HAROKOPIO UNIVERSITY

SCHOOL OF DIGITAL TECHNOLOGY
DEPARTMENT OF INFORMATICS AND TELEMATICS

DIGITAL TRANSFORMATION PROJECT MANAGEMENT METHODOLOGY IMPLEMENTATION

Master Thesis

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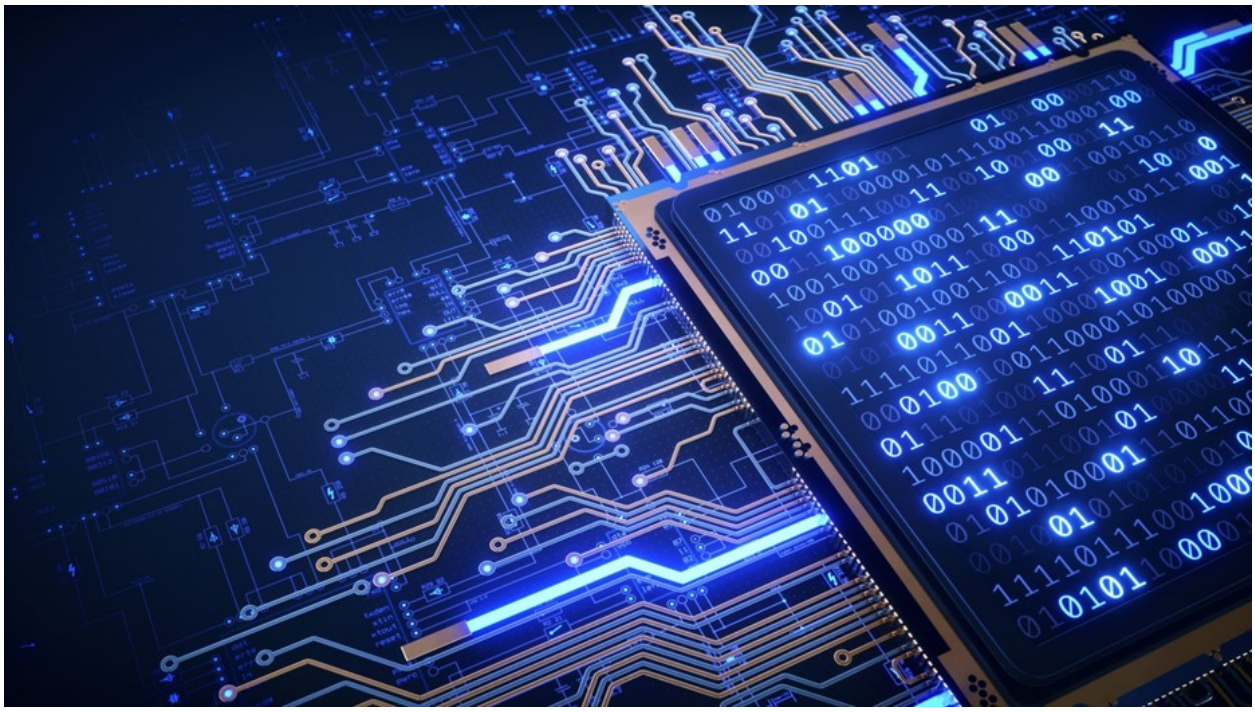

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Dedication Page

To my father...

Quote Page

Capturing and executing a project in the context of business reality has always been a battle (or many battles together) in the war of business survival. A conflict of forces and interests with tensions, losses, sometimes with ”winners”, while even more often, with many ”losers”.
Stelios Vogiatzis

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Reflecting at the end of this journey, I do not regret having undertaken it despite all the difficulties, pressing deadlines, and heavy workload. I have been a thrilling learning experience, which has helped me grow as a researcher and person. Now that I am closing this chapter of my life, I can only wish that the bonds formed during the past years will remain and strengthen in the years to come, wherever my path may take me to.

Contents

Περίληψη

Η Διπλωματική Εργασία αφορά στην ανάπτυξη Μοντέλου Διοίκησης Έργων με στόχο τον Ψηφιακό Μετασχηματισμό των Επιχειρήσεων. Αρχικά, θα καθοριστούν τα βασικά στοιχεία του ψηφιακού μετασχηματισμού, δηλαδή οι ορισμοί, τα χαρακτηριστικά του, οι οδηγοί, οι βασικές επιπτώσεις, η ψηφιακή ωριμότητα κ.λπ. Στη συνέχεια, θα αναφερθούν μεθοδολογικά ζητήματα σχετικά με τη διαχείριση έργων υλοποίησης Πληροφοριακών Συστημάτων με στόχο την επίτευξη Επιχειρήσεων και Ψηφιακού Μετασχηματισμού. Συγκεκριμένα, θα πραγματοποιηθεί σύγκριση των μεθοδολογιών διαχείρισης έργων και θα δούμε ποια είναι κατάλληλη και αποτελεσματική για τη διαχείριση έργων ψηφιακού μετασχηματισμού. Στη συνέχεια, θα αξιολογηθούν οι κύριοι παράγοντες επιτυχίας και αποτυχίας ανά φάση ενός έργου ψηφιακού μετασχηματισμού. θα καταγραφούν όλα εμπόδια και ο τρόπος με τον οποίο η πανδημία επηρέασε τον ψηφιακό μετασχηματισμό. Επιπλέον, θα παρουσιαστούν επιτυχημένες και ανεπιτυχείς μελέτες περιπτώσεων που θα δομηθούν με συγκεκριμένο τρόπο για να έχουν αρχή, μέση και τέλος. Τέλος, θα εξαχθούν συμπεράσματα και θα προταθεί το τελικό μοντέλο που βασίζεται σε δεδομένα από μελέτες περιπτώσεων. Το τελικό μας μοντέλο θα παρουσιάσει την μελέτη περίπτωσης που θα αφορά τον ψηφιακό μετασχηματισμό μιας ασφαλιστικής εταιρείας και την πρόταση ενός σχεδίου διαχείρισης ψηφιακών έργων για την επίτευξή του.

Λέξεις κλειδιά: [Ψηφιακός Μετασχηματισμός, Διοίκηση Έργων, Ψηφιακή Ωριμότητα, Ψηφιακές Επιχειρήσεις]

Abstract

The Thesis concerns the development of a Project Management Model aiming at the Digital Transformation of Businesses. First, the basic elements of digital transformation will be defined, ie its definitions, characteristics, drivers, key implications, digital maturity, etc. Next, methodological issues related to the management of Information Systems implementation projects aimed at achieving Business and Digital Transformation will be reported. Specifically, a comparison of project management methodologies will be made and we will see which one is appropriate and effective for digital transformation project management. Next, the main factors of success and failure per phase of a digital transformation project will be evaluated. all the obstacles and the way in which the pandemic affected the digital transformation will be recorded. In addition, successful and unsuccessful case studies will be presented that will be structured in a specific way to have a beginning, middle and end. Finally, conclusions will be drawn and the final model based on data from case studies will be proposed. Our final model will present the case study that will involve the digital transformation of an insurance company and the proposal of a digital project management plan to achieve it.

Keywords: [Digital Transformation, Project Management, Digital Project, Digital Maturity, Digital Enterprises]

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Shortcuts

PM	Project Management
DT	Digital Transformation
IT	Information Technology
CRM	Customer Relationship Management
IAM	Identity and Access Management
KPIs	Key Performance Indicators
IoT	Internet of Things
IoMT	Internet of Medical Things
SSO	Single Sign On
DESI	Digital Economy and Society Index
EU	European Union
SLA	Service-level Agreement
PMO	Project Management Officer
RPA	Robotic Process Automation
BCP	Business Continuity Plan
MDM	Master Data Management
UAT	User Acceptance Testing
QA	Quality assurance
HR	Human Resources

1 Introduction

1.1 Purpose

Digital Transformation The recent surge of interest in "digital transformation" is changing the business landscape and posing several both organizational and sectoral challenges. The digital transformation of business is a change associated with the application of digital technology in all aspects of business and enables organizations to create new products, services and find more efficient ways of doing business. It concerns the changes digital technologies can bring about on some or all segments within an organization or on entire business models within a specific industry. An interesting example of digital transformation (at different levels of analysis) is the music industry where the advent of the Internet, and related software developments, caused a deep shift in the mechanics of music distribution. Within music industry, first the CD's were replaced by downloads music, such as MP3 and MP4 files, and then streaming services of total recorded music were grown globally. This means that technology transformation has caused deep changes on ways of music distribution, so influencing business strategies, organizational structures, and processes—even before the services provided—of music companies and the growth of a new sector, well known as "Artist and Label Services". The digital transformation is happening within and across organizations of all types, in every industry, so resulting as a disruptive innovation enabling to break down barriers between things, people, and organizations, as well as to create more adaptive processes. In the information age, it is imperative for organizations to develop IT-related capabilities that allow leveraging the potential from digital technologies. Due to the pervasive effects of such transformation on processes, firms, and industries, both scholars and practitioners are interested in better understanding the key mechanisms behind digital business transformation emergence and evolution. In the era of digital transformation, companies are seeking new opportunities to reshaping their business model and to transform their operations, in the order of greater customer interaction and collaboration and to gain competitive advantage through differentiation strategies. (Agrifoglio, Lamboglia, Mancini, & Ricciardi, 2020)

Project Management Project management aims to utilize resources across all technology tracks to achieve the intended goals within a set schedule. Managing digital projects involves managing various digital technologies (e.g., content management systems, portals, search, analytics, etc.) to achieve high-quality deliverables. The vast majority of project management failures we see can be traced back to requirements management, scope creep, change request handling, adoption failures, or sustained maintenance—all activities that are in the realm of project management. (Shivakumar, 2018c)

Our approach Our purpose is to examine the concept of digital transformation and its relationship with the project management by doing an analysis of the available literature on the subject.

Doing this will lead us to have a clearer view of the definition, the characteristics and the concept of digital transformation and project management. Specifically, the phenomenon of digital transformation will be conceptualized, the drivers of digital transformation will be explained, project management practices of digital transformation will be examined, and case companies' actions in digital transformation will be analyzed.
The problem that arises is that new technologies are constantly emerging where companies undertake the adoption of these with the ultimate goal of their business continuity, which cause changes in operations and this transformation requires proper management as a project to be carried out successfully.

1.2 Structure

The main part of the thesis is divided into seven chapters:

1. The introduction chapter, first chapter, provides a general introduction to the research topic. It also discusses the purpose of the research and the chosen research methods and approaches.
2. In the second chapter of this thesis, we will define the basic elements of digital transformation, ie the definitions, its characteristics, the drivers, the key impacts, the transformed areas, the digital maturity etc.
3. In the third chapter, we will compare project management methodologies, and see if it is suitable for managing digital transformation projects. Also, we set the metrics and key performance indicators (KPIs) to be measurable, the performance of the project.
4. In the empirical part, fourth chapter, we will examine the case studies which start to capture best principles and practices for digital transformations. They provide some in-depth insights into what is and is not working.
5. In fifth chapter, we will present the customized case study that will concern the digital transformation of an insurance company and the proposal of a digital project management plan to achieve it.
6. In sixth chapter, we will identify the barriers and how the pandemic affected the digital transformation.
7. Finally, a conclusion to summarize the thesis will be provided.

2 Digital Transformation

2.1 Definition of Digital Transformation

The digital transformation of business is a new important phenomenon and until now does not exist a clear, structured definition. After a survey of the literature there is a plethora of existing definitions of Digital Transformation. In a systematic literature review from Vial, (Vial, 2019), a sample from twenty-eight (28) sources, describes twenty-three (23) unique definitions. As each of them are based on understanding of the past, we will hold on from 2017 on wards. More specifically, see the following table:

Table 1: Extant Definitions of DT

Definitions of Digital Transformation	
Definition	Source
The use of technology to radically improve performance or reach of enterprises.	(Westerman et al., 2011), (Westerman, Bonnet, & McAfee, 2014), (Karagiannaki, Vergados, & Fouskas, 2017)
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). [emphasis original]	(Fitzgerald, Kruschwitz, Bonnet, & Welch, 2014), (Liere-Netheler, Vogelsang, & Packmohr, 2018)
Digital transformation strategy is 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.	(Matt, Hess, & Benlian, 2015)
Digital transformation involves leveraging digital technologies to enable major business improvements, such as enhancing customer experience or creating new business models.	(Piccinini, Hanelt, Gregory, & Kolbe, 2015)
Use of digital technologies to radically improve the company's performance.	(Bekkhus, 2016)
Digital transformation encompasses both process digitization with a focus on efficiency, and digital innovation with a focus on enhancing existing physical products with digital capabilities.	(Berghaus & Back, 2016)

Continuation of Definitions 1	
Definition	Source
Digital transformation is the profound and accelerating transformation of business activities, processes, competencies, and models to fully leverage the changes and opportunities brought by digital technologies and their impact across society in a strategic and prioritized way.	(Demirkan, Spohrer, & Welser, 2016)
Digital transformation encompasses the digitization of sales and communication channels, which provide novel ways to interact and engage with customers, and the digitization of a firm's offerings (products and services), which replace or augment physical offerings. Digital transformation also describes the triggering of tactical or strategic business moves by data-driven insights and the launch of digital business models that allow new ways to capture value.	(Haffke, Kalgovas, & Benlian, 2016)
Digital transformation is concerned with the changes digital technologies can bring about in a company's business model, which result in changed products or organizational structures or in the automation of processes. These changes can be observed in the rising demand for Internet-based media, which has led to changes of entire business models (for example in the music industry).	(Hess, Matt, Benlian, & Wiesböck, 2016)
Use of new digital technologies, such as social media, mobile, analytics or embedded devices, in order to enable major business improvements like enhancing customer experience, streamlining operations or creating new business models.	(Horlacher, Klarner, & Hess, 2016), (Singh & Hess, 2020)

Continuation of Definitions 1	
Definition	Source
Changes and transformations that are driven and built on a foundation of digital technologies. Within an enterprise, digital transformation is defined as an organizational shift to big data, analytics, cloud, mobile and social media platform. Whereas organizations are constantly transforming and evolving in response to changing business landscape, digital transformation are the changes built on the foundation of digital technologies, ushering unique changes in business operations, business processes and value creation.	(Nwankpa & Datta, 2017)
Digital transformation is not a software upgrade or a supply chain improvement project. It's a planned digital shock to what may be a reasonably functioning system.	(Andriole, 2017)
Extended use of advanced IT, such as analytics, mobile computing, social media, or smart embedded devices, and the improved use of traditional technologies, such as enterprise resource planning (ERP), to enable major business improvements.	(Chanias, 2017)
The changes digital technologies can bring about in a company's business model, which result in changed products or organizational structures or automation of processes.	(Clohessy, Acton, & Morgan, 2017)
Distinguishes itself from previous IT-enabled business transformations in terms of velocity and its holistic nature.	(Hartl & Hess, 2017)
Transformations in organizations that are driven by new enabling IT/IS solutions and trends.	(Heilig, Schwarze, & Voß, 2017)

Continuation of Definitions 1	
Definition	Source
Digital transformation as encompassing the digitization of sales and communication channels and the digitization of a firm's offerings (products and services), which replace or augment physical offerings. Furthermore, digital transformation entails tactical and strategic business moves that are triggered by data-driven insights and the launch of digital business models that allow new ways of capturing value.	(Horlach, Drews, Schirmer, & Böhmann, 2017)
The best understanding of digital transformation is adopting business processes and practices to help the organization compete effectively in an increasingly digital world.	(Kane, Palmer, Nguyen-Phillips, Kiron, & Buckley, 2017), (Kane, 2017)
Digital transformation describes the changes imposed by information technologies (IT) as a means to (partly) automatize tasks.	(Legner et al., 2017)
Digital transformation highlights the impact of IT on organizational structure, routines, information flow, and organizational capabilities to accommodate and adapt to IT. In this sense, digital transformation emphasizes more the technological root of IT and the alignment between IT and businesses.	(Li, Su, Zhang, & Mao, 2018)
An evolutionary process that leverages digital capabilities and technologies to enable business models, operational processes and customer experiences to create value.	(Morakanyane, Grace, & O'Reilly, 2017)
The use of new digital technologies, in order to enable major business improvements in operations and markets such as enhancing customer experience, streamlining operations or creating new business models	(Paavola, Hallikainen, & Elbanna, 2017)
Fundamental alterations in existing and the creation of new business models […] in response to the diffusion of digital technologies such as cloud computing, mobile Internet, social media, and big data.	(Remane, Hanelt, Wiesboeck, & Kolbe, 2017)

Continuation of Definitions 1	
Definition	Source
A process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies.	(Vial, 2019)
Note: Definitions are sorted chronologically and alphabetically.	

By analyzing the DT definitions, it is possible to decompose them into the most frequent key components: use of digital technologies, new business models, internal operations, customer experience, society transformation, change process, organizational transformation, digital innovation, digital economy, organizational transformation, value creation, and products and services. (Van Veldhoven & Vanthienen, 2019)

2.2 Defining Digitization

Digitization is the encoding of analog information into a digital format (i.e., into zeros and ones) such that computers can store process, and transmit such information. Research also refers to digitization as a change of analog to digital tasks, or conceptualized it as the integration of IT with existing tasks, and, more broadly, as the development or enabler of cost-effective resource configurations using IT. Based on the above, we define digitization to describe the action to convert analog information into digital information. Examples concern the use of digital forms in ordering processes, the use of digital surveys, or the use digital applications for internal financial declarations. Typically, digitization mainly digitalizes internal and external documentation processes, but does not change value creation activities. (Verhoef et al., 2021)

2.3 Defining Digitalization

Digitalization describes how IT or digital technologies can be used to alter existing business processes. For example, the creation of new online or mobile communication channels that allow all customers to easily connect with firms, and which change traditional firm-customer interactions. Such a change often involves the organization of new sociotechnical structures with digital artifacts, which were not possible without digital technologies. In digitalization, IT serves as a key enabler to seize new business possibilities by changing existing business processes, such as communication, distribution, or business relationship management. Through digitalization firms apply digital technologies to optimize existing business processes by allowing a more efficient coordination between processes, and/or by creating additional customer value through enhancing user

experiences. Hence, digitalization is not only focused on cost savings, but also includes process improvements that may enhance customer experiences.(Verhoef et al., 2021)

2.4 Key Transformed Areas of Digital Transformation

Business Models, Operational Processes Customer Experiences are acknowledged as the key transformed areas of digital transformation initiatives. Focusing transformation on these 3 key areas naturally engages transformation in other aspects of the organization, thus, enabling the transformation impacts to be felt across the organization, see Figure 1, (Westerman et al., 2011). For example, transforming operational processes within the organization has the potential to create an impact in other aspects of the organization, such as improving efficiency, costs saving for both the organization and the customer, resulting in value creation. (Morakanyane et al., 2017)

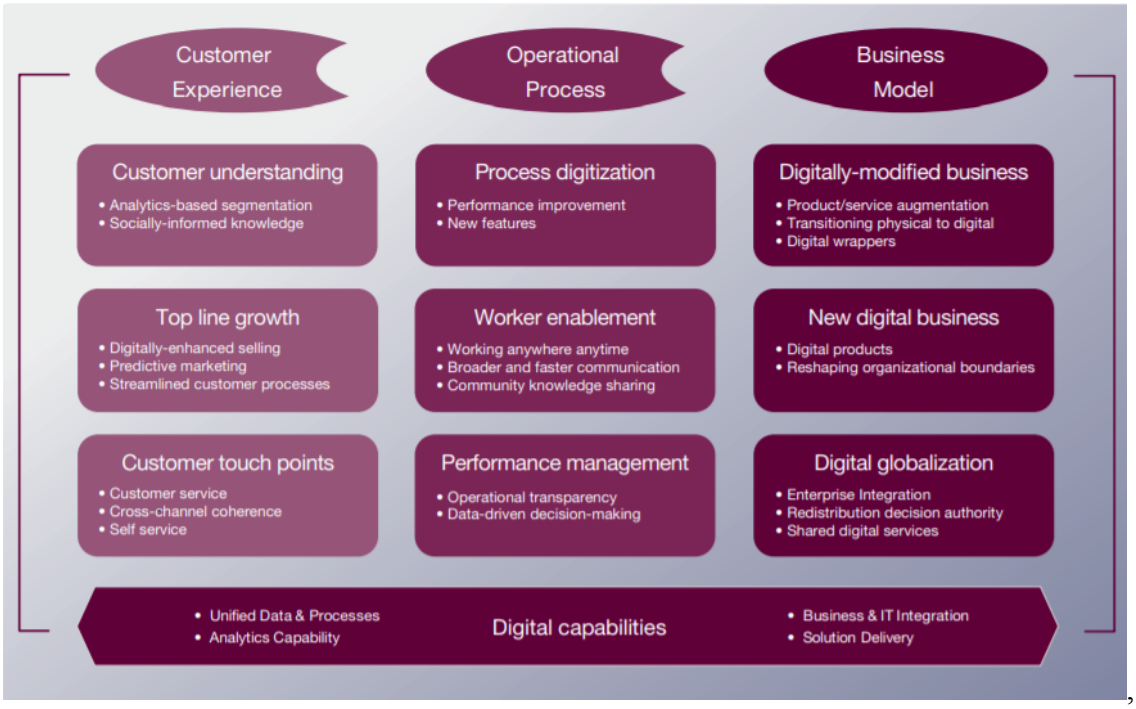

Figure 1: Building blocks of the digital transformation

2.5 Drivers of Digital Transformation

Drivers of digital transformation are attributes that influence and enable the process of digital transformation to take place. Although insufficient, the existing literature identified attributes such as digital capabilities and maturity, digital technologies, strategies, business models, etc. as factors that drive the digital transformation agenda in organizations. Several studies have articulated digital transformation drivers as: profitability and new revenue growth, customer satisfaction, increased operational efficiency, convenience, and the same high-quality technical standard, increase business agility, increased employee productivity, and competitive advantage. While it was also

observed that there was an overlap between digital transformation drivers and impacts in some instances, caution was exercised to separate the two such that drivers remain attributes that influence and enable while impacts are emerging benefits realized from the process of digital transformation. However, while it is arguable which attribute would be possessing more digital drive, digital technologies play a vital role in the digital transformation process. The capabilities these technologies possess, coupled with other factors, such as culture, strategy, and digitally savvy human capital, enable the digital transformation process. Using digital technologies to drive the digital transformation process is not enough and that it also uses digital capabilities, strategies, culture, and talent development. (Morakanyane et al., 2017)

2.5.1 Digital Technologies

Digital transformation is the current dominant type of business transformation, having IT both as a technology enabler and as a strategic driver. Digital technologies are the main drivers for digitalization because digital technologies are changing the way, how business is conducted and have the potential to disrupt existing businesses,(Zimmermann, Schmidt, & Jain, 2021).

