aims to incorporate the content of the two works already completed, while also adding a demonstration of the framework in a real organizational context. The intention is to send this paper to one of the two journals:

- Information Systems Management, Rank Q2.
- Journal of Management Information Systems, Rank Q1.

Finally, the final dissertation report, containing all the content related to DT framework, will be presented to, discussed with and evaluated by a qualified jury to ensure its reliability and the quality of the scientific contribution. Subsequently, the work will be shared with the public.

9

Conclusion

Contents

DT attracts a lot of attention nowadays. In recent years, the number of publications has grown steadily, as researchers broaden the spectrum of the study for different industries. On the other hand, maturity models have been extensively researched and applied in several domains, and the importance of benchmark processes in the form of standards is well-accepted by the community. However, there is a lack of research and artifact proposals for maturity models in terms of DT, more specifically, created using scientific methods. Thereby, in the design of the proposed framework, we resorted to design science research methodology and used the ISO/IEC 330xx family of standards for structure.

Regarding the conducted study, the research problem was described – the lack of a framework with a scientifically based research to guide a DT. Therefore, our proposal was to build a DT framework consisting of a PRM and PAM in order to establish the processes relevant to the domain of DT, and then be able to evaluate for each process the capability level.

Our contribution consisted in identifying the processes relevant to the domain of DT. Our goal of presenting the reference processes was based on the lack of a framework with a scientifically based research to guide a DT. With that in mind we conducted a systematic literature review which had the following as a research question:

- What are the reference processes for DT?

The answer to this question resulted in a matrix table with the intersection between articles and processes. Additionally, a table consisting of two columns was introduced to represent the processes identified by the SLR and the correspondent justification addressed by the articles mentioning that particular process. This task was developed with the purpose of providing some evidence that would be the basis for the process in question to be considered representative of the role played in DT.

Once the processes were identified through SLR, thus constituting our PRM, we were able to move to PAM where we detailed five processes - Manage Digital Strategy, Manage Customer Experience, Manage Digital Channels, Manage Business Processes, and Manage Business Model - following the procedure and structure of ISO/IEC 330XX family of standards.

When equipped with PRM and PAM, we moved on to the framework demonstration, which consisted of an assessment of the manage digital strategy process at Company A to understand its effectiveness and usefulness in a real context.

An artificial evaluation was performed by applying the ISO/IEC 330xx family of standards to prove that it is possible to build a digital maturity model specifically for DT, using a scientific approach based on design science research. Moreover, another artificial evaluation was carried out by transforming our framework in a web-based software tool.

Lastly, a naturalistic evaluation was applied in a real case scenario, that is, in an organization like Company A.

9.1 Limitations and Future Work

The lack of research studies on a recent topic, such as DT, and in particular on the process side, has proven to be a barrier in identifying reference processes for DT.

For this reason, although process identification has been supported by a systematic literature review, the lack of a considerable number of evaluations by DT experts to validate PRM is considered by us to be a limitation.

Another limitation was the lack of application of the framework to a larger number of companies to have a broad set of naturalistic assessments. It would be desirable to conduct assessments for various companies of different sizes and industries for further analysis of the usefulness of the framework in different contexts.

The lack of time, needed to track a company's DT initiative, was also a limitation. Ideally, the result of an assessment would trigger specific actions in order to raise the capability maturity levels of DT processes. Subsequently, it was intended to make a new assessment to verify the evolution of the company in question in respect to the processes that were previously evaluated.

Since DT is a growing topic, with great interest from researchers and practitioners, and where there is little study, it is crucial to continue exploring new methods and frameworks that help large, medium-sized or small businesses navigate a DT initiative. The deepening of knowledge, as well as the contribution of new discoveries, are essential to understand the behavior of a true DT. For future work, we have defined a few preliminary objectives:

- Complete the third paper to be submitted in one of the two journals mentioned above.
- Detail all processes in PRM.
- Conduct questionnaires to DT experts and practitioners that intend to validate, reject or add processes corresponding to the DT.
- Improve the web-based software tool for a better engagement.
- Demonstrate and evaluate the framework in its entirety, i.e. evaluate all processes separately or together in at least one company.
- Demonstrate and evaluate the framework to a substantially larger number of companies, ideally in companies that differ in size and industry, with the ultimate goal of being able to benchmark effectively.
- Provide, after an assessment, the next steps to take, with a particular focus on those processes/outcomes that denote worst ratings, to help the company perform better in the business and achieve higher levels of digital maturity.