Industry 4.0 (I40) is an industrial initiative launched by German government in 2011. I40 aims at innovating production processes in industries which promises several organizational impacts for organizations. The initiative goal is the development of cyber-physical systems (henceforth CPS) which allow the interconnection between machines and human resources as well as the machine self-decision making. In fact, this latter feature allows to predict and address malfunctions in assembly line by machineries without human interactions. The realization of these organizational impacts goes through an effective implementation of a mix of advanced technologies which enables CPS, (Margherita & Braccini, 2020). According to PwC, the figure 2 shows the Industry 4.0 framework and the contributing digital technologies.

Digital technologies are presented as follows:

- **Internet of things (IoT)** describes the operation, in which physical products and machinery are equipped with sensors like Radio-Frequency Identification (RFID henceforth) in order to capture, process, and communicate in real-time data to humans as well as other machineries. These technology requires sensors and actuators to acquire and communicate through a WIFI network.
- **Internet of Medical Things (IoMT)** involves the application of Internet of Things (IoT) concepts, tools, and principles in health and medical domains through interconnected medical equipment, smart health applications, and smart sensors.
- **Big Data** refers to technologies allowing to analyze a massive set of unstructured or semi-structured data, which is not possible to analyze by traditional data process methods owing to their complexity in order to reveal patterns, trends, and associations, especially relating to human behavior and interactions.

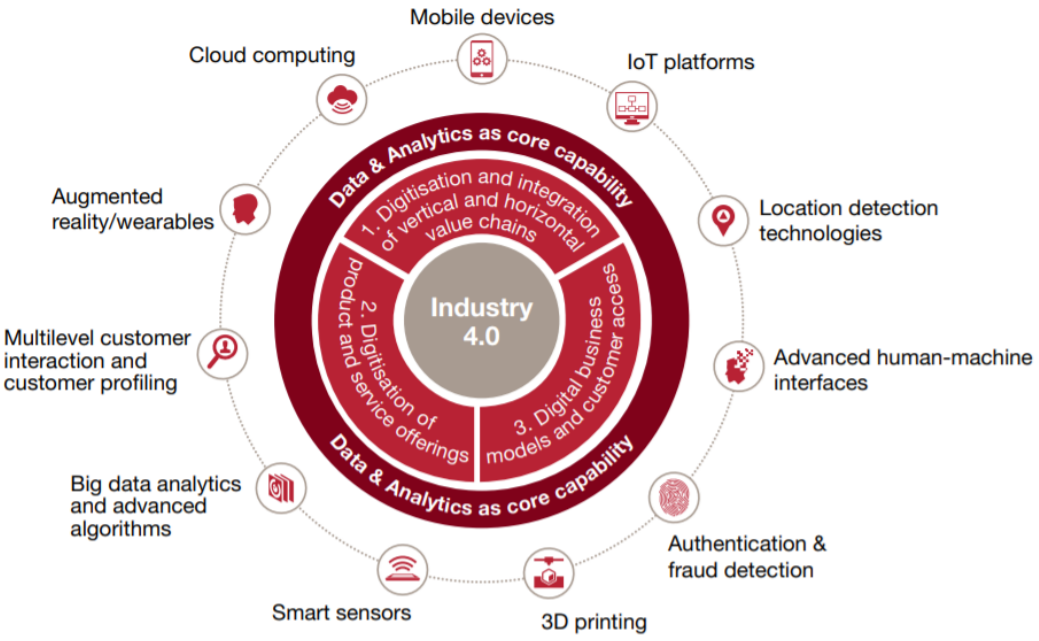

Figure 2: Industry 4.0 framework and contributing digital technologies

- **Additive manufacturing** is an "umbrella term" which employs different technologies, such as 3D printing, to produce a high quality real objects by adding material rather than by mechanically removing or milling material from a solid block.
- **Virtual Reality, Augmented Reality and Hologram** are advanced technologies which aim at designing products, operation planning, factory layout planning, system maintenance through specific hardware and software without using real materials.
- **Cloud manufacturing** is the cloud computing technology that is applied to the manufacturing area. Indeed, Cloud manufacturing is mainly employed for its ability to make the entire manufacturing plant integrated and capable of distributing machines as a service.
- **Block-chain** A few years ago this word was associated only with cryptocurrencies. Now this disruptive technology transforms as businesses as paths of humans' interaction and engagement, it successfully captures both mindshare and investments. Large companies are implementing enterprise grade blockchain solutions to facilitate traversing multiple disparate databases. It is expected that massive transformation and possibilities across industries, functions, and geographies is feasible with cross-organizational business process reengineering.
- **Autonomous robots** Robots, autonomous vehicles and drones by using AI they can automate functions previously made by humans and deliver advanced behaviors.
- **SMACIT** Most of the digital technologies mentioned fit with the popular SMACIT acronym referring to technologies related to: '
  - **S** : Social media

- **M** : Mobile
- **A** : Analytics
- **C** : Cloud
- **IT** : Internet of Things – IoT

The combinations of technologies are particularly relevant in the context of DT. For example, the ability to implement algorithmic decision-making may be contingent upon a firm's ability to perform analytics on big data collected through individuals' use of social media on their mobile phones.(Vial, 2019)

2.5.2 Opportunity with Digital Transformation

Digital transformation provides a major opportunity to address some of the cement industry's greatest challenges. The World Economic Forum projects that digital transformation initiatives will result in over 320 billion dollars of value between 2016 and 2025. Most of that value will be realized through energy savings, increased productivity, and enhanced safety. Enabling technologies will include: (Mielli & Bulanda, 2019)

- Connected worker
- Remote operations
- Autonomous operations and robotics
- Smart sensors
- Integrated platforms
- Asset cybersecurity
- Advanced analytics and simulation modeling

2.6 Digital Capabilities

A capability is a qualification or skill necessary to perform a certain activity or, in other words, "a set of skills and proficiencies needed to achieve a goal". Also, there is a definition of organizational capability as "a firm's ability to perform repeatedly a productive task which relate[s] either directly or indirectly to a firm's capacity for creating value through affecting the transformation of inputs into outputs." The repetitiveness aspect is often highlighted by researchers who view capabilities as entailing routines. Ritter et al. suggests that the combination of skills in data, permission, and analytics represents a firm's digitization capability : (Ritter & Pedersen, 2020)

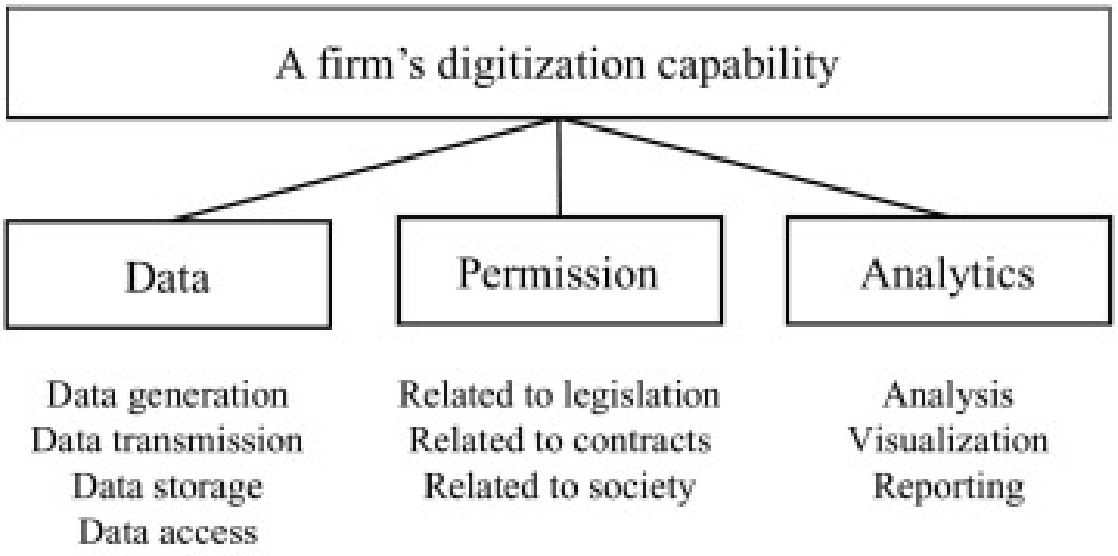

Figure 3: Dimensions of a firm's digitization capability

2.7 Digital Maturity

2.7.1 Digital Maturity

The term "maturity" refers to a state of being complete, perfect or ready (Lahrmann, Marx, Winter, & Wortmann, 2011) and is the result of progress in the development of a system. Maturing systems (e.g. organizations) improve their capabilities over time towards the achievement of some desirable future state. Sometimes digital transformation and digital maturity are used interchangeably without considering differences (von Leipzig et al., 2017) but digital maturity can be seen more as a systematic way for an organization to transform digitally (Kane et al., 2017). Hence the term "digital maturity" specifically reflects the status of a company□s digital transformation. It describes what a company has already achieved in terms of performing transformation efforts and how a company systematically prepares to adapt to an increasingly digital environment in order to stay competitive. Digital maturity goes beyond a merely technological interpretation simply reflecting the extent to which a company performs tasks and handles information flows by IT, but also reflects a managerial interpretation describing what a company has already achieved in terms of performing digital transformation efforts including changes in products, services, processes, skills, culture and abilities regarding the mastery of change processes (Chanias & Hess, 2016). Thus, digital maturity comprises a technological and a managerial aspect and therefore can be seen as a holistic concept. Organizations reach the highest level of maturity when they have both a strong digital foundation and a good understanding of how to leverage this foundation for a strategic business advantage. Moreover, digital maturity is not a static concept because the digital landscape is continuously changing. As such, an organization will need to assess maturity over time (Shahiduzzaman, Kowalkiewicz, Barrett, & McNaughton, 2017). According to (Teichert et al., 2019), the term "digital transformation maturity" is used to reflect the connection between the concept of "digital transformation" and "digital maturity" and to underline that digital maturity is

a holistic concept reflecting a technological and managerial aspect.

2.7.2 Digital Maturity Model

A maturity model provides some guidance on how organizations approach their transformation and maps out typical paths of how organizations go about their transformation, (Berghaus & Back, 2016). Maturity models can be seen as a tool that mainly enables an assessment of the statusquo (Becker, Knackstedt, & Pöppelbuß, 2009) and indicates a potential, anticipated or typical development path to the desired target state (Pöppelbuß & Röglinger, 2011). Digital maturity models help companies to assess their ability to encounter digital transformation according to pre-defined dimensions. Especially in the case of transformation journeys can they assist in understanding the current state and the capabilities of an organization in effectively managing and guiding digital transformation efforts in a systematic way. Digital maturity models consist of dimensions and criteria which describe areas of action and measures in various levels which indicate the evolution path towards maturity (Berghaus & Back, 2016). A dimension is a specific, measurable and independent component which reflects a major, fundamental and distinct aspect of digital maturity and describes an area of action (De Bruin, Rosemann, Freeze, & Kaulkarni, 2005). The definition for the term "maturity level" can be linked to the Capability Maturity Model. In that context, a maturity level consists of related specific and generic practices for a predefined set of maturity dimensions that can improve the organization's overall maturity. The maturity level of an organization provides a way to characterize its performance and can be defined as an evolutionary plateau for organizational maturity improvement. The terms "maturity stage" and "maturity level" can be used interchangeably, (Teichert et al., 2019). The digital maturity model defines various phases in the digital transformation journey and each phase has a defined set of features, challenges, and digital elements.

Stages of Digital Maturity Model The stages of the digital maturity model as defined in Figure 4 are described next, (Shivakumar, 2018a):

- **Basic stage:** During this stage, the organization is maintaining multiple web applications mainly for static information delivery. Each of the web applications has its own user experience, leading to a disjoint experience for the end users navigating across web applications. In this stage, the technical ecosystem will not have centralized systems or records. Data, functionality, and concerns are distributed across various systems. The main challenges at this stage are inconsistent user experience with absence of single sign on (SSO) and tracking key performance indicators (KPIs). The main digital elements at this stage are static web sites, legacy web applications, etc.
- **Consolidated platform:** During this stage, all disparate web applications are consolidated into a single platform. For instance, various internal web applications such as HR application, leave application, and travel application are consolidated into an intranet portal. The

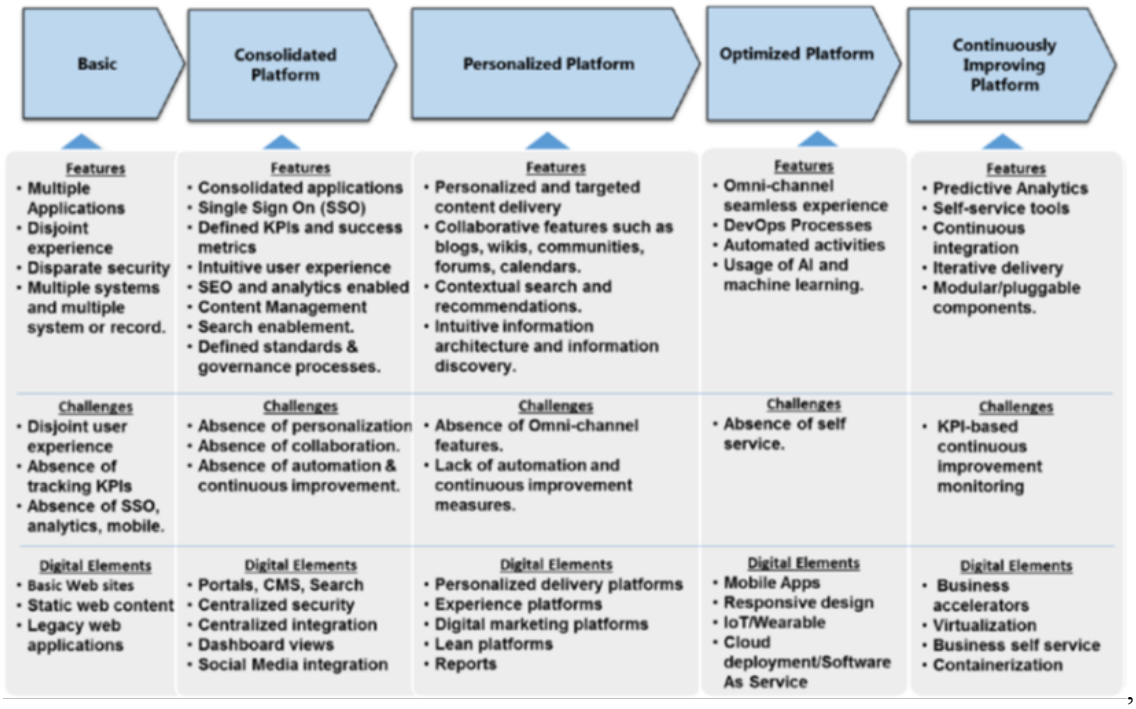

Figure 4: Sample digital maturity model

integrated experience is enabled by single-sign-on (SSO), which provides seamless access to all secured applications. The digital platform mainly consists of portals, content management systems, and enterprise searches. Search Engine Optimization (SEO) and analytics are enabled for the applications. Standards and governance processes are defined for the key business processes. Personalization, collaboration, and automation are not implemented as part of this stage. The main digital elements used in this system are portals, CMS, search, and centralized integration (such as ESB and API gateways).

- **Personalized platform:** At this stage, the information and functionality are personalized based on user preferences and behavior. Based on contextual information, targeted information is presented to the users. The digital platforms at this stage have intuitive information architectures (including menus, site hierarchy, and navigation elements) and provide user-friendly information discovery features, such as search, saved searches, top downloads, popular topics, etc. Omni-channels and automation are yet to be implemented at this stage. At this stage, personalized presentation platforms, digital experience platforms, digital marketing platforms, lean portals, and reports are used.

- **Omni-channel platform:** At this stage, the digital platforms are optimized for all channels such as web, mobile, tables, and PDAs. Users have a seamless experience across various touch points. Many of the business processes are automated and artificial intelligence (AI) techniques such as chat bots and machine learning are employed for enhanced user engagement. DevOps processes are used to optimize the release management and deployment processes. The key digital elements at this stage are mobile apps, wearable systems, responsive design techniques, and cloud enabled systems.

- **Engagement platform:** At this stage, the digital platform provides many features to actively engage the users. This includes self-service tools, decision-making tools, and predictive analytics that actively engage the end users. At this stage, the digital platform and ecosystem implement continuous integration continuous testing, and iterative delivery. The components are developed as pluggable and modular components. The main digital elements are business accelerators, virtualization, business self-service, and containerization.

Characteristics of Digitally Mature Enterprises Although many enterprises struggle to take advantage of digital opportunities, other enterprises manage to take advantage of the benefits of emerging technologies and achieve a high level of digital maturity. Among enterprises that are considered digitally mature, there are certain similarities and points of convergence , as shown in figure 5. (Journal, 2021)

Characteristics	Sebastian[a]	Horlacher[b]	Russell[c]	Zomer[d]
Digital strategy that defines a social, mobile, analytics, cloud and Internet of Things (IoT) (SMACIT)–inspired value proposition	X			
Operational backbone that facilitates operational excellence	X			
Digital services platform that enables rapid innovation and responsiveness to new market opportunities	X			
Better understanding of digital consumer behavior, preferences and choices			X	
Greater digital intensity (i.e., more investment in technology-enabled initiatives)				X
More integrated digital strategy				X
Higher proportion of top management team members with a background in digital technology and innovation				X
More decentralized management structure				X
Greater investment in skill-set building				X
Stronger risk-taking culture				X
Stronger communication skills		X		

Source: (a.) Sebastian, I. M.; *et al.*; "How Big Old Companies Navigate Digital Transformation," *MIS Quarterly Executive*, vol. 16, iss. 3, 2017, p. 197–213. (b.) Horlacher, A.; 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," 49th Hawaii International Conference on System Sciences, Institute of Electrical and Electronics Engineers Computer Society, 2016. (c.) Russell, K. D.; P. O'Raghallaigh; P. O'Reilly; J. Hayes; "Business to Digital Transformation: A Proposed Framework for Achieving Business Intelligence Alignment," Irish Academy of Management Annual Conference, University College Cork, Ireland, 2018. (d.) Zomer, T.; A. Neely; V. Martinez; "Enabling Digital Transformation: An Analysis Framework," University of Cambridge, USA, May 2018, *https://cambridgeservicealliance.eng.cam.ac.uk/resources/Downloads/Monthly%20Papers/MayPaper_EnablingDigitalTransformationAnAnalysisFramework.pdf*.

Figure 5: Characteristics of Digitally Mature Enterprises

2.7.3 Digital Maturity of Greece

Digital Economy and Society Index (DESI) The Digital Economy and Society Index (DESI) monitors Europe's overall digital performance and tracks the progress of EU countries in digital competitiveness. By providing data on the state of digitisation of each Member State, it helps them identify areas requiring priority investment and action. (Commission, 2020)

DESI's Dimensions DESI is made up of 5 dimensions, presented in Table 2:

Table 2: The structure of DESI

1	**Connectivity**	Fixed broadband take-up, fixed broadband coverage, mobile broadband and broadband prices
2	**Human Capital**	Internet user skills and advanced skills
3	**Use of Internet**	Citizens' use of internet services and online transactions
4	**Integration of Digital Technology**	Business digitisation and e-commerce
5	**Digital Public Services**	e-Government

Greece's position on the European digital map is assessed by the European Commission's DESI index. Through the DESI data, helpful insights are presented, and proposals of policy are simultaneously being presented, in order to accomplish digital convergence with other European countries. The following figure 6 shows the ranking of Member States on the Digital Economy and Society Index in 2020 based on 2019 data. Finland, Sweden, Denmark and the Netherlands have the most advanced digital economies in the EU followed by Malta, Ireland and Estonia. Bulgaria, Greece, Romania and Italy have the lowest scores on the index.