Bibliography

[1] K. Peffers, T. Tuunanen, M. A. Rothenberger, and S. Chatterjee, "A Design Science Research Methodology for Information Systems Research," *Journal of Management Information Systems*, vol. 24, no. 3, pp. 45–77, 2008.

[2] P. Brereton, B. A. Kitchenham, D. Budgen, M. Turner, and M. Khalil, "Lessons from applying the systematic literature review process within the software engineering domain," *The Journal of Systems and Software*, vol. 80, no. 4, pp. 571–583, 2007. [Online]. Available: http://dx.doi.org/10.1016/j.jss.2006.07.009

[3] H. Gimpel, S. Hosseini, R. Huber, L. Probst, M. Röglinger, and U. Faisst, "Structuring Digital Transformation: A Framework of Action Fields and its Application at ZEISS," *Journal of Information Technology Theory and Application*, vol. 19, no. 1, pp. 31–54, 2018.

[4] ed ISACA, "COBIT 5: A business framework for the governance and management of enterprise IT," *ISACA*, 2012.

[5] International Standard Organization , "Technical Specification ISO / IEC TS 33052 Information technology — Process reference model (PRM) for information security management," vol. 2016, 2016.

[6] International Standard Organization, "Technical Specification ISO / IEC TS 33072 Information technology - Process assessment - Process capability assessment model for information security management," vol. 2016, 2016.

[7] R. A. Lancioni, "A strategic approach to industrial product pricing : The pricing plan," vol. 34, no. July 2004, pp. 177–183, 2005.

[8] E. Hartl and T. Hess, "The Role of Cultural Values for Digital Transformation : Insights from a Delphi The Role of Cultural Values for Digital Transformation : Insights from a Delphi Study Full Paper Abstract," no. January 2019, 2017.

[9] I. Haffke and B. Kalgovas, "The Role of the CIO and the CDO in an Organization ' s Digital Transformation Completed Research Paper," no. December, 2016.

[10] A. Horlacher and T. Hess, “What Does a Chief Digital Officer Do ? Managerial Tasks and Roles of a New C-level Position in the Context of Digital Transformation.” in *Hawaii International Conference on System Sciences*, 2016.

[11] C. Matt, T. Hess, and A. Benlian, “Digital Transformation Strategies,” *Business & Information Systems Engineering*, vol. 57, no. 5, pp. 339–343, 2015.

[12] A. Bharadwaj, O. A. E. Sawy, P. A. Pavlou, N. Venkatraman, and O. A. E. Sawy, “Digital Business Strategy: Toward a Next Generation of Insights,” *MIS Quarterly, Management Information Systems Research Center, University of Minnesota*, vol. 37, no. 2, pp. 471–482, 2013.

[13] C. Heavin and D. J. Power, “Challenges for digital transformation – towards a conceptual decision support guide for managers,” *Journal of Decision Systems*, vol. 0125, no. May, pp. 1–8, 2018. [Online]. Available: https://doi.org/10.1080/12460125.2018.1468697

[14] B. Y. B. Solis, W. A. Littleton, and T. Leaders, “The 2017 State of Digital Transformation Contents,” no. October, pp. 1–38, 2017.

[15] B. Tabrizi, E. Lam, K. Gerard, and V. Irvin, “Digital Transformation Is Not About Technology.” *Harvard Business Review Digital Articles*, pp. 2–6, 2019.

[16] J. Russell, K.D., O’Raghallaigh, P., O’Reilly, P. and Hayes, “Business to Digital Transformation : A Proposed Framework for Achieving Business Intelligence Alignment,” in *Irish Academy of Management Annual Conference 2018, University College Cork*, 2018.

[17] N. Sebastian, I., Ross, J., Beath, C., Mocker, M., Moloney, K., & Fonstad, “How Big Old Companies Navigate Digital Transformation,” *MIS Quarterly Executive*, vol. 16, no. 3, pp. 197–213, 2017.

[18] D. Gerster, “Digital Transformation and IT: Current State of Research,” *Pacific Asia Conference on Information Systems 2017 Proceedings*, p. 12, 2017.

[19] L. Li, “Digital transformation by SME entrepreneurs : A capability perspective,” no. February 2016, pp. 1129–1157, 2018.

[20] R. Hansen and S. K. Sia, “Hummel ’ s Digital Transformation Toward Omnichannel Retailing : Key Lessons Learned,” vol. 14, no. June, 2015.

[21] D. B. Michael Fitzgerald, Nina Kruschwitz and M. Welch, “Embracing Digital Technology: A New Strategic Imperative, Capgemini Consulting Worldwide,” *MIT Sloan Management Review*, vol. 55, no. 1, pp. 1–13, 2013. [Online]. Available: https://www.capgemini-consulting.com/SMR

[22] G. C. Kane, D. Palmer, D. Kiron, and N. Buckley, “Aligning the Organization for Its Digital Future,” no. 58180, 2016.

[23] T. Hess, A. Benlian, C. Matt, and F. Wiesböck, “Options for Formulating a Digital Transformation Strategy,” vol. 2016, no. June, pp. 17–33, 2016.

[24] Hevner, March, Park, and Ram, “Design Science in Information Systems Research,” *MIS Quarterly*, vol. 28, no. 1, p. 75, 2004. [Online]. Available: https://www.jstor.org/stable/10.2307/25148625

[25] B. Kitchenham, “Procedures for Performing Systematic Reviews.”

[26] T. Puthiyamadam, “How the Meaning of Digital Transformation Has Evolved,” *Harvard Business Review*, 2017.

[27] G. C. Kane, “Digital Maturity, Not Digital Transformation,” *MIT Sloan Management Review*, 2017. [Online]. Available: http://sloanreview.mit.edu/article/digital-maturity-not-digital-transformation/

[28] A. Bonnet, D., Ferraris, P., Westerman, G. and McAfee, “Talking ‘ bout a revolution,” *Digital Transformation Review*, pp. 17–33, 2012.

[29] Deloitte, “Deloitte Digital Maturity Model,” no. February, 2018.

[30] M. Gill and S. VanBoskirk, “The Digital Maturity Model 4 . 0,” *Forrester*, pp. 0–17, 2016.

[31] P. Offermann, O. Levina, and M. Schönherr, “Outline of a Design Science Research Process,” in *Proceedings of the 4th international conference on design science research in infor-mation systems and technology*, 2009.

[32] H. C. Lucas and J. M. Goh, “Disruptive technology: How Kodak missed the digital photography revolution,” *Journal of Strategic Information Systems*, vol. 18, no. 1, pp. 46–55, 2009. [Online]. Available: http://dx.doi.org/10.1016/j.jsis.2009.01.002

[33] D. Kurti, E., Haftor, “No Title,” *In Proceedings of 9th European Conference on Information Management and Evalua-tion*, 2015.

[34] T. V. Leipzig, M. Gamp, D. Manz, and K. Schöttle, “Initialising customer-orientated digital transformation in enterprises,” *Procedia Manufacturing*, vol. 8, no. October 2016, pp. 517–524, 2017. [Online]. Available: http://dx.doi.org/10.1016/j.promfg.2017.02.066

[35] P. Hoberg, H. Krcmar, G. Oswald, and B. Welz, “Skills for Digital Transformation,” 2015.

[36] A. Horlacher, T. Hess, and P. Klarner, “Crossing Boundaries : Organization Design Parameters Surrounding CDOs and Their Digital Transformation Activities Full Paper,” no. 1988, pp. 1–10, 2016.

[37] World Economic Forum, “Digital Transformation of Industries : Digital Enterprise,” 2016.