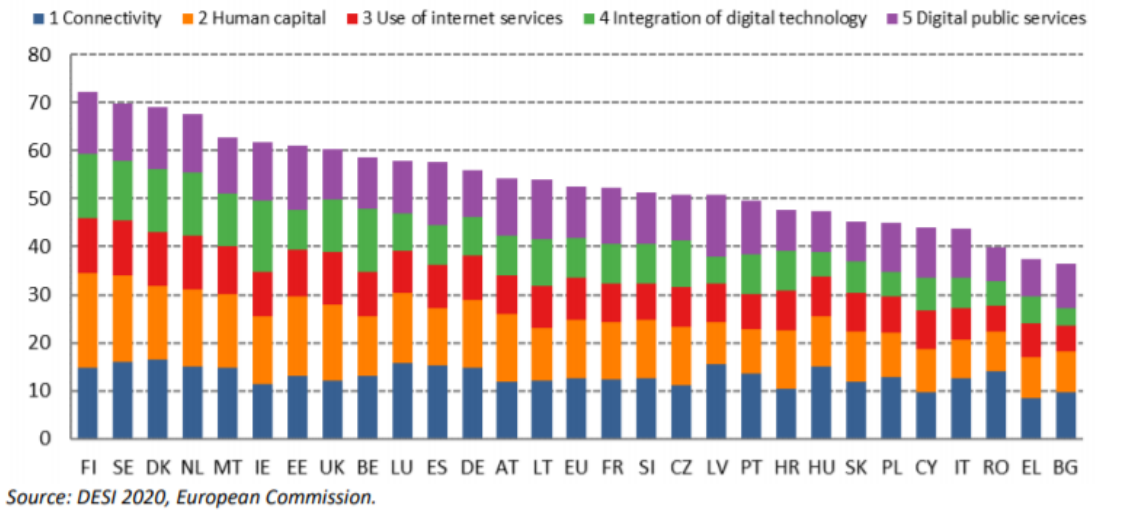

Figure 6: Digital Economy and Society Index, 2020

Still, the overall score for Greece has improved from 35.1 in 2019 to 37.3 in 2020. Greece has demonstrated for the first time a major improvement in digital skills, with over 50 per cent of Greek citizens claiming to have at least the basic digital skills. On Connectivity, the country has seen the progress of over 15 per cent compared to 2019. The signs of digitization are there for Greece, however the country needs to accelerate its digital growth, as it falls way behind the EU average. In more detail: (Found.ation, 2021)

1. **Connectivity:** There is no improvement since 2017 for Greece in Connectivity, one of the five indicators at DESI, as the country ranks last among the 28 EU member states. The fast broadband take-up is 76 per cent, which is lower than the EU average, due to high prices

in the Greek telecommunications market. However, it is worth noting that there has been a significant improvement on the fast broadband coverage in 2019, which was expanded by fifteen points compared to 2018, reaching 81 per cent, just five points below the EU average. There has also been an increase of eleven per cent on the mobile broadband take-up, although there were only 86 subscriptions per 100 people when the continent's average is 100 subscriptions per 100 people. Meanwhile, 4G coverage (96 per cent) exceeds the EU average by 1 per cent.

2. **Human Capital:** As for digital skills, Greece has made significant progress. 51 per cent of people between 16 and 74 years of age had at least basic digital skills in 2019, a 5 per cent rise compared to 2018, rise much faster than the EU average. In the last three years, the number of ICT professionals has also increased, although the 1.8 per cent of the total workforce is still way below the EU average, at 3.9 per cent

3. **Use of Internet:** There is a significant increase in the use of specific internet services in Greece. For Greeks, reading online news, using social media and video calls are the three most popular internet services, the use of which is way above the EU average. 88 per cent of users are reading news online, while video calls are making 67 per cent of them. On the other hand, internet banking is still quite low, with only 40 per cent of internet users making online transactions, while 51 per cent shops online.

4. **Integration of Digital Technology:** Despite Greece's priority in the digitization of business, enterprises still struggle to implement the goals of digital transformation. However, Greek businesses share of electronic information sharing is above the EU average, while the use of social media fell sharply by 2 per cent in 2019.

5. **Digital Public Services:** The public sector shows signs of improvement; however, it still ranks second to last among the EU member-states. The open data maturity indicator shows that Greece in 2020 ranks at the EU average with 66 per cent. On the supply side (in the provision of online public services), Greece continued to progress in 2019, with 25/100 pre-filled forms compared with 23/100 in 2018, though this remains well below the EU average. The number of internet users that are active users of e-government services at 39 per cent with a 3 per cent increase in 2019. The availability of digital public services for businesses increased to 63 per cent.

Digital Maturity study of Greek Economy and Greek Enterprises Deloitte collaborated with SEV for the preparation of the Observatory's inaugural report, which studies Greece's digital maturity. For the purposes of the Observatory a new composite index was created, SEV Digital Maturity Index, consisting of 100 published key indicators and metrics that monitor the country's performance across 7 different dimensions, (SEV-Deloitte, 2020):

1. ICT / High Technology Sector

2. Connectivity Infrastructure

3. Policies Regulatory Framework
4. Digital Skills
5. Digital Maturity of Businesses
6. Digital Maturity of Society
7. Digital Maturity of Public Sector

Greece's performance is better than last year's, as it increased its ranking by one place (from 28th to 27th), but it remains in the queues among EU-28 members, based on the most recent available measurements (2019) and the immediately preceding ones (2018), see figure 7. Similarly, Greece comes last in the individual aspects, with a better performance in dimension 7, of the digital maturity of the public sector, where it improved four positions compared to the previous year. Finland is the country with the best overall performance in the index, having surpassed Denmark.

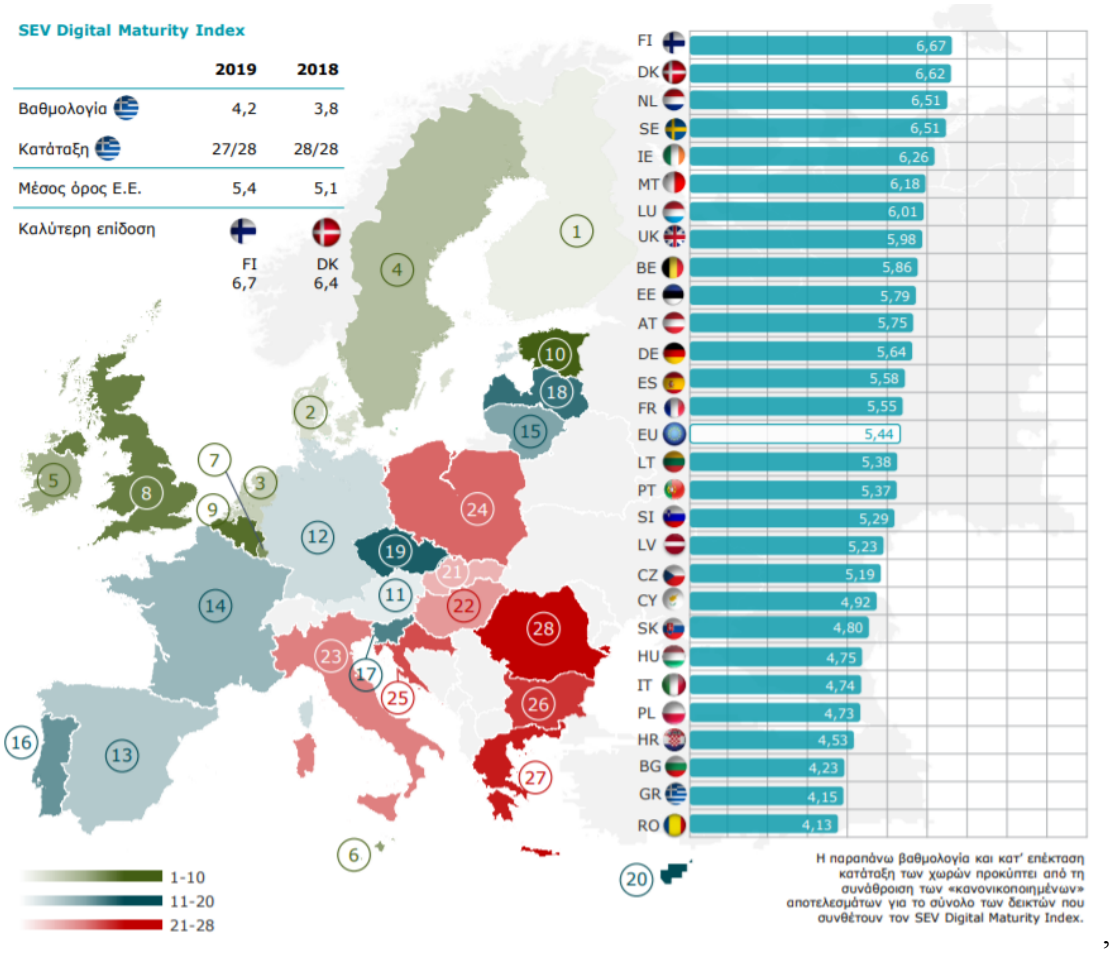

Figure 7: SEV Digital Maturity Index, 2020

2.8 Digitalization of business model

Business models are the fundamental of organizations, and they can represent the current and the future state. They are simplified and structurally similar illustrations of all or selected aspects of the company's resource transformation and its exchange relationships with other market participants. (Hrustek, Furjan, & Pihir, 2019) Business model canvas is the most used and cited business model framework. Business model canvas is not only used for creating a business model, it is also used for managing and improving of each of the nine business model elements that it contains. (Hrustek et al., 2019) Business model canvas is divided into 9 Building blocks, (Genzorova, Corejova, & Stalmasekova, 2019), as it is shown in figure 8:

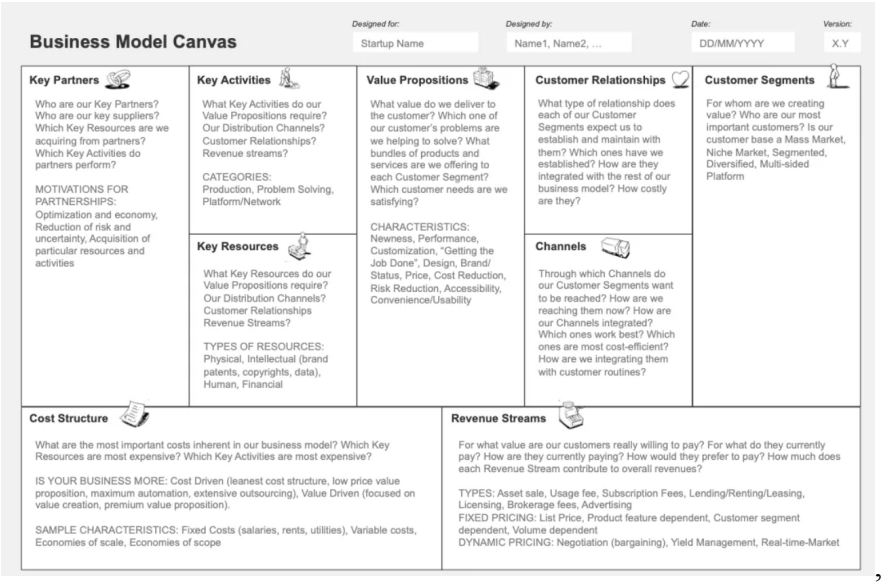

Figure 8: Business Model Canvas Template

- Customer segments
- Customer relationships
- Channels
- Value proposition
- Revenue streams
- Key resources
- Key activities
- Key partners
- Cost structure
- Revenue streams

2.9 Main strategic goals

2.9.1 Four Dimensions of Digital Transformation Strategies

According to (Matt et al., 2015),independent of the industry or firm, digital transformation strategies have certain elements in common. These elements can be ascribed to four essential dimensions:

1. **Use of technologies**
   The use of technologies addresses a company's attitude towards new technologies as well as its ability to exploit these technologies. It therefore contains the strategic role of IT for a company and its future technological ambition. A firm needs to decide whether it wants to become a market leader in terms of technology usage with the ability to create own technological standards, or whether it prefers to resort to already established standards and sees technologies as means to fulfill business operations. While being a technological market leader can lead to competitive advantages and can create the opportunity of other firms becoming dependent on one's technological standards, it might be more risky and requires certain technological competences.

2. **Changes in value creation**
   From a business perspective, the use of new technologies often implies changes in value creation. These concern the impact of digital transformation strategies on firms' value chains, i.e. how far the new digital activities deviate from the classical – often still analog – core business. Further deviations offer opportunities to expand and enrich the current products and services portfolio, but they are often accompanied by a stronger need for different technological and product-related competences and higher risks owing to less experience in the new field.

3. **Structural changes**
   The digitization of products or services can enable or require different forms of monetization, or even adjustments to firms' business scope, if other markets or new customer segments are addressed. With different technologies in use and different forms of value creation, structural changes are often needed to provide an adequate basis for the new operations. Structural changes refer to variations in a firm's organizational setup, especially concerning the placement of the new digital activities within the corporate structures.For this assessment it is further important, whether it is mainly products, processes, or skills that are affected most by these changes. If the extent of the changes is fairly limited, it might be more reasonable to integrate the new operations into existing corporate structures, while for more substantial changes it might be better to create a separate subsidiary within the firm.

4. **Financial aspects**
   However, the former three dimensions can only be transformed after considering financial aspects. These include a firm's urgency to act owing to a diminishing core business and its ability to finance a digital transformation endeavor; financial aspects are both a driver and a

bounding force for the transformation. While lower financial pressure on the core business may reduce the perceived urgency to act, companies already under financial pressure might lack external ways to finance a transformation. Therefore, firms should confront the need to conduct digital transformations and explore their options openly and in good time.

To ensure the successful roll-out of a digital transformation strategy and fully exploit its intended effects, it is essential to closely align the four different dimensions: use of technologies, changes in value creation, structural changes, and financial aspects. The four transformational dimensions and their dependencies can be integrated into one joint Digital Transformation Framework, shown in Figure 9, (Matt et al., 2015). If all of these account as part of the framework, this will support firms in the assessment of their current abilities and the formulation of a digital transformation strategy.

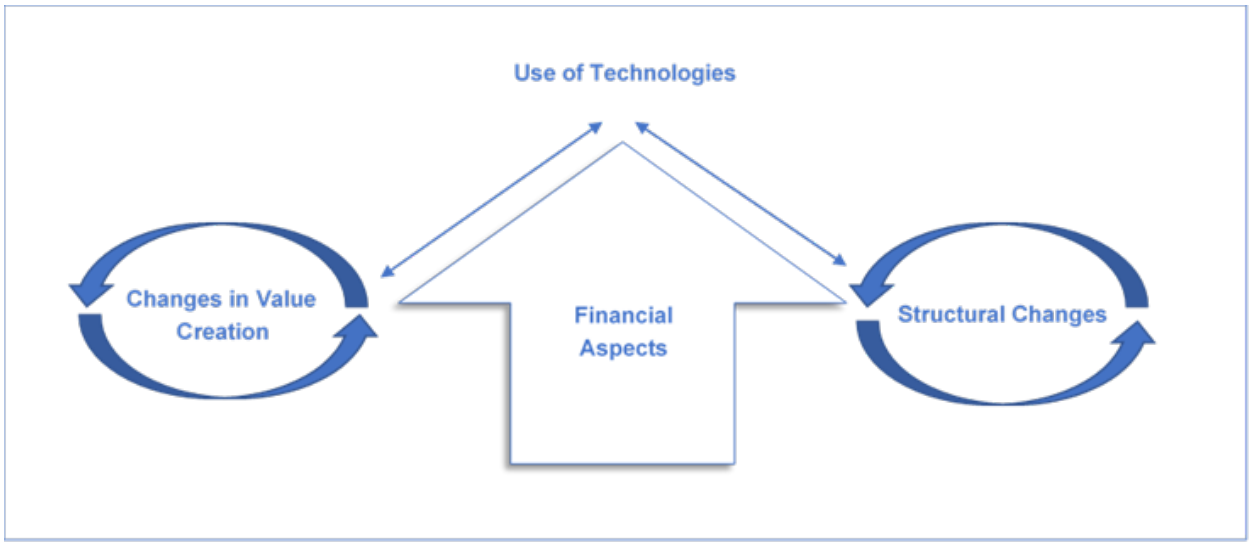

Figure 9: Digital transformation framework: balancing four transformational dimensions

2.9.2 Interpretation Lenses of Digital Transformation

People, Process, Product, and Policy (4Ps) The author,(Bonanomi, 2019) proposes four interpretation lenses to frame the changes which multidisciplinary design firms implement in order to manage digital transformation. These four lenses are People, Process, Product, and Policy (4Ps), as illustrated in table 3, (Bonanomi, 2019). Finally, the combination of the literature review and expert interviews leads the author to identify two paradigm shifts that synthesize the process-oriented and organizational changes associated with the digital transformation of multidisciplinary design firms: (1) From a silo-based and sequential to a collaborative and iterative digital design process; and (2) From a vertical and hierarchical to a platform-based and networked organization.

Table 3: The four lenses: People, Process, Product, and Policy (4Ps)

Dimension	Topic	Details
People	Personnel training	The training is managed internally or externally
		Both the operative (power workers) and the managerial (project managers/ partners) personnel is involved
		All the business units have been trained since the early stages of the firm's digital transformation
	Changing and new roles and responsibilities	New roles and responsibilities are formally defined
		Existing organizational structure is (re)-configured accordingly to new or changing roles and responsibilities
Process	Supply chain relationships are changed	Consultants and suppliers are chosen in relation to their digital skills and capabilities
		(Im-)maturity of the reference market in terms of digital technologies and processes influences the firm's digital transformation.
Product	Setting the technological infrastructure	Hardware and software
		Standards and procedures developed to support the implementation of digital technologies and processes
Policy	Contractual and legal aspects are managed accordingly to the new requirements of digital technologies and processes	
	Relationships with clients/owners are managed to provide digital deliverables	

2.10 Impact

Digital transformation impacts are the effects that business organizations experience as a result of the transformation process. (Morakanyane et al., 2017) The key impacts are the following, as shown in figure 10:

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Figure 10: Key Impacts

2.11 Digital world and Cybersecurity

2.11.1 Cyber Security

The term cybersecurity refers to techniques and practices designed to protect data that is stored, transmitted, or used in information systems. Therefore, cybersecurity is one of the cross-cutting issues in digital transformation today, because it is fundamental that authorized messages be delivered at any time and at any place and to the right place and in real-time and without any disturbance and without malicious attack. Hence, effective cybersecurity reduces the risk of cyber threat attacks and protects public and private organizations from unauthorized exploitation of cyber and physical devices, networks, systems, (Möller, 2020).

2.11.2 CIA Triad

The fundamental objective in information security refers to protecting data as well as information systems from unauthorized access, destruction, disclosure, disruption, modification, or usage. Therefore, the three fundamental principles in information security are the principles of Confidentiality, Integrity, and Availability, which are commonly referred to as CIA Triad. The CIA Triad, shown in 11, is a well-known model for the development of security policies used in identifying problem areas, along with necessary solutions in the arena of information, data and system security. (Möller, 2020)

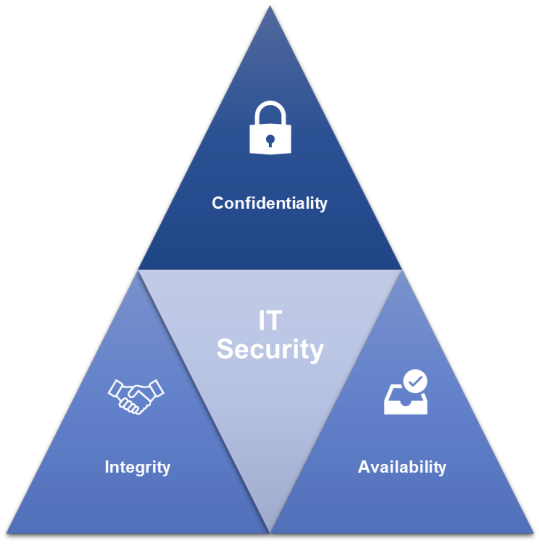

Figure 11: CIA Triad: Confidentiality, Integrity, Availability

1. **Confidentiality:** Vital security characteristic in the era of digital transformation. Term is roughly equivalent to privacy. However, it means protecting data from unauthorized access and misuse, for instance by a set of rules that limit access to data. Measures undertaken to ensure confidentiality are designed to prevent sensitive data from reaching the wrong people, making sure that the right people can in fact get it. The definition of confidentiality is

"preserving authorized restrictions on access and disclosure, including means for protecting personal privacy and proprietary information." This requires a number of access controls and protection as well as ongoing monitoring, testing and training. Data encryption is a common method of ensuring confidentiality. In this regard, user IDs and passwords constitute a standard procedure. Other options include bio-metric verification, by which a person can uniquely evaluate one or more distinguishing biological traits, as well as security token, which is a small hardware device that an owner carries to authorize access to a network service, and key fobs, which means a small, programmable hardware device that provides access to a physical object, or soft token, a software-based security token, that generates a single-use login PIN. However, to satisfy desired security requirements the solution should include a holistic consideration.

2. **Integrity:** Involves maintaining consistency, accuracy, and trustworthiness of data over its entire life cycle. This covers the important topics of data integrity and system integrity. Data integrity is the requirement of data and programs being changed only in a specified and authorized manner, while system integrity refers to the requirement of a system performing its intended function in an unimpaired manner, free from deliberate or inadvertent unauthorized manipulation. Against this background, a deficiency in integrity can allow for modification of data and programs stored on the memory of digital systems used, which can affect the crucial and critical operational functions of the digital systems, without ad-hoc detection.

3. **Availability:** Information, data and programs are accessible by authorized users when needed and is an essential requirement in the era of digital transformation. This can be ensured by rigorously maintaining all system hardware, immediately performing hardware repairs when needed, and maintaining a correct functioning operating system environment that is free of software conflicts. If crucial and critical operational systems cannot access needed data when required, data, and programs of operational systems are not secure. That availability is a fundamental feature of a successful deployment of digital systems in the era of digital transformation. To prevent data loss, a backup copy may be stored in a geographically isolated location, perhaps even in a digital safeguard. Extra security equipment or software such as firewalls and proxy servers can guard against downtime and unreachable data and programs due to malicious activities such as Denial-of-Service attacks, and network intrusions.