[38] A. Westerman, G., Calméjane, C., Bonnet, D., Ferraris, P., McAfee, “Digital Transformation: A Roadmap for Billion-Dollar Organizations,” *MIT Center for Digital Business and Capgemini Consulting*, 2011.

[39] E. Stolterman and A. Croon Fors, “Information Technology and The Good Life,” *Information Systems Research: Relevant Theory and Informed Practice*, vol. 1, no. 1, pp. 687–692, 2004.

[40] G. Gudergan and P. Mugge, “The gap between the practice and theory of Digital Transformation,” pp. 1–15, 2017.

[41] G. Westerman and T. H. Davenport, “Why So Many High-Profile Digital Transformations Fail,” pp. 1–6, 2018. [Online]. Available: https://hbr.org/2018/03/why-so-many-high-profile-digital-transformations-fail

[42] B. Kara, “5 reasons companies struggle with digital transformation,” *MIT Sloan Management Review*, 2018.

[43] K. D. Russell, P. O’Raghallaigh, P. O’Reilly, and J. Hayes, “Digital privacy GDPR: A proposed digital transformation framework_[U+3010][U+5F69][U+4E91][U+5C0F][U+8BD1][U+3011].pdf,” *Americas Conference on Information Systems 2018: Digital Disruption, AMCIS 2018*, 2018.

[44] T. Zomer, A. Neely, and V. Martinez, “Enabling Digital Transformation: An Analysis Framework,” no. June, 2018. [Online]. Available: www.cambridgeservicealliance.org

[45] C. M. MacKenzie, K. Laskey, F. McCabe, P. F. Brown, and R. Metz, “Reference Model for Service Oriented Architecture 1.0,” *OASIS Standard*, 2006.

[46] O. Mangin, N. Mayer, B. Barafort, and P. Heymans, “An Improvement of Process Reference Model Design and Validation Using Business Process Management,” *SPICE 2013, CCIS*, vol. 349, pp. 73–83, 2013.

[47] T. de Bruin and M. Rosemann, “Towards a business process management maturity model,” *Proceedings of the 13th European Conference on Information Systems*, no. May, pp. 521–532, 2005. [Online]. Available: http://sdaw.info/asp/aspecis/20050045.pdf

[48] C. V. Weber, M. C. Paulk, C. J. Wise, and J. V. Withey, “Key Practices of the Capability Maturity Model,” *CMU/SEI-91-TR-25. CARNEGIE-MELLON UNIV PITTSBURGH PA SOFTWARE ENGINEERING INST*, 1991.

[49] C. V. Paulk, M. C., Curtis, B., Chrissis, M. B., Weber, “Capability Maturity Model for Software, Version 1.1,” *IEEE software*, pp. 18–27, 1993.

[50] J. Becker, R. Knackstedt, and J. Pöppelbuß, “Developing Maturity Models for IT Management,” *Business & Information Systems Engineering*, vol. 1, no. 3, pp. 213–222, 2009.

[51] M. Rosemann, T. De Bruin, and T. Hueffner, “A Model for Business Process Management Maturity,” *Australasian (ACIS)*, p. 7, 2004.

[52] M. Rohloff, “Case study and maturity model for business process management implementation,” *International Conference on Business Process Management, Springer*, pp. 128–142, 2009.

[53] U. Kulkarni and R. Freeze, “Development and Validation of a Knowledge Management Capability Assessment Model,” *25th International conference on information systems (ICIS)*, pp. 657–669, 2004.

[54] P. Gottschalk, “Maturity levels for interoperability in digital government,” *Government Information Quarterly*, vol. 26, no. 1, pp. 75–81, 2009. [Online]. Available: http://dx.doi.org/10.1016/j.giq.2008.03.003

[55] International Standard Organization, “Technical Specification ISO / IEC TS 33002 Information technology - Process assessment - Requirements for performing process assessment,” 2015.

[56] International Standard Organization , “Technical Specification ISO / IEC TS 33001 Information technology - Process assessment - Concepts and terminology,” 2015.