2.11.3 Countermeasures

The cyber landscape is constantly altering and evolving due to the speed of technological change, the complexity of the attackers, the value of potential targets and the effects of attacks, (Weber & Studer, 2016). With the widespread use of computer networks, hackers have taken advantage of network-based services to gain personal benefit and reputation. In a threat environment where security products need to be constantly refined or updated to identify the recent exploitation, the challenge is to find a solution that provides a future-proof defense to ensure lasting network safeguard, (Ervural & Ervural, 2018).

The types of security measures taken vary, as shown in figure 12, (Commission, 2020). Most EU enterprises have put in place basic measures such as keeping software up-to-date (87%); requiring strong password authentication (77%)), and backing up data in a separate location including backing data up to the cloud (76%)). A smaller percentage of enterprises use more sophisticated measures such as ICT risk assessments (34%)) or ICT security tests (36%)), and only a few enterprises use biometric methods for user identification and authentication (9.5%)).

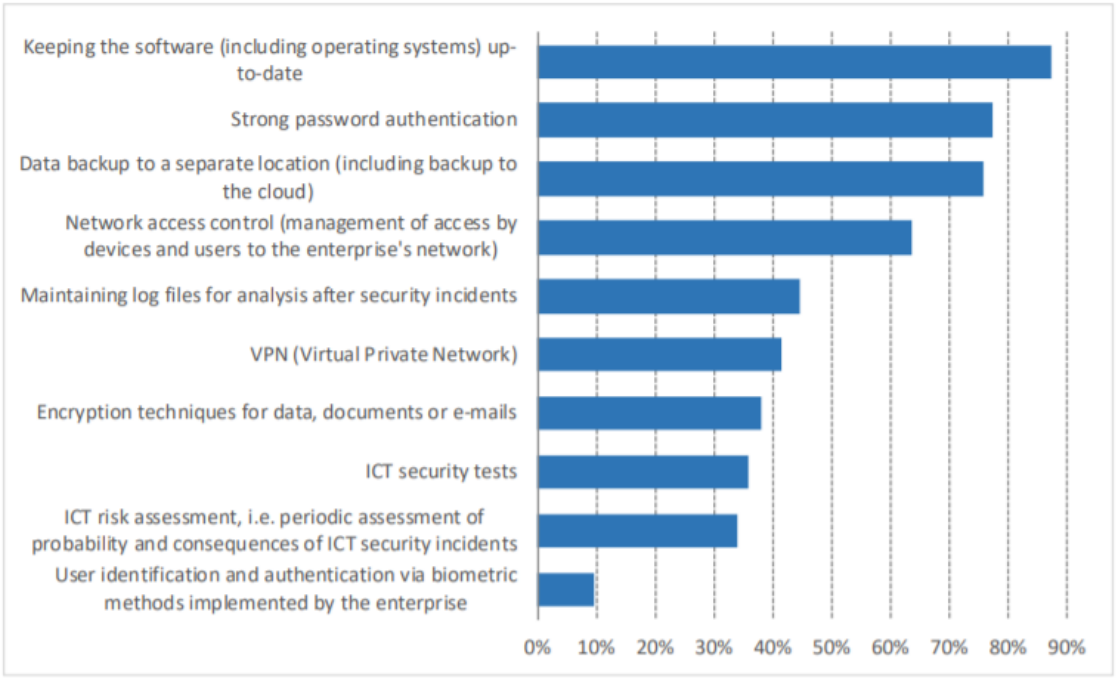

Figure 12: Type of ICT security measures adopted by EU enterprises (%) of enterprises) 2019

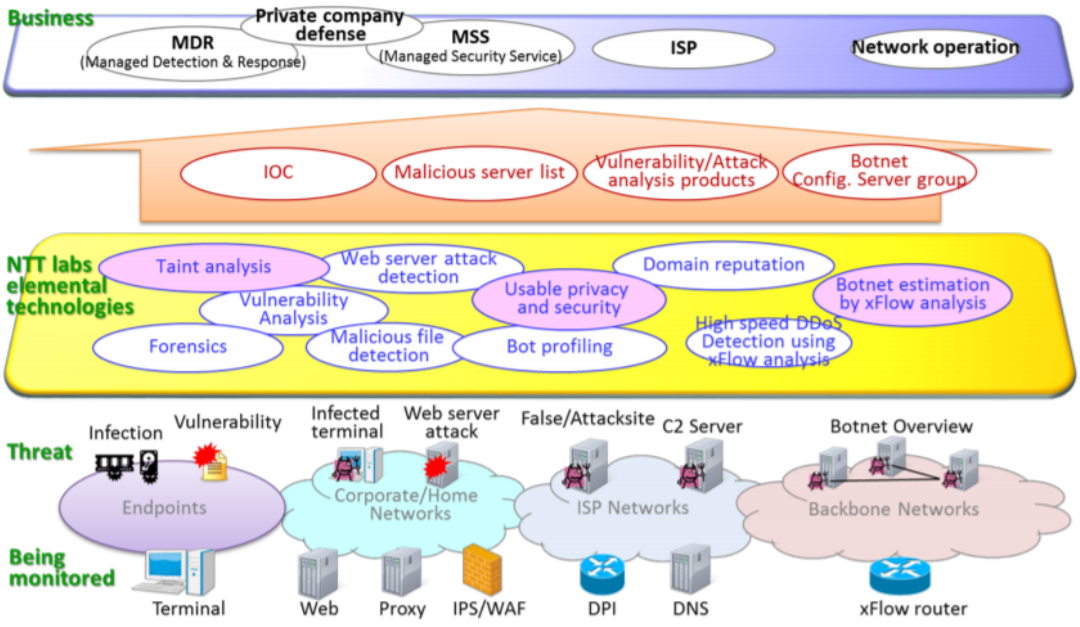

Figure 13: Cyber-attack countermeasures

Cyber-attacks are getting smarter and increasing in scale in these ways, so the scope of

monitoring needs to expand in order to oppose them. Conventionally, corporate, home and ISP networks were monitored, but this must expand to include both micro and macro perspectives, from endpoints to backbone networks (Fig. 13), (Ohkubo, 2019) . Regarding endpoints, advanced Indicators of Compromise (IOC) are generated by using technologies such as taint analysis to precisely analyze malware behavior. Such IOC can be effectively used in Managed Detection and Response (MDR) and other products. On backbone networks, analysis of large volumes of flow data can reveal the overall structure (Herder, C2 server and bot terminals) of a botnet, and provide clues to appropriate countermeasures, (Ohkubo, 2019).

2.11.4 Cybersecurity in Greece

In Greece, the competent department for the national strategic cyber security planning is the General Directorate of Cybersecurity of the Ministry of Digital Government. In addition, this Service has been designated as the National Cybersecurity Authority (NCSA), oversees the implementation of law 4577/2018 (A'199), and functions as the national single point of contact for network and information security, acting as a liaison to ensure cross-border co-operation within the EU. With the National Cybersecurity Strategy (2018), a significant effort has been launched a major effort to upgrade it level of cybersecurity of networks and services, covering overall thirteen (13) objectives, in line with European and international practices. In addition, with the provisions of Law 4577/2018 (A' 199) and of the Civil Code No. 1027/2019 (B' 3739) the legislation of Greece was harmonized with the provisions of the NIS Directive. These include, but are not limited to, the obligations of operators, the essential security requirements of network and information systems, and the procedures for sharing information and security incidents to the competent authorities. (of Digital Governance, 2021)

The 5 strategic pillars of the National Goverment Strategy for 2020-2025 Following the above, the Directorate-General for Cybersecurity, following its cooperation with ENISA, has already evaluated the existing strategic planning and is developing an appropriate methodology for its updating in the context of five (5) fundamental axes of intervention, which are, (of Digital Governance, 2021):

1. The ***first*** strategic pillar concerns the development of an operational system of governance and aims at the specific activities that include the optimization of the framework for the organization and operation of structures and procedures, the effective planning of risk assessment and emergency management but also the strengthening of cooperation at national, European and international level.

2. The ***second*** pillar concerns the protection of critical infrastructure, with security and new technologies, which will be achieved through an understanding of technological developments and how they affect digital governance, by upgrading critical infrastructure protection and by shielding systems; and applications through enhanced security requirements.

3. The ***third*** pillar defines case management optimization, the fight against cybercrime and the protection of privacy. The specific objectives are the optimization of methods, techniques and tools for analysis, response and notification of incidents, the strengthening of deterrence mechanisms and optimization of business cooperation and cyber security and privacy protection.

4. The ***fourth*** pillar defines the creation of a modern investment environment with emphasis on the promotion of Research and Development through the provision of appropriate investment incentives and the use of Public-Private Partnerships (PPPs).

5. The ***fifth*** pillar of the project concerns capacity building and the promotion of information and awareness. This will be achieved by aiming to improve skills through the organization of appropriate exercises, the use of modern methods and tools of training and education and the ongoing information of agencies and citizens regarding cybersecurity issues.

3 Project Management - Basic Elements

3.1 Defining the Project

3.1.1 Project

A project (Institute, 2013),is a temporary endeavor undertaken to create a unique product, service, or result. The temporary nature of projects indicates that a project has a definite beginning and end. The end is reached when the project's objectives have been achieved or when the project is terminated because its objectives will not or cannot be met, or when the need for the project no longer exists. A project may also be terminated if the client (customer, sponsor, or champion) wishes to terminate the project. Temporary does not necessarily mean the duration of the project is short. It refers to the project's engagement and its longevity. Temporary does not typically apply to the product, service, or result created by the project; most projects are undertaken to create a lasting outcome. Projects can also have social, economic, and environmental impacts that far outlive the projects themselves.

Every project creates a unique product, service, or result. The outcome of the project may be tangible or intangible. Although repetitive elements may be present in some project deliverables and activities, this repetition does not change the fundamental, unique characteristics of the project work.

An ongoing work effort is generally a repetitive process that follows an organization's existing procedures. In contrast, because of the unique nature of projects, there may be uncertainties or differences in the products, services, or results that the project creates. Project activities can be new to members of a project team, which may necessitate more dedicated planning than other routine work.

In addition, projects are undertaken at all organizational levels. A project can involve a single individual or multiple individuals, a single organizational unit, or multiple organizational units from multiple organizations.

Examples of projects include, but are not limited to:

- Developing a new product, service, or result;
- Effecting a change in the structure, processes, staffing, or style of an organization;
- Developing or acquiring a new or modified information system (hardware or software);
- Conducting a research effort whose outcome will be aptly recorded;
- Constructing a building, industrial plant, or infrastructure; or
- Implementing, improving, or enhancing existing business processes and procedures.

3.1.2 Digital Project

Digital projects refer mainly to modern day software projects that predominantly use digital technologies such as experience platforms, enterprise portals, content systems, commerce platforms, user experience technologies, mobile technologies, search, and collaboration. (Shivakumar, 2018c) There are typically three phases in digital projects:

- **Planning phase:** During this phase, project initiation activities are performed. We define the scope and determine the functional/ non-functional requirements. The project manager performs activities such as scope planning, schedule planning, cost and effort planning, resource planning, communication planning, and risk planning.
- **Execution phase:** Code development and testing are the main activities of this phase. The project manager carries out various quality control measures and performs risk management activities during this phase.
- **Maintenance phase** During this phase, we maintain the solution and add incremental enhancements. Post-production deployment, the project enters into steady state operations mode. The project manager is involved in release management, change management, defect management, SLA monitoring, and other production-related operations.

The following figures 14, (Shivakumar, 2018a) provide phase-wise milestones, activities, and deliverables for digital projects. The project life-cycle stages Requirements Elaboration and Architecture and Design are part of project planning phase. The Build and Test activities are part of the project execution phase and the Support and Maintenance step is part of the project maintenance phase.

##	Digital Project Lifecycle Stage	Key Milestones	Activities	Deliverables
1	Requirements Elaboration	• Baselined requirements • Detailed implementation plan • Testing strategies and acceptance criteria • Project Governance definition and project execution structure	• Prioritization of requirements with business and IT stakeholders • Define scope and project plan. • Understand key constraints and establish dependency/issues tracking. • Establish processes, templates and tools for development. • Identify and establish Project Management Office (PMO) for governance • and change management. • Define Non-Functional Requirements (NFR) and establish benchmarks for system requirements. • Establish necessary infrastructure for development/SIT/UAT environment • User profiling to validate UI requirements and determine ease of navigation. • Map all the requirements to use case and identify any missing links. • Understand business processes. • Interaction with stakeholders and business end users to understand end user requirements, user journeys, navigation model, interaction model, and layout plan. • Develop a requirements traceability matrix; requirements traceability matrix is a cross reference table linking every stage of the application lifecycle with the previous and next stages. • Identify interface requirements and based on that, prepare integration requirements. • Review requirements specification and acceptance criteria documents by business stakeholders. • Identify development resource requirements (software, hardware, and infrastructure to be used during project execution).	• Project plan • Validated system requirements specification. • Validated UI standards and specifications. • [Optional] Migration requirements document

2	Architecture and Design	• Technical architecture document definition • Detailed design definition • Wireframe creation • • Visual design	• Define standards for the design and development activities. • Choose templates and checklists for key project deliverables. • Prepare functional design specifications document. • Prepare integration and system test plans. • Update traceability matrix to ensure complete and accurate coverage of all requirements. • Design review session will be conducted to capture any missing requirements and analyze any process gaps. • Review and stakeholder sign-off of key design deliverables • UI design – information architecture, layouts, navigation flows, etc. • Review project specifications • Plan unit testing • Review unit test plan • Plan for using reusable components. • Update traceability matrix with details like the functionality being addressed. • Identification of critical scenarios for uses cases and prototyping. • Medium fidelity wireframes for typical use cases. • One to two concept designs for key pages • Obtain Stakeholder buy-ins. • Creation of visual design style guide and graphic assets • Design validation proof-of-concept (PoC)	• Sequence diagrams and business process diagrams • Detailed development plan • High-level test plan • Detailed test plan • Software architecture document • Detailed design document • Information architecture • Wireframes and visual design and visual style guide • Content strategy definition
3	Build and Test	• Source code development • Unit, functional, • integration, and system • testing • Code review sign-off • Testing sign-off • Production Go-live	• Develop code. • Conduct code review • Unit testing of code modules • Incorporate feedback from interim functional checkpoints. • Explore the possibility of making reusable components. • Update traceability matrix • Defect prevention activities to identify causes of defects, thereby taking action to prevent recurrence. • Continuous integration and testing • Release management and deployment	• Code artifacts • Detailed test cases
4	Support and Maintenance	• Iterative releases • Patching • Product upgrades	• Production incident management and defect fixes • Implementing enhancements • SLA monitoring in production environment	• SLA reports • Production incident report

Figure 14: Stage-Wise Activities and Deliverables for Digital Projects

3.2 Difference between Software Projects and Digital Projects

While digital projects have the fundamentally same features of any regular software projects, they have their own set of unique features and challenges as well. The 4 provides the key differences between a regular software project and a digital project, (Shivakumar, 2018c).

Table 4: Digital Projects vs. Regular Software Projects

	Digital Projects	Regular Software Projects
Primary Technology	Modern digital technologies such as portals, CMS, and search	Proven matured technologies such as legacy technologies and legacy web frameworks
Execution Methodology	Mostly Agile or iterative	Mostly waterfall
Resource Needs	Needs niche skill-set with limited availability	Rich availability of resources
Target Audience	Mainly Internet (B2C) audience	Targeted to B2B and B2C audience

3.3 Defining Project Management

Project management (Institute, 2013) is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements. Project management is accomplished through the appropriate application and integration of the 47 logically grouped project management processes, which are categorized into five Process Groups. These five Process Groups are:

- Initiating,
- Planning,
- Executing,
- Monitoring and Controlling, and
- Closing.

Managing a project typically includes, but is not limited to:

- Identifying requirements;
- Addressing the various needs, concerns, and expectations of the stakeholders in planning and executing the project;
- Setting up, maintaining, and carrying out communications among stakeholders that are active, effective, and collaborative in nature;
- Managing stakeholders towards meeting project requirements and creating project deliverables;
- Balancing the competing project constraints, which include, but are not limited to:
  - Scope,
  - Quality,
  - Schedule,
  - Budget,
  - Resources, and
  - Risks.

The specific project characteristics and circumstances can influence the constraints on which the project management team needs to focus.

The organization's processes and procedures for conducting project work include, but are not limited to:

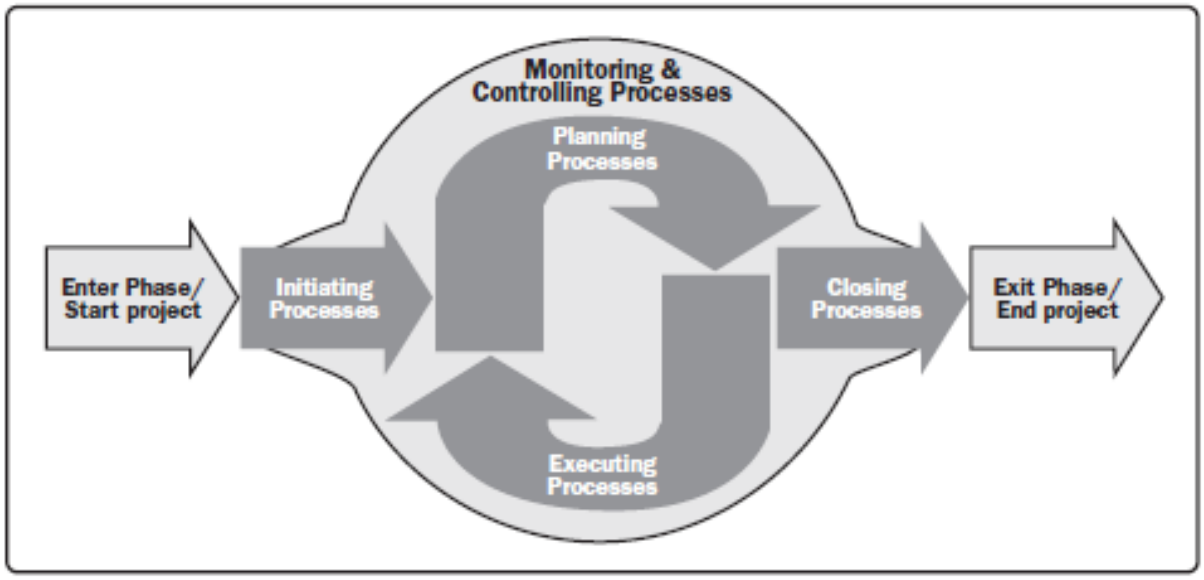

Figure 15: Common Project Management Process Interactions

- **Initiating and Planning:**
  - Guidelines and criteria for tailoring the organization's set of standard processes and procedures to satisfy the specific needs of the project;
  - Specific organizational standards such as policies (e.g., human resources policies, health and safety policies, ethics policies, and project management policies), product and project life cycles, and quality policies and procedures (e.g., process audits, improvement targets, checklists, and standardized process definitions for use in the organization); and
  - Templates (e.g., risk register, work breakdown structure, project schedule network diagram, and contract templates).
- **Executing, Monitoring and Controlling:**
  - Change control procedures, including the steps by which performing organization standards, policies, plans, and procedures or any project documents will be modified, and how any changes will be approved and validated;
  - Financial controls procedures (e.g., time reporting, required expenditure and disbursement reviews, accounting codes, and standard contract provisions);
  - Issue and defect management procedures defining issue and defect controls, issue and defect identification and resolution, and action item tracking;
  - Organizational communication requirements (e.g., specific communication technology available, authorized communication media, record retention policies, and security requirements);
  - Procedures for prioritizing, approving, and issuing work authorizations;

- Risk control procedures, including risk categories, risk statement templates, probability and impact definitions, and probability and impact matrix; and
- Standardized guidelines, work instructions, proposal evaluation criteria, and performance measurement criteria.

- **Closing:**
  - Project closure guidelines or requirements (e.g., lessons learned, final project audits, project evaluations, product validations, and acceptance criteria).

3.4 Project Governance

Project governance is an oversight function that is aligned with the organization's governance model and that encompasses the project life cycle. Project governance framework provides the project manager and team with structure, processes, decision-making models and tools for managing the project, while supporting and controlling the project for successful delivery. Project governance is a critical element of any project, especially on complex and risky projects. It provides a comprehensive, consistent method of controlling the project and ensuring its success by defining and documenting and communicating reliable, repeatable project practices. It includes a framework for making project decisions; defines roles, responsibilities, and accountabilities for the success of the project; and determines the effectiveness of the project manager. A project's governance is defined by and fits within the larger context of the portfolio, program, or organization sponsoring it but is separate from organizational governance. (Institute, 2013)

3.5 Digital Project Management Model

Project governance plays a key role in effective project management. This section looks at the governance aspects such as digital project governance model, PMO, proactive quality governance, and project auditing. (Shivakumar, 2018a)

Every digital project should define the governance model for the entire project. A sample governance model is depicted in Figure 16, (Shivakumar, 2018a). It depicts a three-tier pyramid structure of a project management hierarchy with communication frequency, activities, and ownership at each of the levels. The roles, activities, and responsibilities are clearly defined at each level.