[57] K. Liere-Netheler, K. Vogelsang, S. Packmohr, and U. Hoppe, “Towards a Framework for Digital Transformation Success in Manufacturing,” *26th European Conference on Information Systems (ECIS 2018)*, no. Schwab 2017, pp. 1–19, 2018.

[58] S. Berghaus and A. Back, “Disentangling The Fuzzy Front End of Digital Transformation: Activities and Approaches,” *Thirty Eigth International Conference on Information Systems*, pp. 1–17, 2017.

[59] M. Lederer, S. Betz, and W. Schmidt, “Digital Transformation , Smart Factories , and Virtual Design – Contributions of Subject Orientation,” *International Conference on Subject-Oriented Business Process Management*, 2018.

[60] A. Manfreda, “New Business Models – From Business Process Redesign To The Digital Transformation Era,” vol. 1, no. 1, pp. 69–79, 2018.

[61] S. Sathananthan, P. Hoetker, D. Gamrad, D. Katterbach, and J. Myrzik, “Realizing digital transformation through a digital business model design process,” *2017 Internet of Things Business Models, Users, and Networks. IEEE*, 2017.

[62] S. Seufert and C. Meier, “From eLearning to Digital Transformation: A Framework and Implications for L&D,” *International Journal of Advanced Corporate Learning (iJAC)*, vol. 9, no. 2, p. 27, 2016.

[63] N. Sahu, H. Deng, and A. Molla, “A capability based framework for customer experience focused digital transformation,” 2018.

[64] J. A. Perez Gama, A. Vega Vega, and M. Neira Aponte, “University Digital Transformation Intelligent Architecture: A Dual Model, Methods and Applications,” no. July, pp. 19–21, 2018.

[65] M. Ylinen and S. Pekkola, “A Process Model for Public Sector It Management to Answer the Needs of Digital Transformation,” *Proceedings of the 52nd Hawaii International Conference on System Sciences*, pp. 6219–6228, 2019.

[66] M. Kirchmer, “Business Process Management 4 . 0 : Enabling a Value-Driven Digital Transformation,” no. September, 2018.

[67] J. Stanković and J. Djorđević-Boljanović, “Knowledge As a Source of Value in the Process of Marketing Channel Digital,” *IBC 2012 Internet & Business Conference*, no. June 2012, pp. 0–7, 2012.

[68] L. Heilig, E. Lalla-Ruiz, and S. Voß, “Digital transformation in maritime ports: analysis and a game theoretic framework,” *NETNOMICS: Economic Research and Electronic Networking*, vol. 18, no. 2-3, pp. 227–254, 2017.

[69] W. Caputa, “the Process of Digital Transformation As a Challenge for Companies,” *Zeszyty Naukowe Politechniki Częstochowskiej Zarządzanie*, vol. 27, no. 1, pp. 72–84, 2018.

[70] D. Schuchmann and S. Seufert, “Corporate Learning in Times of Digital Transformation: A Conceptual Framework and Service Portfolio for the Learning Function in Banking Organisations,” *International Journal of Advanced Corporate Learning (iJAC)*, vol. 8, no. 1, p. 31, 2015.

[71] C. E. S. Arbaiza, “Critical variables for success in the technology adoption process in the framework of digital transformation,” pp. 109–113, 2018.

[72] C. C. Manfred Schmitz, Christian Dietze, “Enabling Digital Transformation Through Robotic Process.pdf,” *Digitalization Cases: How Organizations Rethink Their Business for the Digital Age, Springer International Publishing*, pp. 15–33, 2019.

[73] N. M. Ochara, A. Sotnikov, A. Kadyamatimba, and Y. Telnov, “Digital Transformation of Enterprises : A Transition Using Process Modelling Antecedents,” *2018 Open Innovations Conferencee (OI), Johannesburg*, pp. 325–331, 2018.

[74] T. V. Ershova, Y. E. Hohlov, and S. B. Shaposhnik, “Methodology for Digital Economy Development Assessment as a Tool for Managing the Digital Transformation Processes,” *2018 Eleventh International Conference ”Management of large-scale system development” (MLSD*, vol. 2, no. 3, pp. 1–3, 2018.