3.6 Project Team

3.6.1 Project Team

Project teams include roles such as (Institute, 2013):

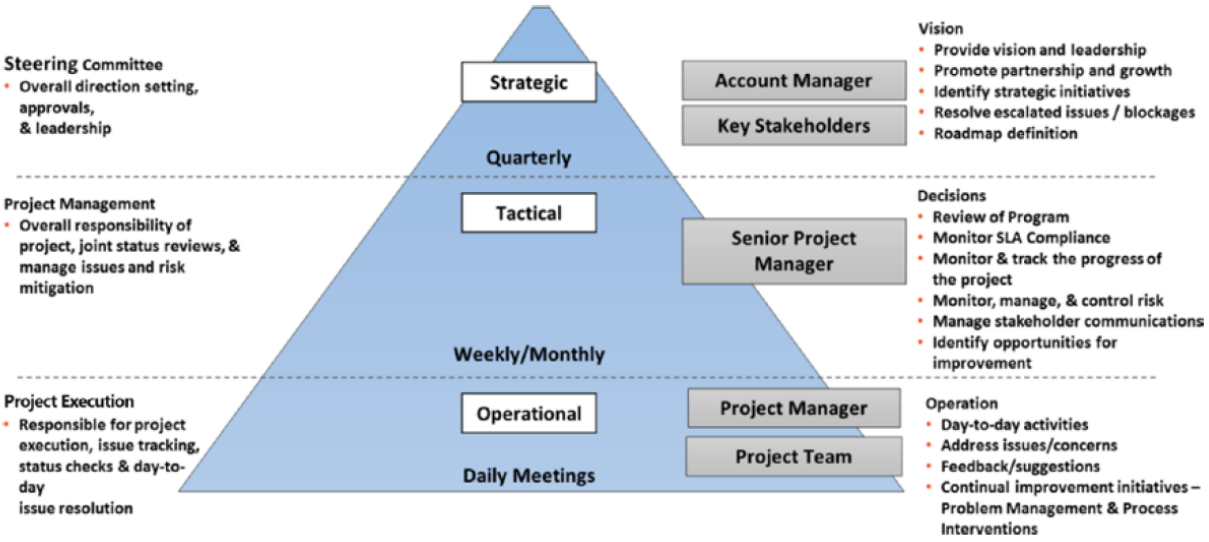

Figure 16: Sample project governance model

- **Project management staff:** The members of the team who perform project management activities such as scheduling, budgeting, reporting and control, communications, risk management and administrative support. This role may be performed or supported by a project management office (PMO).

- **Project staff:** The members of the team who carry out the work of creating the project deliverables.

- **Supporting experts:** Supporting experts perform activities required to develop or execute the project management plan. These can include such roles as contracting, financial management, logistics, legal, safety, engineering, test, or quality control. Depending on the size of the project and level of support required, supporting experts may be assigned to work full time or may just participate on the team when their particular skills are required.

- **User or Customer Representatives:** Members of the organization who will accept the deliverables or products of the project may be assigned to act as representatives or liaisons to ensure proper coordination, advise on requirements, or validate the acceptability of the project's results.

- **Sellers:** Sellers, also called vendors, suppliers, or contractors, are external companies that enter into a contractual agreement to provide components or services necessary for the project. The project team is often assigned the responsibility to oversee the performance and acceptance of sellers' deliverables or services. If the sellers bear a large share of the risk for delivering the project's results, they may play a significant role on the project team.

- **Business partner members:** Members of business partners' organizations may be assigned as members of the project team to ensure proper coordination.

- **Business partners:** Business partners are also external companies, but they have a special relationship with the enterprise, sometimes attained through a certification process. Business partners provide specialized expertise or fill a specified role such as installation, customization, training, or support.

3.6.2 Critical Roles and Responsibilities in Digital Transformation

According to (Nissen, 2018), the wide scope, complexity and high risk of large-scale transformations require ensuring adequate and clear responsibilities for the definition and implementation of a digital transformation strategy. As a result of an extensive online survey with 1487 participants representing the full range of regions, industries, company sizes, functional specialties, and tenures, the following critical roles in the course of a digital transformation are suggested:

- **CEO**: The CEO should be the face of the change in large-scale transformations. He should act as a visionary leader who shows the organization the way by communicating a compelling change story and being a visible advocate for the changes taking place. Moreover, he puts the critical teams in place to lead the day-to-day effort in major work streams of the transformation.
- **Senior leaders**: Senior leaders should act as mobilizers of both the message and the people in their organizations. Senior leaders must support company-wide coordination by sharing aligned messages and providing transparent communication across the organization—on both the changes that will take place and the desired outcomes. They lead work stream teams and ensure that team members are committed to the changes.
- **Human Resources**: Human resources as a critical player in their transformations' outcomes. However, in companies with the most successful transformations, HR leaders are best at connecting the high-level transformation objectives with employees' day-to-day work and communicating about this link to employees.
- **Project Managers / Transformation Offices**: Leaders of program-management offices (PMOs) or transformation offices act as problem solvers, identify barriers to change in the organization, serve as thought partners to senior managers, and help to disseminate transformation related knowledge and best practices across the organization.
- **Leaders of individual transformation initiatives**: The leaders of individual transformation initiatives have clear ownership of their initiatives in the most successful transformations. They work well with their peers leading other initiatives, and understand the significance of their contribution within the broader transformation effort.
- **Line managers**: Line managers have an important role as motivator for front line employees, whose involvement and buy-in is very important to a transformation's success. They must make the transformation efforts tangible and digestible to the front-line employees and motivate their teams to adopt the changes in their daily work routines.

- **Change agents**: Change agents work as facilitators or agents of the transformation, and support other employees in developing new capabilities and mind-sets essential for success. They are most valuable to a transformation as role models for others throughout the organization, demonstrating the shifts in mindsets and behaviors that the transformation requires.

According to (Bucy, Hall, & Yakola, 2016), following their experience in transformation projects, further elaborate on the 'transformation office' (TO) as an important institution in digital transformation. The TO oversees the transformation, constantly pushes for decisions, and thus drives the change at a faster speed than daily routine business. Thus, this faster clock speed is one of the most defining characteristics of successful transformations. Collaborating with senior leaders across the entire business, the TO must have the grit, discipline, energy, and focus to drive forward five to eight major work streams. All of them are further divided into perhaps hundreds of separate initiatives, each with a specific owner and a detailed, fully costed bottom-up plan. Moreover, the position of a Chief Transformation Officer should be created, an authority to push the organization to its full potential.

3.7 Project Management Methodologies

3.7.1 Project Life Cycle

A project life cycle is the series of phases that a project passes through from its initiation to its closure. The phases are generally sequential, and their names and numbers are determined by the management and control needs of the organization or organizations involved in the project, the nature of the project itself, and its area of application. The phases can be broken down by functional or partial objectives, intermediate results or deliverables, specific milestones within the overall scope of work, or financial availability. Phases are generally time bounded, with a start and ending or control point. A life cycle can be documented within a methodology. The project life cycle can be determined or shaped by the unique aspects of the organization, industry, or technology employed. While every project has a definite start and a definite end, the specific deliverables and activities that take place in between will vary widely with the project. The life cycle provides the basic framework for managing the project, regardless of the specific work involved. (Institute, 2013)

3.7.2 Project Phases

A project may be divided into any number of phases. A project phase is a collection of logically related project activities that culminates in the completion of one or more deliverables. Project phases are used when the nature of the work to be performed is unique to a portion of the project, and are typically linked to the development of a specific major deliverable. A phase may emphasize processes from a particular Project Management Process Group, but it is likely that most or all processes will be executed in some form in each phase. Project phases typically are completed sequentially, but can overlap in some project situations. Different phases typically have a different duration or effort. The high-level nature of project phases makes them an element of the project life cycle. (Institute, 2013)

3.7.3 Waterfall Methodology

1. **Waterfall Model**
   The Waterfall Model was the first Process Model to be introduced. It is also referred to as a linear-sequential life cycle model. It is very simple to understand and use. In a waterfall model, each phase must be completed fully before the next phase can begin. This type of software development model is basically used for the project, which is small and there are no uncertain requirements. At the end of each phase, a review takes place to determine if the project is on the right path and whether or not to continue or discard the project. In this model software testing starts only after the development is complete. In waterfall model phases do not overlap. (Hassani, El Bouzekri El Idrissi, & Abouabdellah, 2018)

2. **Waterfall Diagram**

The following diagram represents the Waterfall model:

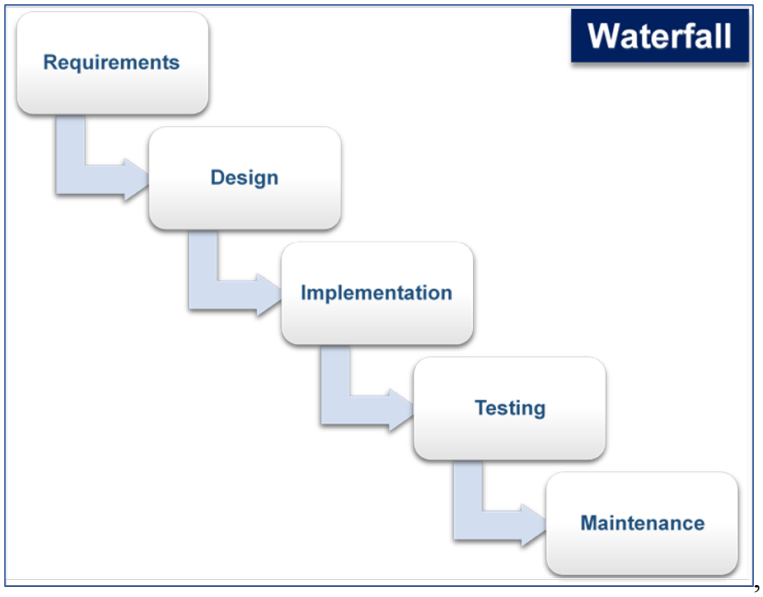

Figure 17: Waterfall Model Diagram

3. **Advantages and disadvantages of Waterfall model**

Table 5: Advantages and disadvantages of Waterfall model

Advantages	Disadvantages
This model is simple and easy to understand and use	Once an application is in the testing stage, it is very difficult to go back and change something that was not well-thought out in the concept stage
It is easy to manage due to the rigidity of the model – each phase has specific deliverables and a review process.	No working software is produced until late during the life cycle.
In this model phases are processed and completed one at a time. Phases do not overlap.	High amounts of risk and uncertainty.
Waterfall model works well for smaller projects where requirements are very well understood.	Not a good model for complex and object-oriented projects.
	Poor model for long and ongoing projects.
	Not suitable for the projects where requirements are at a moderate to high risk of changing.

4. **When to use the Waterfall model:**

- This model is used only when the requirements are very well known, clear and fixed
- Product definition is stable
- Technology is understood
- There are no ambiguous requirements

- Ample resources with required expertise are free available
- The project is short

Very less customer interaction is involved during the development of the product. Once the product is ready, then only it can be deemed to the end users. Once the product is developed and if any failure occurs, then the cost of fixing such issues are very high, because we need to update everywhere from document till the logic.

3.7.4 Agile Methodology

1. **Agile Model**
   Agile development model is also a type of Incremental model. Software is developed in incremental, rapid cycles. This results in small incremental releases with each release building on previous functionality. Each release is thoroughly tested to ensure software quality is maintained. It is used for time critical applications. Extreme Programming (XP) is currently one of the most well-known agile development life cycle models. According to PM², agile is an approach to managing projects based on a specific set of principles and practices, which promote adaptive planning, evolutionary development, early incremental delivery and continuous improvement. It encourages rapid and flexible responses to change. (PM², 2021) (Hassani et al., 2018)

2. **Agile Diagram**
   The following diagram represents the Agile model:

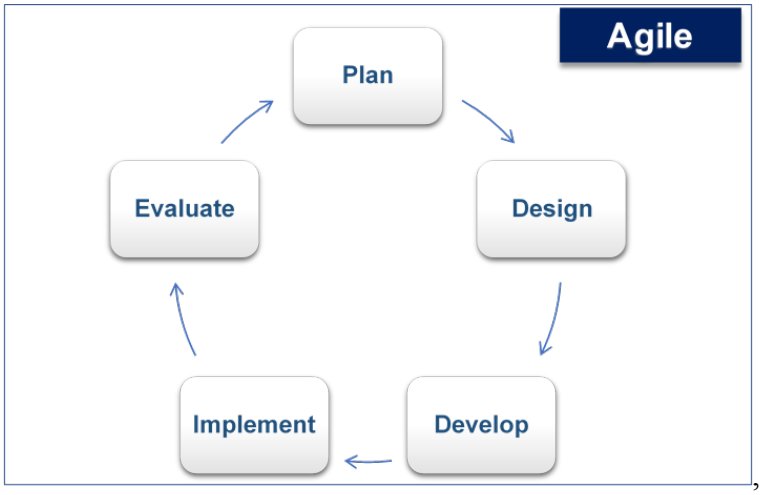

Figure 18: Agile Model Diagram

3. **Advantages and disadvantages of Agile model**

4. **When to use the Agile model:**
   When new changes are needed to be implemented. New changes can be implemented at very little cost because of the frequency of new increments that are produced. (Hassani et al., 2018)

Table 6: Advantages and disadvantages of Agile model

Advantages	Disadvantages
Customer satisfaction by rapid, continuous delivery of useful software.	In case of some software deliverables, especially the large ones, it is difficult to assess the effort required at the beginning of the software development life cycle.
People and interactions are emphasized rather than process and tools. Customers, developers and testers constantly interact with each other.	There is a lack of emphasis on necessary designing and documentation
Working software is delivered frequently (weeks rather than months).	The project can easily get taken off track if the customer representative is not clear what the final outcome that they want.
Face-to-face conversation is the best form of communication.	Only senior programmers are capable of taking the kind of decisions required during the development process. Hence it has no place for newbie programmers, unless combined with experienced resources.
Close, daily cooperation between business people and developers.	
Continuous attention to technical excellence and good design.	
Regular adaptation to changing circumstances.	

- To implement a new feature the developers need to lose only the work of a few days, or even only hours, to roll back and implement it.
- Agile assumes that the end users' needs are ever changing in a dynamic business and IT world. Changes can be discussed and features can be newly effected or removed based on feedback. This effectively gives the customer the finished system they want or need.
- Both system developers and stakeholders alike, find they also get more freedom of time and options than if the software was developed in a more rigid sequential way. Having options gives them the ability to leave important decisions until more or better data or even entire hosting programs are available; meaning the project can continue to move forward without fear of reaching a sudden standstill.

Scrum Methodology The Scrum methodology is one of the popular Agile models that is widely adopted for digital projects. In this methodology, a product is incrementally developed in multiple sprints (iterations), as depicted in Figure 19. Each sprint is time-boxed with a specific set of goals. Normally each sprint lasts about 6-8 weeks. The main Scrum roles include the product owner, who owns product backlog and prioritizes requirements, the Scrum master, who resolves conflicts and dependencies and works with team members, and self-organized teams, which estimate and work on user stories. (Shivakumar, 2018c)

Scrum Diagram The following diagram represents the Scrum model:

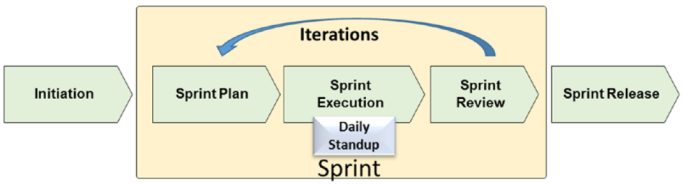

Figure 19: Scrum Model Diagram

Key practices of the Scrum methodology include the following, (Shivakumar, 2018c):

- ***Sprint planning:*** Product owner creates the product backlog (compilation of tasks or user stores) and discusses it with the team. The team decides on the required sprints, sprint goals, and the delivery schedule. All identified features (user stories) go into the Sprint backlog.
- ***Sprint:*** Each Sprint is time-boxed for a fixed time (usually 3-6 weeks based on the deliverables and project complexity) and uses a sprint backlog for execution. Sprint activities are monitored through stand-up meetings and through burn-down charts.
- ***Daily stand-up calls:*** The product owner, Scrum master, and team members participate in short daily meetings to discuss the previous day's work and the current day's planned work along with any challenges/roadblocks. These meetings contribute to the overall health of the sprint and enable self-organizing teams.
- ***Sprint review:*** At the end of each sprint, the team reviews the sprint accomplishments and lessons and discusses the plan for the next sprint. During the process, the team also identifies the scope for re-usability and tools/frameworks. The team also provides a product demo to stakeholders.
- ***Sprint artifacts:*** The main Sprint artifacts are as follows:
  - *User story:* The basic work unit of a sprint. It describes the who, what, and why of the requirements. User stories provide an effective mechanism to break the work down into independent, testable, and deploy-able units. User stories can be classified as functional and non-functional.
  - *Product backlog:* A list of user stories managed by the product owner. It forms the repository of user stories for the sprint backlog.
  - *Sprint backlog:* Consists of all tasks/features that are part of a given sprint. The team uses a product backlog to create tasks of sprint backlog based on priority and complexity.

3.7.5 Hybrid/Iterative Methodology

1. **Hybrid/Iterative Model**
   Hybrid Project Management combines the formal and agile methods to create a new project

management method. Hybrid employs the thoroughness of Work Breakdown Structure (WBS) with speed and lean benefits of Agile for a new project management method which is both detailed and fast. Most projects benefit from using Hybrid project management method. Only very small projects don't require hybrid method. (Hassani et al., 2018) The proposed model includes the advantages of the waterfall and agile methods, and it is called a hybrid model for digital projects, which is a particular implementation of the digital development life cycle that focuses on an initial requirement gathering and analytics, then the global system design, and finally a handful of stages are repeated over and over before deployment. In an era of digital transformation, digital projects require exponential evolution and improvement, customer involvement, they can be large, medium or small, as they can be of a simple or high level of complexity. Also, the requirements for this type of project is clear and precise at the beginning of production, but it is subject to improvement and evolution according to the new digital trends that may occur during the production.(Hassani et al., 2018)
The stages of the hybrid model are the following:

- ***Planning Requirements:*** As with most any development project, the first step is going through an initial planning stage to map out the specification documents, establish digital requirements, and generally prepare for the upcoming stages of the cycle.
- ***Analysis Design:*** Once planning is complete, an analysis is performed to nail down the appropriate business logic, database models, and the like that will be required at this stage in the project. The design stage also occurs here, establishing any technical requirements (languages, data layers, services, etc.) that will be utilized in order to meet the needs of the analysis stage.
- ***Iterations "communication, implementation and testing":*** Following the identified iterations (in the first step), the development and tests of each are started according to the fixed schedule. So, once the current build iteration has been coded and implemented, the next step is to go through a series of testing procedures to identify and locate any potential bugs or issues that have cropped up. Every iteration must be in 2 to 4 weeks (small iterations).
- ***Deployment:*** Once all prior stages have been completed, it is time for a thorough evaluation of development up to this stage. This allows the entire team, as well as clients or other outside parties, to examine where the project is at, where it needs to be, what can or should change, and so on. For large or complex projects, it is necessary to think to produce several versions, starting from a simple version (light) to a more complete one. This method, will allow to follow the trends of the digital transformation in real time i.e, a light version in terms of size and complexity implies rapid production and respecting the triangle : quality, price, and schedule. Also, based on the first version, a more complete version can be produced, which follows trends that have taken place in the meantime, and which can include UX (user experience) and CX (customer experience), and can also include changes in customer requirements which took place during the implementation of the project.

2. **Hybrid/Iterative Diagram**

The following diagram represents the hybrid model:

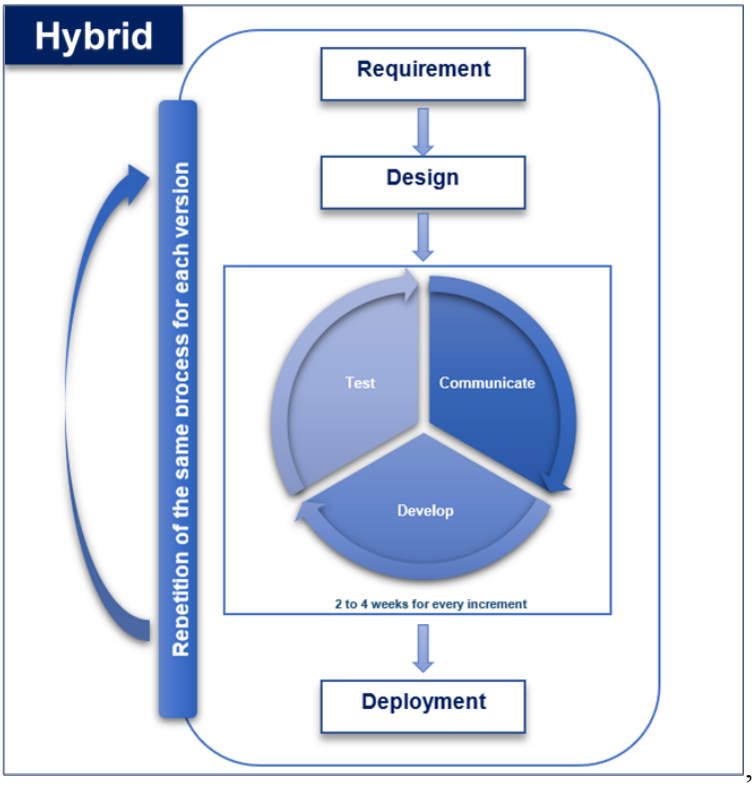

Figure 20: Hybrid Model Diagram

3. **Advantages and disadvantages of Hybrid/Iterative model**

Table 7: Advantages and disadvantages of Hybrid/Iterative model

Advantages of hybrid-model	Disadvantages of hybrid model
Simple and easy to understand and use	Convince the customer to go through versions for large projects or projects of high complexity.
Customer satisfaction by rapid, continuous delivery of useful version of the digital project	
People and interactions are emphasized. Customer, developers and testers constantly interact with each other	
Working digital project is delivered frequently (weeks rather months)	
Continuous attention to technical excellence and good design	
Regular adaptation to changing circumstances	
Exponential improvement - Works for all type of digital projects (every size, every complexity)	
Clear and precise visibility on the whole project at any time	

4. **When to use the Hybrid/Iterative model:**

(Hassani et al., 2018)

- To produce digital projects, it is no longer necessary to make analyzes, or have a big experience to choose the right method, but rather, the identification of iterations as well as versions if necessary.