[75] M. L.-s. S.-e. Processess, T. V. Ershova, and Y. E. Hohlov, "Digital Transformation Framework Monitoring of Large-Scale Socio-Economic Processess," *2018 Eleventh International Conference "Management of large-scale system development" (MLSD)*, pp. 1–3, 2018.

[76] M. A. Sanchez, "A Framework to assess organizational readiness for the digital transformation," *Dimensión Empresarial*, vol. 15, no. 2, pp. 27–40, 2017. [Online]. Available: http://ojs.uac.edu.co/index.php/dimension-empresarial/article/view/976

[77] A. Issa, B. Hatiboglu, A. Bildstein, and T. Bauernhansl, "Industrie 4.0 roadmap: Framework for digital transformation based on the concepts of capability maturity and alignment," *Procedia CIRP*, vol. 72, pp. 973–978, 2018. [Online]. Available: https://doi.org/10.1016/j.procir.2018.03.151

[78] L. Gehrke, R. Bonse, and M. Henke, "Towards a management framework for the digital transformation of logistics and manufacturing," *23rd EurOMA Conference*, no. October, pp. 1–10, 2016.

[79] K. L. Johan Sandberg, Jonny Holmström, "Digital Transformation of ABB Through Platforms: The Emergence of Hybrid Architecture in Process Automation," *Digitalization Cases: How Organizations Rethink Their Business for the Digital Age. Springer International Publishing*, pp. 273–291, 2019.

[80] A. Baryshnikova and V. Taratukhin, "Digital Transformation Framework for Smart Factory," *American Conference on Information Systems 2017 Workshop on Smart Manufacturing Proceedings*, 2017. [Online]. Available: http://aisel.aisnet.org/sigbd2017

[81] L. Santiago da Costa, L. Pereira, and A. Akkari, "A Proposed Framework to Identify Digital Transformation Maturity in Small Industries," *Proceedings Name*, vol. 156, no. November, pp. 30–33, 2018.

[82] M. A. Tîţu, E. Eng, A. Stanciu, and [U+FFFD] Ţîţu, "Business Process Outsourcing. Integrity in an era of digital transformation," *Journal of Electrical Engineering, Electronics, Control and Computer Science – JEEECCS*, vol. 4, no. 11, pp. 1–4, 2018.

[83] K. B. Charlotte Vogt, Martin Gersh, Claudia Spies, "Digital Transformation in Healthcare: How the Potential of Digital Heaalth is Tackled to Transform the Care Process of Intensive Care Patient Across All Healthcare Sectors," pp. 343–361, 2019.

[84] J. Ryan, B. Doster, S. Daily, and C. Lewis, "A Case Study Perspective to the Digital Transformation of a Hospital's Perioperative Process," *Proceedings of the 52nd Hawaii International Conference on System Sciences*, vol. 6, pp. 4049–4058, 2019.

[85] A. M. Hansen and L. Mathiassen, "Uarterly xecutive," vol. 10, no. 4, pp. 61–64, 2011.

[86] D. Paschek, C. T. Luminosu, and A. Draghici, “Automated business process management – in times of digital transformation using machine learning or artificial intelligence,” *MATEC Web of Conferences*, vol. 121, p. 04007, 2017.

[87] A. Shrestha, A. Cater-Steel, M. Toleman, and T. Rout, “Benefits and relevance of International Standards in a design science research project for process assessments,” *Computer Standards and Interfaces*, vol. 60, no. May, pp. 48–56, 2018. [Online]. Available: https://doi.org/10.1016/j.csi.2018.04.011

[88] J. Pries-Heje, R. Baskerville, and J. R. Venable, “Strategies for Design Science Research Evaluation,” in *Proceedigns of the 16th European Conference on Information Systems (ECIS 2008)*, 2008. [Online]. Available: http://aisel.aisnet.org/ecis2008/87

[89] J. R. Venable, “A Framework For Design Science Research Activities,” *Emerging Trends and Challenges in Information Technology Management*, no. 2, pp. 184–187, 2006.