3.8 Project Time Management

3.8.1 Digital Project Estimation Framework

The digital project manager has to establish the estimation framework that can be used for the digital project. The key components of the estimation framework are depicted in Figure 21, (Shivakumar, 2018b).

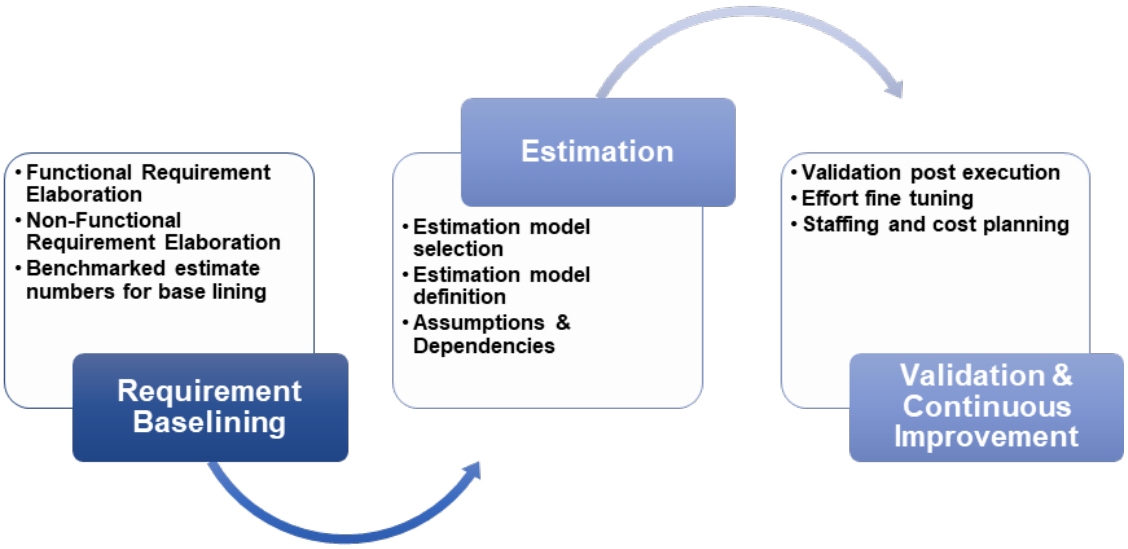

Figure 21: Estimation Framework

The initial phase of the estimation framework is the Requirements Baselining phase, wherein all the requirements are properly defined. For waterfall models, the complete requirements for the entire project are defined. For Agile models, the requirements for the current sprint are defined. The business rules, use cases, business flows, and exception scenarios related to functional requirements should be fully defined. The SLAs and testing scenarios for non-functional requirements such as security, performance, etc. should also be completely defined. The effort estimates from similar projects are taken as baselines for the next stage in the estimation framework. During the Estimation phase of the framework, the digital project manager selects the most appropriate estimation model needed for the project. Depending on the project's execution model and requirement type, the project manager has to select the most appropriate estimation model. Prominent estimation

models include function point estimation, SMC estimation, use case estimation, user story based estimation, etc. The next section explains the definition process for the estimation model for each of the prominent estimation models. The project manager also should document the assumptions and dependencies used in the estimation process. During the Validation phase, the planned effort values are compared with the actual effort values once the project is completed. The effort deviations are used to update and correct the estimation guidelines for future project iterations. This process is repeated across various iterations and projects to continuously improve the estimation model. The estimation model is used for staffing and costing purposes.

3.9 Metrics and Goals

Metrics and key performance indicators (KPIs) quantify the performance of the project. To realize the full potential of digital transformation, digital firms need to measure the performance improvements on key performance indicators (KPIs) to facilitate learning and fine-tune the business model. The relevance and use of KPIs may differ across the phases of digital transformation. (Verhoef et al., 2021) (Shivakumar, 2018b)

3.9.1 Technical KPIs

The following figure 22 lists some of the main KPIs related to an enterprise search technology.

KPI	Details
Search exit rate	Depicts the rate at which the users are abandoning search or when users are not finding the right information. This can be used to root cause an issue.
Search performance	Provides the response time of the search function in all geographies and in all supported languages. It is measured as time taken to present the search results in the presentation layer.
Zero-result query	Identifies the keywords and queries that are returning empty search results. For all terms returning zero results, you can use synonyms and related terms to include them in the search results so that the query keyword provides non-zero results.
Query metrics (queries per day, queries per session, query performance, top queries, usage of query facets, queries that returned error, time on result set page, result pages viewed per query)	These are some of the core metrics for measuring the performance of a search query. Based on these metrics, the query performance is analyzed and optimized. Many enterprise search engines provide explain plans (providing the details of the internal query) that could be used to troubleshoot performance issues.
Successful search rate	The metric measures the rate of users who ended up clicking on search results.
Top pages in search results	This would indicate the most popular and important pages that are featured in many search results. We could further optimize these pages.
Keywords metrics (most used keywords, conversion per keyword, keywords driving traffic)	This indicates the main keywords used in search and driving traffic and conversions for the site. We could optimize the search results for these keywords to further enhance traffic and conversion rate.
Content metrics (most used content, most popular document, content/document not reached by search)	Content metrics shed light on usage of particular content and documents. If the search engine cannot reach certain content, you need to analyze its metadata, path, and content formats to root cause the issue and take appropriate corrective measures.

,

Figure 22: Technical KPIs Related to Search Product

3.9.2 Business KPIs

The following figure 23 provides the main enterprise search KPIs from a business standpoint.

KPI	Details
Customer satisfaction index	As many websites use a search-centered experience, the overall user satisfaction of the website depends largely on crucial functions such as search. The index provides insights into users' search experience and the search effectiveness.
Conversion rate	Rate of increase in conversion (the ratio of number of people who purchased something to number of visitors) due to a search function. Other related metrics in this domain are percent increase in average order value, percent increase in revenue per customer, and percent increase in average transaction amount.
Most popular keywords	Be sure to know which keywords are popular so that you can enhance users experiences and return quality results to them.
Percent reduction in support calls	Rate of reduction in support calls due to search-based self-service.
Percent improvement in issue resolution time	In self-service applications, search success can be measured based on its effectiveness in improving the issue resolution time through relevant results and enabling service representatives.
Page-related metrics (popular pages, pages with high exit rate)	These metrics can be used to identify the root cause of success or failure of the pages. You can analyze the content, navigation model, and information architecture and take appropriate corrective measures for poorly performing pages. Since search is a key information discovery tool, it can be used to improve page metrics.
Click-through rate from search results of every page	These metrics indicate that users are finding the search results useful.
Query metrics (queries that satisfy a large set of users, queries that satisfy least set of users, etc.)	These metrics indicate query usage among the user population. You can fine tune the performance of the most frequently used queries.

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Figure 23: Business KPIs Related to Search

4 Digital Transformation Projects

4.1 Approach for Digital Transformation in Small and Medium-sized Enterprises

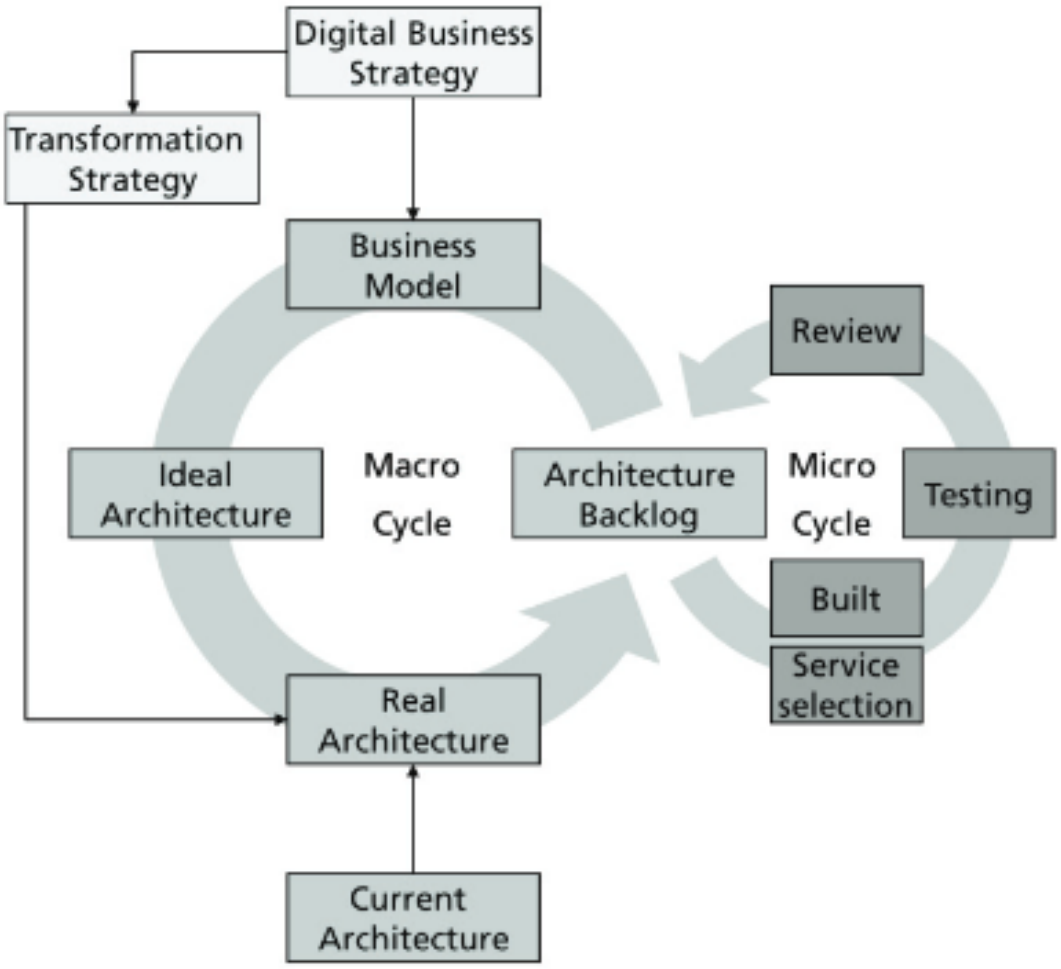

Figure 24: Agile enterprise architecture for digital transformation

The approach for Digital Transformation in Small and Medium-sized Enterprises is divided into a macro and a micro cycle, as shown in figure 24, (Goerzig & Bauernhansl, 2018). The macro cycle defines the architecture of the entire SME. In the micro cycle single functions are implemented and tested. Besides the incrementally developed macro and micro cycle there are two quite stable fields which help to conserve the digital strategy of an enterprise. The digital business strategy is the initial point of the approach. It contains basic decisions concerning speed, scale and scope of the digital technology application in the enterprise. (Goerzig & Bauernhansl, 2018)

1. **Macro Cycle**

- The first step of the macro cycle is to derive the business model from the digital business strategy. As described earlier, the business model contains information like value proposition, customer segments or revenue streams.
- The second step is to elaborate an ideal architecture. The aim of this step is to detail the business model in a very rough way. The ideal architecture contains descriptions of the main processes, main IT services and information that is needed for realization. An important feature is that there are no restrictions. The target of the ideal architecture is to give the architect room for new ideas without considering legacy systems or strategic restrictions.
- Afterwards, the real architecture is derived from the ideal architecture. In this step, the transformation strategy and the current architecture are considered. Since the fundamental change during a digital transformation should be realized incrementally, there are always legacy systems and interfaces that have to be taken into account. Nevertheless, the architect should not continue to use legacy systems at any price.
- The architecture backlog follows similar ideas as the product backlog in the scrum approach. Based on the differences between current and real architecture, user stories are defined in the architecture backlog. These user stories are capsuled service systems with defined interfaces. A defined set of user stories can run through the micro cycle independently from other user stories. They describe the users, the desired functionality and the benefit. There are no details about used software or hardware. The aim of this is to create free space for the development team. Within the backlog, user stories are prioritized. Moreover, it is defined which user stories are built by the enterprise and which are provided by partners within the ecosystem. Services that are part of the core competence or are not available on the market are developed single-handedly.

2. **Micro Cycle** After running through the macro cycle the micro cycle can be started for the first time.

   - This cycle begins with choosing the prioritized user stories from the backlog. The amount depends on the speed of change an enterprise aims for. Next step is the built or the service selection phase. During the built phase, the developers implement the user stories in a sprint. But in most cases the selection of services off the shelf is the better choice. Especially when a service is not part of the core competence and is already available on the used platform, an internal development should be avoided.
   - After implementation or purchase, each user story is tested. Testing can be realized either together with a test customer or in a testbed as provided by different organizations (e.g. research institutes, universities).
   - Next step is the review. There are three possible decisions. The first possibility is that the user story is marked as done. Then the teams start with the next user story. The second possibility is that adaptions are required and the micro cycle has to start again. The third possibility is that there are findings that have an impact on the whole architecture. Then the macro cycle starts again. With the first pass of the macro cycle,

the architecture is still very rough. With every pass, there are more details. The macro cycle should always give enough space for decisions in the micro cycle.

4.2 Successful Projects Use Cases

First use case is a case of digital disruption, a field that refers to the monitoring and analysis of emerging technologies. It also includes the development of competencies for leveraging these technologies. Second use case is a case related to digital business, a field covering the realization of new business models that are enabled by digital technologies and disrupt the traditional business. It often results from the smart fusion of the physical and digital world. Finally, the other use cases cover cases on digital transformation which refers to technology-induced organizational change. It embraces the organizational, processual, and technological efforts necessary for organizations to succeed in the digital age. (Urbach & Röglinger, 2019)

4.2.1 Digital Disruption: Telecommunication Company

The case of Schmitz et al.(Schmitz, Dietze, & Czarnecki, 2019) reports on Deutsche Telekom, which aimed to implement a digital strategy and identified Robotic Process Automation (RPA) as an enabling technology to digitalize and automate transactional processes. In addition to the setup and execution of the RPA initiative, the case outlines the most important results, such as an increasing number of automated transactions per month.

- **Situation faced:** Due to the high number of customer contacts, fault clearances, installations, and product provisioning per year, the automation level of operational processes has a significant impact on financial results, quality, and customer experience. Therefore, the telecommunications operator Deutsche Telekom (DT) has defined a digital strategy with the objectives of zero complexity and zero complaint, one touch, agility in service, and disruptive thinking. In this context, Robotic Process Automation (RPA) was identified as an enabling technology to formulate and realize DT's digital strategy through automation of rule-based, routine, and predictable tasks in combination with structured and stable data.
- **Action taken:** Starting point of the project was the aim to implement DT's digital strategy. In an early stage of the project, it was decided to utilize RPA as enabler, in particular to drive digitization and automation of transactional activities. From a methodical perspective, the set-up and conduction of the RPA project was structured into:

  1. Organization and governance (see figure 26),
  2. processes,
  3. and technology and operations.

  From the content perspective, the RPA project defined and implemented a multitude of detailed RPA use cases, whereof two concrete use cases are described.

Cornerstones—DTTS digital strategy			
Digital journeys	Process digitization	Predictive services	Digital assistant
• Omni channel journeys • Self service • Live contact	• Digital and AI workflows • Digitization and automation of transactional activities • Remote and no touch installation	• Predictive maintenance • Predictive care and sales • Advanced analytics	• Digital service bots • AI capabilities support agent
Technology Enabler: Robotic Process Automation (RPA) (focus of this case)			

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Figure 25: Cornerstones, core elements, and enablers of DTTS digital strategy

- **Results achieved:** Within less than 6 months from the project start, the first transactions were performed automatically through RPA. In March 2016, approx. 229 thousand automatic transactions were successfully realized. Since then, the number of automatic transactions through RPA per month has been increasing significantly. The increase of automatic transactions per month was realized through a growing amount of usage of RPA in different process areas of DT. Within 1 year, the number of automatic transactions per month has been increased to more than 1 million, see figure 27.

- **Lessons learned:** The case provides an example for a concrete technology induced change as part of a digital transformation. The concept of RPA provides an opportunity to automate human activities through software robots. The lessons learned utilizable for future RPA projects are:

  1. Agile design and implementation are important for a successful digital transformation.
  2. Understand technical innovations as enabler of the digital transformation.
  3. Investigate technical and organizational interrelations from the beginning.
  4. RPA is more than a pure cost cutting instrument.
  5. The impact of RPA on the people dimension should be managed carefully from the beginning.

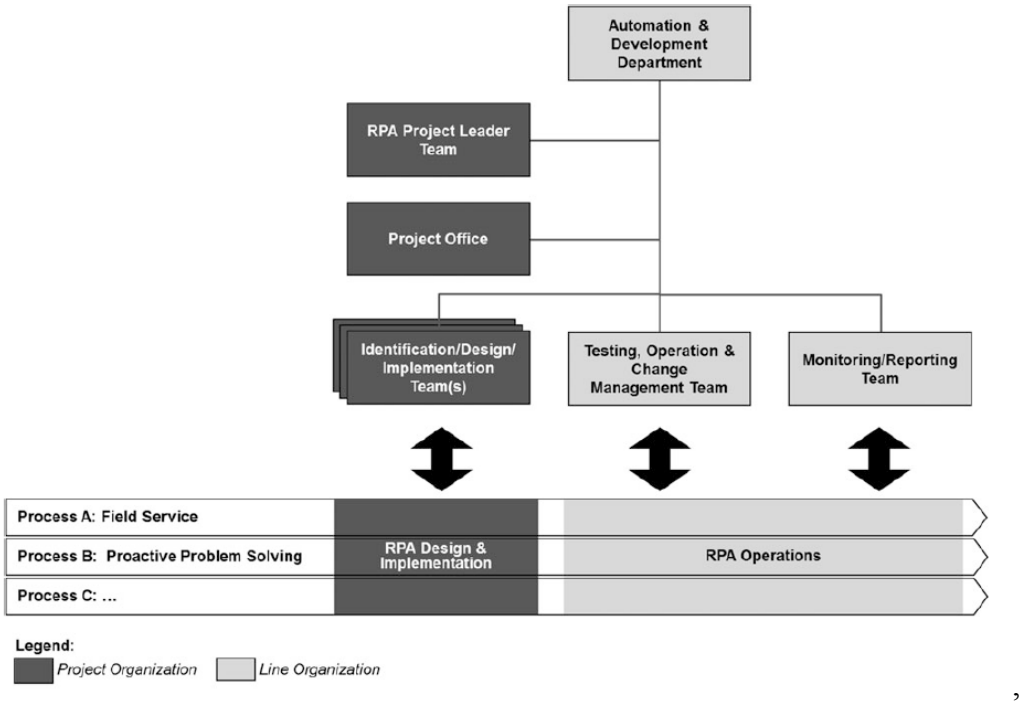

Figure 26: RPA organizational set-up

4.2.2 Digital Business: Insurance Company

Using an anonymous insurance company as example, Weingarth et al. (Weingarth, Hagenschulte, Schmidt, & Balser, 2019) present a strategic digital transformation initiative driven by the top management to build up digital capabilities and to meet the state-of-the-art agility/innovation requirements. The case demonstrates that actively managing cultural change is paramount across all business and functional areas right from the beginning.

- **Situation faced:** INSUR is one of the top fifteen insurance companies in Germany. Between 2000 and 2015, the organization focused on (1) external growth through several acquisitions as well as (2) the integration of these acquisitions including the corresponding IT landscape into the overarching organization. From 2016 onwards, INSUR's strategic focus shifted to actively shaping its group's digital journey, including the build-up of new digital capabilities to fulfill the agility and innovation requirements of the business units. INSUR's strategy focused on growth and efficiency gains through digitalization as well as on fostering innovation in developed digital solutions and services. The transformation focused on the restructuring and consolidation of the IT landscape and thus provided the technical, structural and financial foundation for the digitalization initiative. It had two focus areas: (1) infrastructure and IT operations and (2) and IT-architecture and IT systems landscape (see Fig. 28 for an overview). Figure 29 provides an overview of the application clusters and exemplary application sub-clusters, including the percentage expressing the reduction of legacy systems.

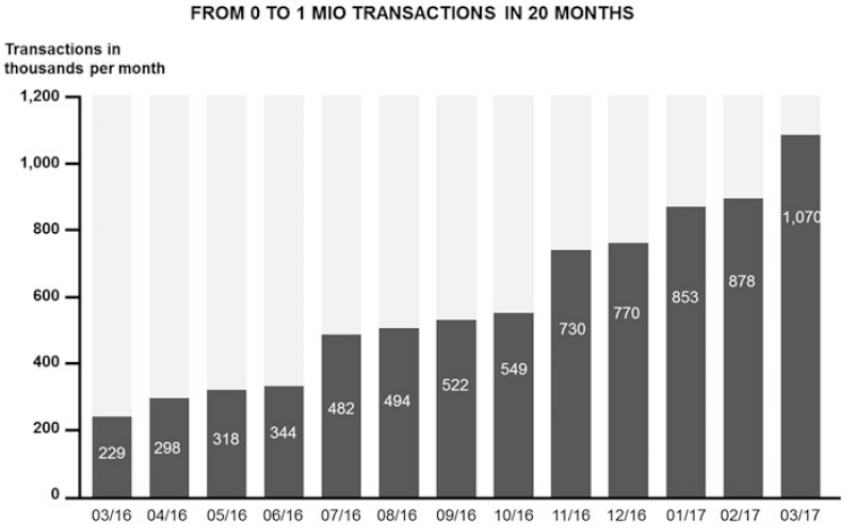

Figure 27: Number of automatic transactions through RPA per month

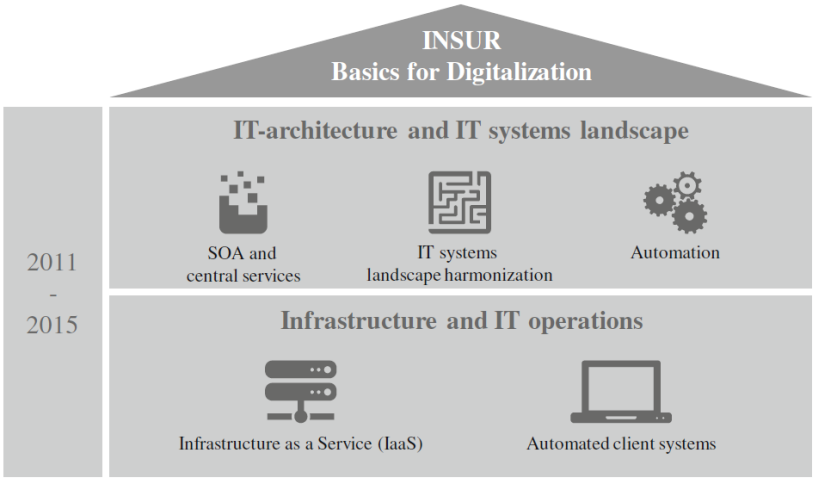

Figure 28: Overview pre-digitalization transformation

- **Action taken:** At the end of 2015, INSUR's top management started a strategic digital transformation initiative to define the cornerstones of the groups' innovation and digital agenda. This agenda followed six strategic imperatives:

  1. Creating digital awareness throughout the organization;
  2. Developing a group-wide common understanding of digitalization and establishing the first digital and innovation strategy;
  3. Selecting and validating strategic focus areas for digitalization;
  4. Enlarging the company's digital ecosystem using collaborations with startup accelerators and universities;
  5. Setting up a digital lab to develop and prototype digital use cases;
  6. Enhancing and scaling the digital lab towards a digital factory, see figure 30

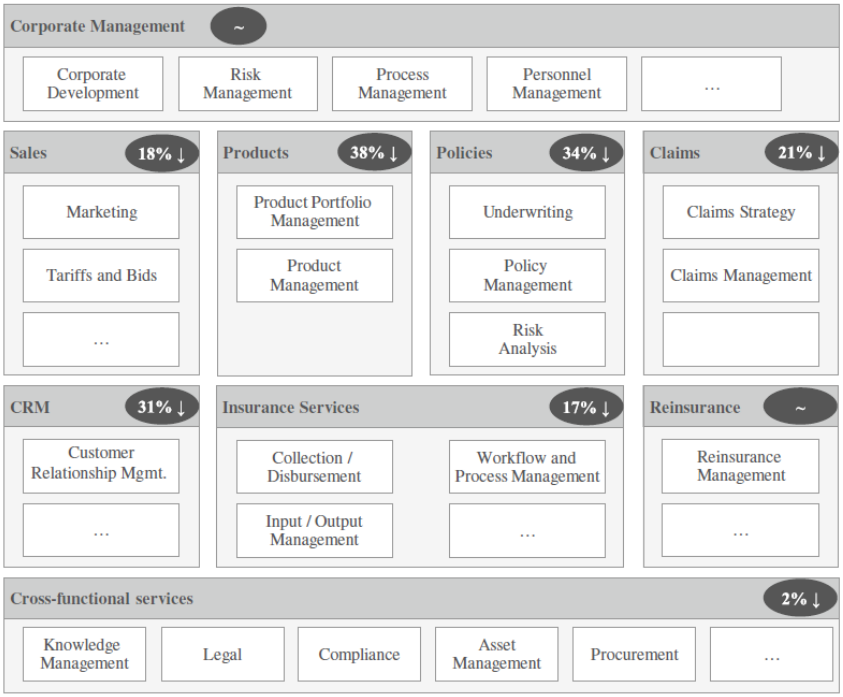

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Figure 29: Overview of application clusters (% indicates reduction of legacy systems)

- **Results achieved:** INSUR successfully initiated its digitalization journey and developed a high-level, group-wide digital and innovation strategy and selected its digital focus topics. Further, it set up an innovation management process and enlarged its digital ecosystem. The digital lab that INSUR started, however, did not take on as well as expected. Realizing that a small incubator is insufficient, INSUR is currently upscaling and transitioning the lab towards an integrated end-to-end digital factory, see figure 31.
- **Lessons learned:** While all changes might require some management support, the nature of digitalization requires top management support across all business and functional areas right from the beginning. Even if there are still legacy systems that need to be shut down or renewed, digitalization should be addressed early on while continuing to renovate the IT. Furthermore, fostering cultural change to be an attractive employer for new digital talents, which are required on all levels to make the digital transformation a success, is a key success factor. Finally, handling and actively managing concerns and required cultural change within the organization are paramount.

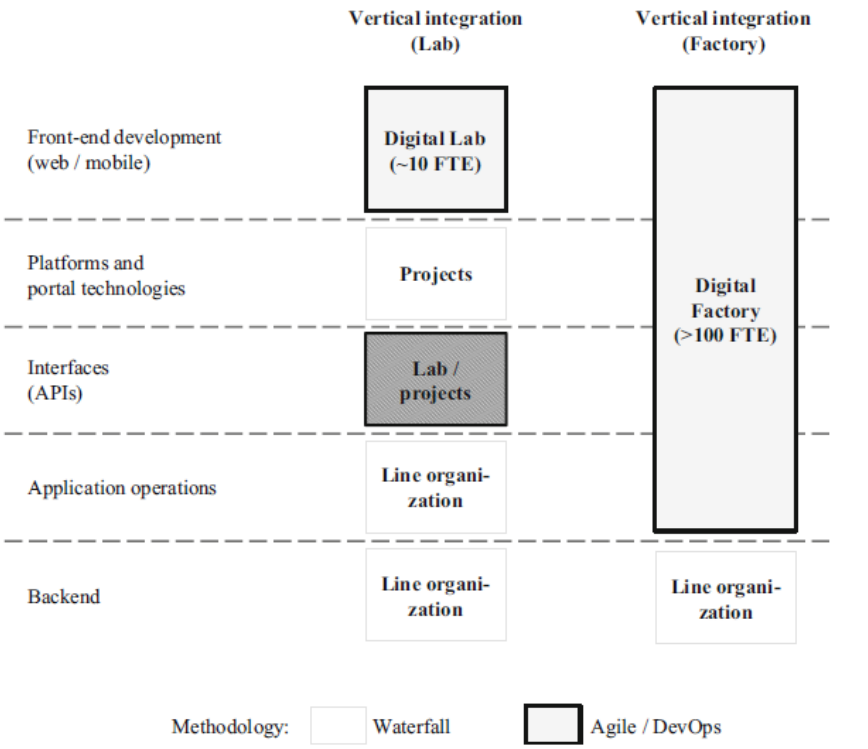

Figure 30: Enhancement of digital lab towards digital factory

4.2.3 Digital Transformation: Social services organization

Deelmann and Müller present the case of BruderhausDiakonie (Müller & Deelmann, 2019), a social services organization, willing to engage in digital transformation under the slogan "standardization before digitalization". By identifying routine tasks, implementing an easy-to-use technology platform and mobile devices, as well as giving data security a number one priority, the organization already achieved the first digitalization successes.

- **Situation faced:** In Germany's public sector, one of the main challenges is the demographic change and the resulting lack of skilled human resources. At the same time, digital solutions for e.g. citizens, businesses or other stakeholders move from "nice to have" towards "must have". The automation of services seems to be a promising approach to combine these two developments. This paper features BruderhausDiakonie, a social services organization which is growing horizontally at many new locations in order to ensure closeness to its clients. This process leads to an increase in complexity for its daily business and necessitates a change in thinking regarding the organization's IT towards increased digitalization.
- **Action taken:** In 2016, BruderhausDiakonie initiated a change process. The central message, which guided the project team from the beginning, gets to the root of the problem regarding digital transformation: Standardization before digitalization. The first step of a thorough analysis is the identification of routine tasks. Additionally, the vision of no more "Turnschuh-IT-Administration" (eng: "IT department in sneakers") was developed and communicated. An easy to use technology platform was implemented, mobile devices were in-

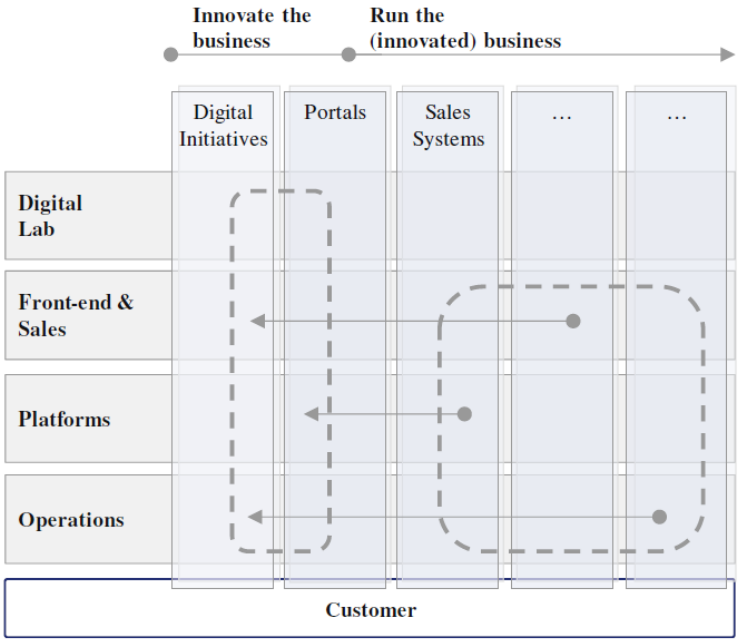

Figure 31: Structure of digital factory

tegrated—and data security was given number one priority.

- **Results achieved:** The digitalization process of BruderhausDiakonie is not yet finished. However, first results are already visible. In August 2017, five pilot offices were reorganized towards the new model. Until 2020, the process is to be finished for all offices. The first effects are already observable, along with the feedback of the involved employees. After all, the tangible benefits of digital transformation take a certain amount of time to become clear to employees. The IT department can help to start a new process, but everyone can and should be actively involved. The employees working in care or other departments feel the change happening, which is indicative of how their daily work is going to be in the future. Their work becomes more convenient, more comfortable and less time-consuming in regard to purely administrative tasks. Additionally, BruderhausDiakonie is also taking a pioneering position in how they will implement the benefits of the Internet of Things (IoT) as quickly as possible in their offices. In the future, employees should not only be provided with mobile devices, but also intelligent working materials, which not only make their work with clients easier, but diagnosis and care as well.

- **Lessons learned:** Digital transformation is a challenge, but it is feasible. It is important to choose an IT which allows for a gradual development towards the digital age. Knee-jerk solutions seem to be counterproductive. More promising is a step-by-step change process in regard to digital transformation, because it allows all involved parties a smooth adjustment to the digital requirements of the future. Three lessons learned stand out:

  – Digital transformation is more complex than expected;
  – All employees need to be involved and creating acceptance is a continuous task;
  – One has to carry on and not to stop after the first successes.

4.2.4 Digital Transformation: Measuring the digital maturity of hospitals

At Aarhus Denmark, the case of Meister et al. (Meister, Burmann, & Deiters, 2019) captures the initiative of the Danish Government to build five super hospitals in different regions that implement vertically and horizontally digitalized processes by having a common information architecture. The preliminary results deduced from the case are used to define a basic framework and to define a method called "maturity index for hospital 4.0" to measure the digital maturity of hospitals.

- **Situation faced:** Digitalization is changing healthcare. Especially hospitals are under tremendous pressure and there is a recognizable difference of digital maturity compared along the European states. Besides German hospitals, Fraunhofer ISST is supporting the Danish Government as they are in an outstanding restructuring process with the aim of building five super hospitals in different regions. The vision, fixed by the Danish DNU Hospital in Aarhus, was to allow the overall vertical and horizontal digitalization of processes by having one common information architecture. Fraunhofer ISST was contracted by DNU to support the definition and valuation of a reference architecture.
- **Action taken:** We started with a very lean approach and identified three key requirements:
  1. Support of operative processes
  2. Analysis and optimization
  3. Automation and planning

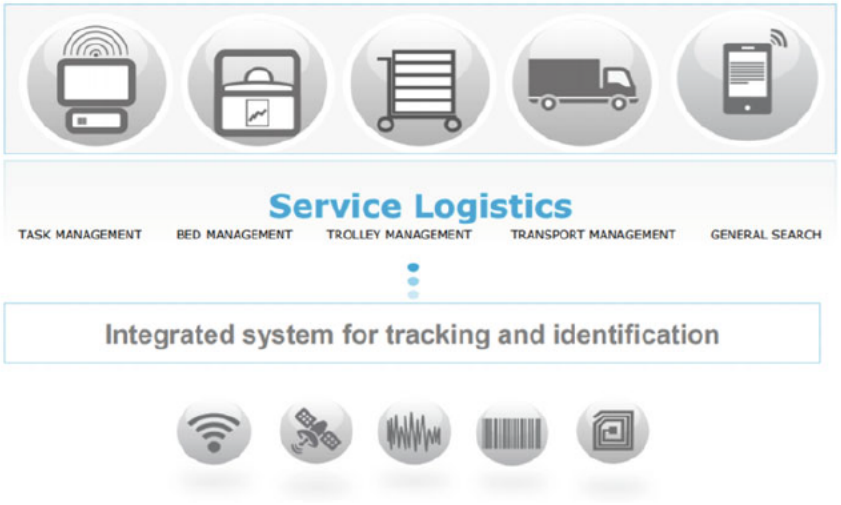

Figure 32: Overall architecture integrating horizontal and vertical information streams

A first idea was to implement an "Automated Transport Service" in a logistical scenario by combining the "trolley service" with the "task management service". The whole vision could be reduced to one aim: Optimization by automation. To reach this aim we identified the need for a structured process for digital transformation that will pay attention to the demand and needs as well as the competences of the employees. Therefore, Fraunhofer ISST started

to develop the approach called “Digital Health Innovation Engineering” (DHIE).The DHIE method is shown in Figure 33.

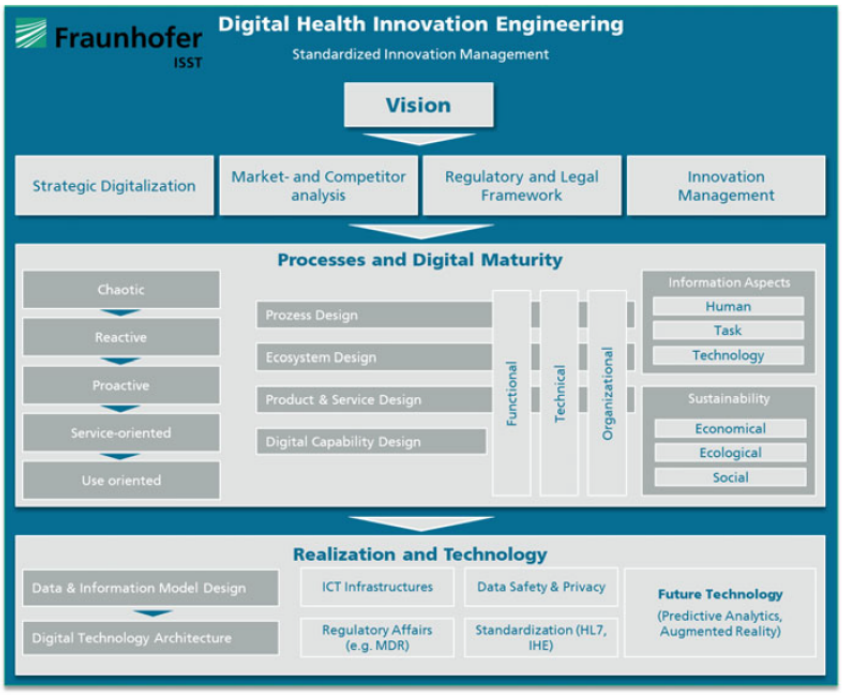

Figure 33: Overall architecture integrating horizontal and vertical information streams

- **Results achieved:** Making use of digitalization in healthcare requires a structured process called digital transformation to enable health companies, hospitals and other facilities to do so. The preliminary results deduced from the learnings at the DNU hospital were used to define the basic framework of DHIE. Furthermore, we detailed the method called “maturity index for hospital 4.0” to measure the digital maturity of hospitals paying attention to technical as well as human factors, see figure 34.
- **Lessons learned:** We identified, that the introduction of digital solutions and processes requires a structured process. Digitalization is more than technology; it is a process of transformation. Especially in healthcare, the human-to-human interaction like patient to physician plays an important role. Thus, digitalization has to define solutions how processes can change with respects to its human actors.

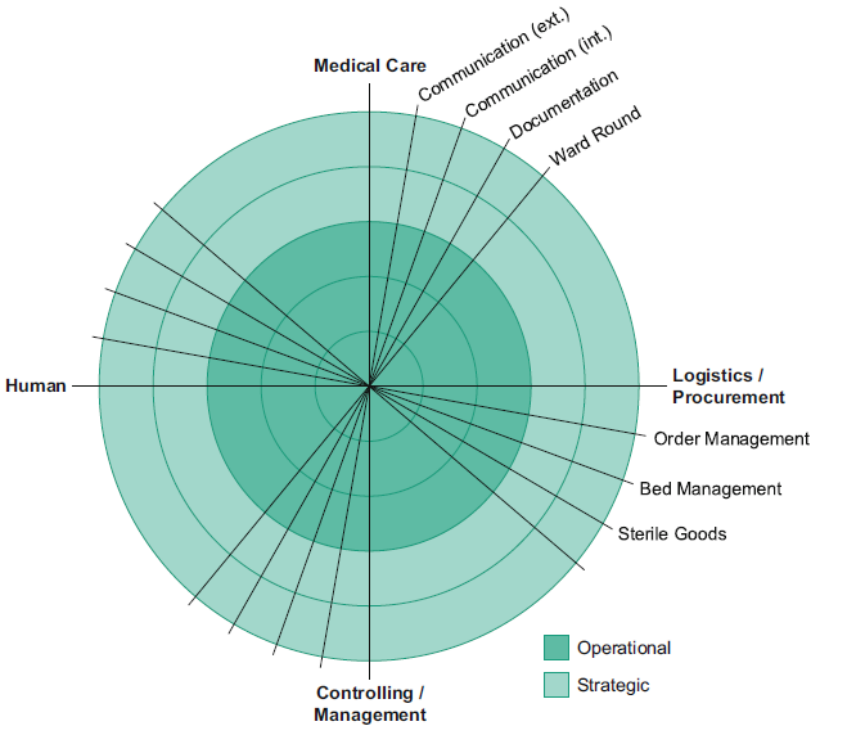

Figure 34: Digitization dimensions and exemplary subcategories

4.2.5 Digital Transformation: Transportation industry

The case of Fortmann et al. (Fortmann, Haffke, & Benlian, 2019) demonstrates how Deutsche Bahn Vertrieb reorganized its IT division in the passenger transportation industry. After restructuring the IT division into a single digital IT unit, channel-spanning strategies were enabled, and the organization experienced a boost in motivation and employee engagement, although bringing different modes of operation together took longer than expected.

- **Situation faced:** Deutsche Bahn Vertrieb GmbH (DB Vertrieb) is a sales company, operating as part of the DB Group in the passenger transportation industry. Around the millennium, the firm introduced digital sales channels in addition to its traditional ones. The inherent increasing visibility of DB Vertrieb's IT systems for the customer required a flexible and fast IT function. The IT function was organized in a separate IT department under the control of the CIO (see Fig. 35). Fifteen years later, the importance and pervasiveness of IT accounted for the need to integrate all parts—traditional and digital—of DB Vertrieb's channel strategy to allow for a smooth omni-channel customer experience.
- **Action taken:** The company reorganized its IT division twice. First, it established a second IT function within its online and mobile channel division. The new IT unit was small and flexible, incorporating a start-up culture. The divisionally separated bimodal IT approach lasted for about 15 years before both functions were reintegrated within the firm's new digital division, see figures 37 and 38. DB Vertrieb also introduced a framework for scaling the agile approach of the former online IT to the corporate level. DB Vertrieb took several actions in

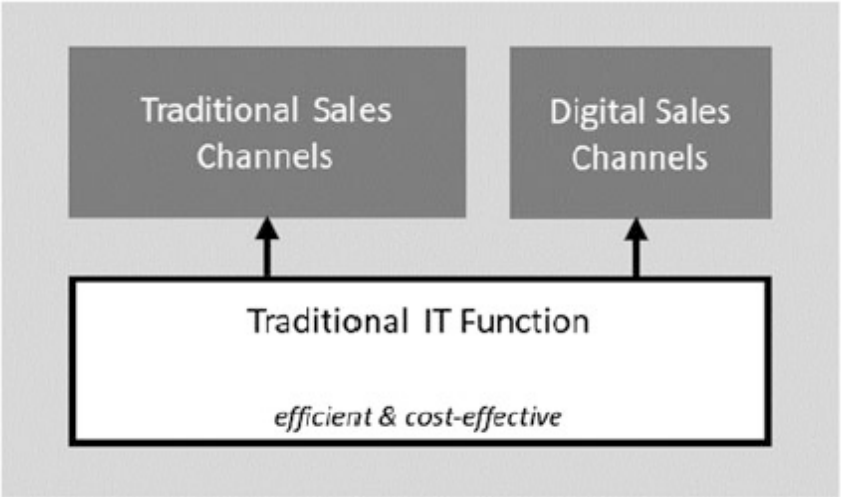

Figure 35: Traditional IT setup at DB Vertrieb

the course of its IT transformations, see Figure 36. .

Divisionally separated bimodal IT setup (1999–2015)	Reintegrated bimodal IT setup (2016—today)
• Installed small and collocated Online IT unit in the digital sales channel department • Established overarching requirements management unit • Worked with standing teams and product owners (Scrum techniques) in the Online IT function • Enlarged Online IT unit gradually and introduced subunits	• Merged Online and Traditional IT unit in the digital division • Included IT strategy in corporate digitization strategy • Installed innovation labs and omni-channel management function • Introduced the Scaled Agile Framework (SAFe), Scrum and DevOps methods • Trained employees concerning methods and models intensely • Hired transformation coordinator • Established governance board

Figure 36: Actions taken during IT transformations at DB Vertrieb

- **Results achieved:** The bimodal IT design enabled the company to implement changes quickly with regard to the online and mobile channels. However, the setup also led to cultural differences between the two IT units impeding desirable collaboration. After the restructuring into a single digital division IT unit, channel-spanning strategies were possible and DB Vertrieb experienced a boost in motivation and employee engagement. Nevertheless, bringing the modes of operation together takes more time than expected, so the new setup still lacked the desired success in terms of tangible results.
- **Lessons learned:** The case demonstrates how bimodal IT as a tool can facilitate the IT transformation necessary to accomplish a company's digital transformation. A continuous reassessment of the bimodal IT type is vital. It enables the IT unit to support the business in satisfying changing customer needs in the best way possible. In addition, certain strategic components, such as omni-channel strategy, seem to be in need of a specific type of bimodal IT. Furthermore, the case indicates which leadership roles, training styles, and measures are

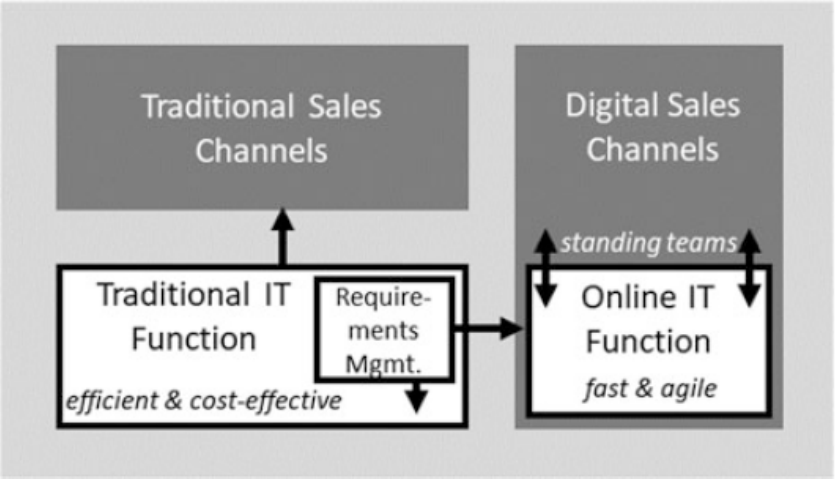

Figure 37: Divisionally separated bimodal IT setup at DB Vertrieb

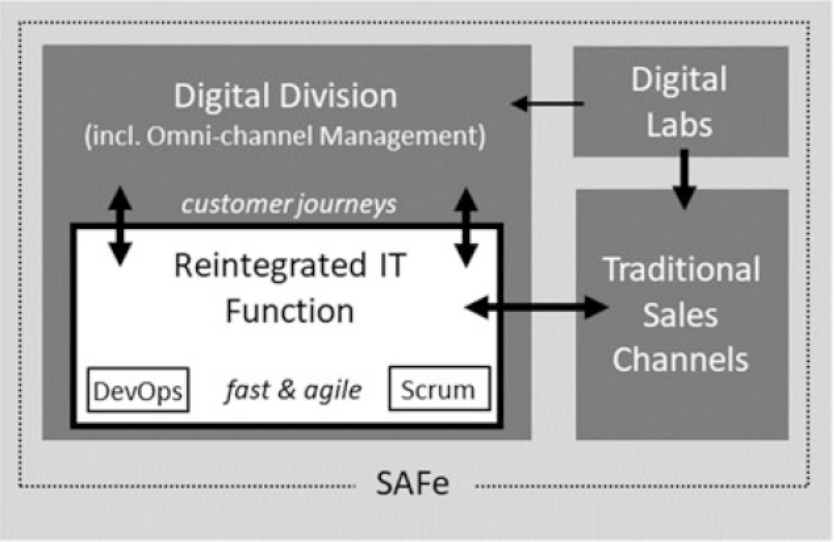

Figure 38: Reintegrated bimodal IT setup at DB Vertrieb

pivotal for successful transformation through bimodal IT and how adaption of a different type of bimodal IT helps to push core IT topics.

4.3 Failed Projects Use Cases

4.3.1 Digital Transformation: Automotive Company

- **Failed use case:** In 2014, classic American car company Ford attempted a digital transformation by creating a new segment called Ford Smart Mobility, (Forbes, 2019). The goal was to build digitally enabled cars with enhanced mobility. The issues arose when the new segment wasn't integrated into the rest of Ford. Not only was it headquartered far from the rest of the company, but it was seen as a separate entity with no cohesion to other business units.

As Ford dumped huge amounts of money into its new venture, it faced quality concerns in other areas of the company. Ford's stock price dropped dramatically, and the CEO stepped down a few year later.

- **Lesson:** Integrate digital transformation efforts with the rest of the company. In this case, digital transformation as less of an actual transformation and more of a pivot into a new business area. To be successful, digital transformation needs to be integrated into the company.

4.3.2 Digital Transformation: Electricity Company

- **Failed use case:** General Electric fancied to own the industrial internet, (Forbes, 2019) (Cigniti, 2020). In this endeavor, the American conglomerate spread its resources too thin, resulting in a failed digital transformation initiative. Formed in 2015 as a separate unit, GE Digital aimed to centralize all of the IT operations of the company. With the vision to become one of the top ten software companies by 2020, GE spent billions of dollars on its digital initiatives. Instead of individual units taking care of their respective digital needs, a separate entity in the form of GE Digital was formed to centralize the digital initiatives of the company. Although, GE Digital was supposed to enhance the company's data analytics capabilities and position General Electric as a more technologically-focused enterprise. The unit's objectives were strikingly different than the company's expertise. The hurried transitional effort from huge machinery to cloud-based software solutions actually backfired on the company, leaving GE in a dark economic pothole. The quarterly PL requirements prevented GE digital to invest in long-term strategies, limiting themselves to short-term goals that did not add significant value to the overall business. Against the expectations of opening new revenue streams, GE digital led to plummeted stock prices, bad reputation, and economic losses. The new CEO, John Flannery, is now driving a more focused strategy for GE digital along with a 25% budget cut and a sharp pivot in the digital strategy. The intent of GE was right, but it got lost in the process of doing everything at once. Without a clear vision, driving the digital transformation at the scale of a GE-level enterprise is a suicide mission. Despite the heavy investments and best-in-class talent, the digital initiatives did not succeed due to the lack of balance between the business needs and capabilities. The biggest pitfalls causing the digital strategies to fail are:

  1. Not having a clarity on what digital transformation means
  2. Not having the buy-in from the management
  3. Doing everything at once
  4. Absence of quantifiable metrics to measure the digital progress
  5. Lack of a change management plan

- **Lesson:** Focus on quality, not quantity. GE tried to do too much without a real strategic focus in any area. The company was simply too large to transform all at once, especially without a

true vision of what it was trying to achieve. Digital transformations are often done best with a handful of passionate people leading the charge instead of thousands of employees.

4.4 Main factors of success and failure

Issues at Various Project Life-cycle Stages Figure 39 provides the list of key issues you might face at various project life-cycle phases, (Shivakumar, 2018b):

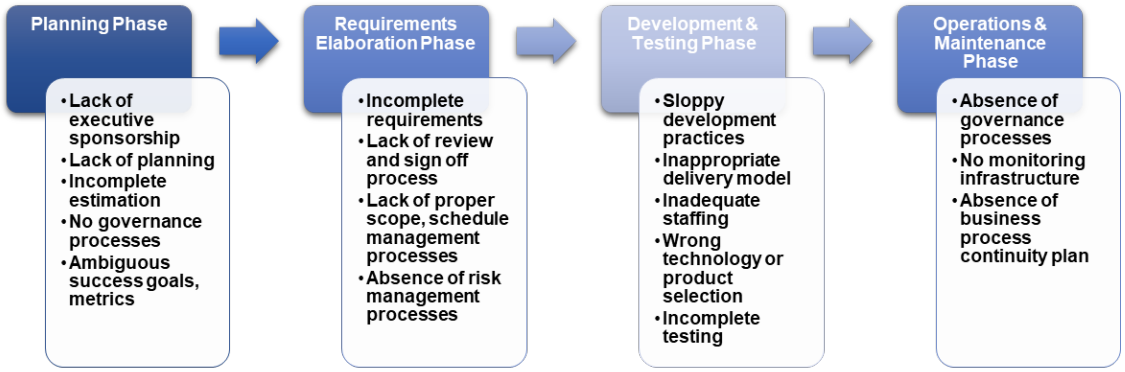

Figure 39: Common challenges in project life-cycle phases

1. During the ***planning phase***, if the digital programs fail to secure executive sponsorship from the business stakeholders, this would later lead to budget issues and adoption challenges. Project planning and estimation are two key activities that should be handled properly in the planning phase. Poor planning and estimation can later lead to schedule slippage and cost/effort overrun. Defining robust governance processes is another important activity in the project planning phase. Lack of defined governance processes can later lead to quality issues. If the success criteria, metrics, and KPIs are not well defined, it is challenging to understand the business benefits.

2. In the requirements ***elaboration phase***, absence of robust requirements management process is one of the key issues. Failure to elaborate detailed functional requirements and non-functional requirements and associated business rules impacts the subsequent phases and leads to a higher defect rate during the validation phase. All requirements documents should be reviewed and signed off by all stakeholders to freeze and baseline these requirements. Failure to define processes related to scope management, change request management, and risk management processes can later lead to effort and schedule overrun.

3. During the ***development and testing phases***, adopting sloppy development and testing practices can lead to poor quality deliverables. Not staffing the right skilled resources and the

right number of resources (based on accurate effort estimation and staffing) can later lead to deliver slippages. Due diligence and product evaluation should be done to select the appropriate technology and product. As the digital software ecosystem is continuously evolving with niche technologies, it is important to select the right products and technologies.

4. During the ***operations and governance phase***, the absence of a monitoring infrastructure can impact the performance and availability of SLAs. Without a real-time monitoring and notification infrastructure, the operations team cannot respond quickly to production incidents. The absence of a business continuity plan (BCP) (using a disaster recovery setup) will severely impact availability during natural/unexpected emergencies.

5 Digital Transformation Project Management: Insurance Company Case Study

In this chapter, we will present the management of a digital transformation project through a case study by the Insurance industry. The digital transformation project management methodology which is applied in this case study, is adopted by a corresponding case study of Shivakumar et al. (Shivakumar, 2018a), which in a similar fashion presents a Digital Transformation Project Management Case Study from the Banking industry.

5.1 Case Study Background

In recent years, the insurance industry has experienced a significant transformation. To stay ahead of the competition, traditional insurance companies are trying to integrate emerging digital technologies into their services. In this elaborate case study, we look at the digital transformation of an insurance company and the project management methodology adopted. Insurance market customer needs are changing, with digital products and purchase options becoming more essential to the modern consumer. Yet the different technologies used for digital services have varying levels of business impact. When we look at the potential of digital innovation, there are three levels that companies can aim for: basic, transformative and disruptive. Basic innovation is using digital means to replace or simplify existing processes. Today's examples include process automation, chatbots, cloud computing and AI triaging high-volume, low-value claims. These areas bring incremental improvements that deliver short-term benefits and is where most insurers are focusing the majority of their time and attention today. In contrast, transformative innovation can potentially change the way insurers interact with their customers. Key to this transformation is a shift from a product-centric to a customer-centric approach, in which insurers use AI, big data and analytics to understand customers and provide data that allows decision-makers to act quickly. (KPMG, 2019)

5.2 Current Status

The insurance company has identified the following elements to record the current situation, and in the next section to redefine them:

1. **Applications Legacy**
    - There is a current procedure to integrate SAP.
2. **Infrastructure Legacy**
    - There is a storage for VMware infrastructure, however the license of the support ends at 2022.

- The warranty for the IT Assets ends within two years (approximately 100 pieces).

3. **Move To The Cloud**
    - There is an attend to make a Move to the Cloud and this procedure progresses as planned until now.
    - Migration baseline comprises 30 applications of which 10% have been migrated to the Cloud during 2021.
4. **Data Foundations**
    - All insurance data are gathered in one central repository.
    - Applicative Corrective and Evolving maintenance is provided by internal teams.
    - Migration from on -premises DaaS to cloud is in progress.
5. **IT Security**
    - The company is certified with ISO 27001:2013.
    - The maturity level according to ISO 27001 reached 3.
    - The company has 100% Digital Presence.
    - The company has high operational resilience.
6. **AI and Emerging Technologies**
    - Pilot Bot for policy covers and claims processing is in progress.
    - Use of RPA - Automated issuance of mass/retail products is in progress.
7. **Identity and access management (IAM) - B2C**
    - There is a new cross platform technology and improved security for LDAP (token based authentication).
8. **Servicing**
    - The Customer Relationship Management - CRM Servicing capabilities are implemented over MS Dynamics.
    - The Integration with Customer MDM (Master Data Management - MDM) in progress, to be concluded by end of 2021.
9. **Distribution**
    - Examining possible partnerships with third parties to promote insurance services to their customer base.
    - Currently the reporting is manually managed.
10. **Employee Benefits**
    - Portfolio of Employee Benefits does not cover all dimensions until now.

5.3 Digital Company's Vision

The insurance company has identified the following vision elements for developing a next-generation digital insurance company:

1. **Applications Legacy**
    - The decommission of servers and SAP Unification will be finished.
    - There will be an initiation of one Back-office program, executing migration over commoditized infrastructure in anticipation of core asset cloudification.
2. **Infrastructure Legacy**
    - For all licenses will be a renewal or areplacement at 2021.
    - There will be a replacement of Laptops, which warranty ends at 2021
3. **Move To The Cloud**
    - There will be migration of Security applications cluster, services, MS project server and SAS Base and R-Statistics.
4. **Data Foundations**
    - There will be a stabilization of Applicative Corrective and Evolving maintenance in cloud
    - Assess alternative to reporting tools and migrate (if applicable)
    - Assess non-programmatic data transfers mechanisms for the core systems to cloud and implement (if applicable)
    - Integrate data from web portals and customer transaction systems to cloud
5. **IT Security**
    - The company will strength the Cyber Security Defense and the Operations.
    - The company will enhance Endpoint security.
    - The company will develop the Cloud security.
    - The company will increase the Security Awareness, Behaviors and Culture
    - The company will enhance the Operational Resilience capabilities
    - The company will Strength Physical Security controls
6. **AI and Emerging Technologies**
    - There will be integration of online services.
    - Bot for Motor / Property Claims Assessment

- Further utilisation of RPA capabilities (RPA - Automated issuance of mass/retail products in progress)

7. **Identity and access management (IAM) - B2C**
    - There will be a Move to the cloud LDAP assessment
8. **Servicing**
    - There will be Integration of CRM capabilities with Insurance Workflows (Underwriting, Claims mgt.) and customer portal (self-servicing)
    - The smart call center will be integrated with servicing CRM for more efficient call routing
9. **Distribution**
    - Partner with online Retailers for micro-insurance products
    - The company will enhance the integration layer with third parties through APIs
10. **Employee Benefits**
    - The company will develop the International Classification of Diseases (ICD)
    - Extend the portfolio of Employee Benefits which will covers all dimensions i.e. protection (life and disability) and retirement cover

5.4 Challenges

1. Upskilling of internal resources in addition to the lack of skills in certain domains (e.g. digital, agile, cloud) in the Greek market.
2. Sustained cost reduction targets while requesting expansion of IT services and additional Digital maturity.
3. Key Cloud services not included in the list of company's approved services, limiting the range of cloud solutions that can be delivered and thus minimizing the benefits of the cloud model.
4. Significant capacity /effort required to manage company's teams, taking over integration and coordination activities.
5. Synchronize the migration on cloud technologies with the retirement of legacy infrastructure to avoid sunk cost.
6. Execution of Move to the Cloud program while delivering Company project portfolio and initiatives.

5.5 Support Required

1. Pace transformation programs that are driven from company's top technology management according specificities of the entities, provide sourcing support and examine the possibility of financial support.
2. Plan these programs well in advance in collaboration with the entities, avoiding disruptive impact in Planning Budgeting.
3. Assess adding sustainability envelopes in the IT budget planning process, according standard ratios of IT expenses.
4. Accelerate the assessment process of the non-approved cloud services, and provide alternative solutions for the non-compliant services (or during the assessment exercise)
5. Push for improved contractual and financial management of services, establish regularity in invoicing.

5.6 Benefits

1. **Cost Avoidance:**
    - Avoidance of costly upgrades on outdated software
    - Avoidance of infrastructure upfront costs with the Pay-as-you-go model
2. **Business IT Operational excellence:**
    - Improve productivity and level of automation
    - Minimise technical dependencies with containers
3. **Business Innovation and Digital Agility:**
    - Allow rapid deployment and prototyping of business solutions
    - Easier adaptation of solutions to changing business requirements

5.7 Digital Transformation Project Management Plan

This section discusses the various aspects of the project management plan, such as project execution details and sprint activities.

5.7.1 Digital Project Execution

The digital transformation is planned using the Agile mode. Various activities are depicted in the following Figure 40, (Shivakumar, 2018a). Details about the activities in various sprint phases are depicted in the following table, 6.

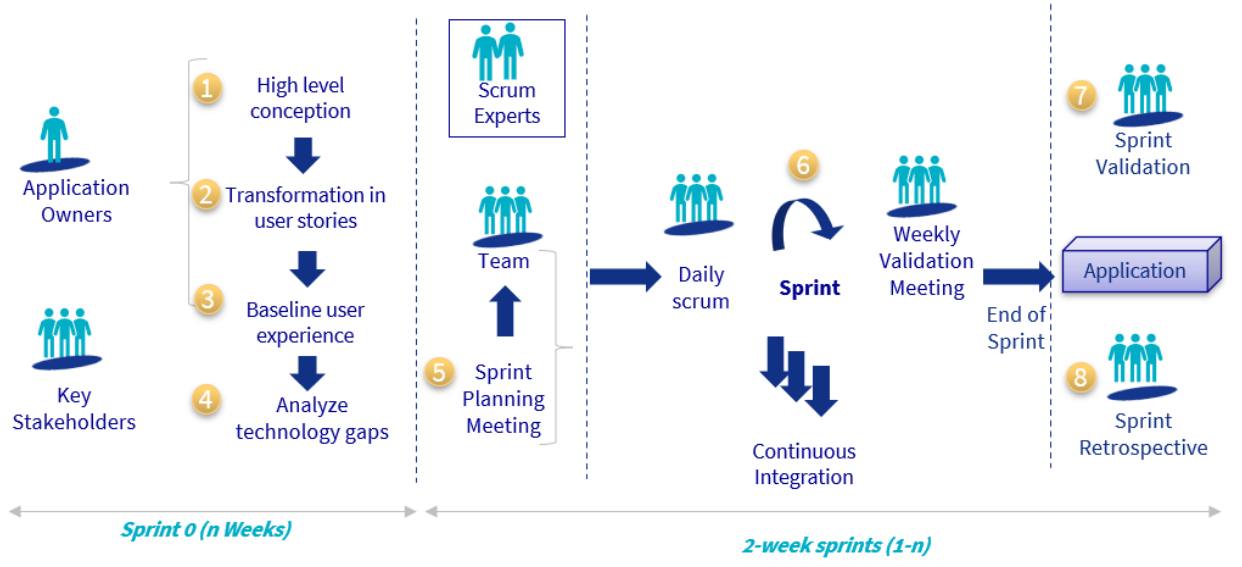

Figure 40: Activities of Agile execution

Table 8: Sprint Activities

Sprint Phase	Activities
	· Converting requirements to user stories. Based on the nature and complexity of the project mapping of requirements to user stories, this may take more time.
	· Define and baseline the user experience.
	· Maintain healthy product backlog for projects across next three-four sprints.
	· Identify gaps in and challenges with existing systems.

Table 8: Sprint Activities

Sprint Phase	Activities
Sprint 0: Conception, Story Transformation	· Keep the engineering teams engaged with forthcoming requirements and changes.
	· Create requirement trace ability matrix for all functional and non-functional requirements.
	· Prioritize the backlog for each sprint.
Sprint Planning	· Arrive at an understanding with IT on exact features to be delivered in the sprint.
	· Define the stories and finalize the success criteria.
	· Create the wire frames, visual design, navigation model, information architecture, and content needed for the sprint pages.
	· Define the acceptance criteria.
Sprint Execution	· Hold daily scrum meetings.
	· Understand day-to day progress.
	· Re-prioritize features/stories per customer requirements.
	· Design, build, integrate, test, and deploy.
	· Perform continuous integration.
Sprint Validation and Retrospection	· Clarify what's delivered in the sprint.
	· Perform scrum validation and testing.
	· Perform ROI measurement and metrics tracking.

Phase 1 of the digital transformation project execution was done for 10 months, as depicted in Figure 41, (Shivakumar, 2018b). Seven sprints were executed, followed by UAT and production support. Each sprint had the necessary integrations, sprint planning, and QA for the sprint deliverables. Production roll-out happened after UAT in month seven, followed by production support. Continuous feedback from business stakeholders was prioritized and implemented in future sprints. Continuous integration, program management, and automated security/ performance testing were all used throughout the entire program execution.

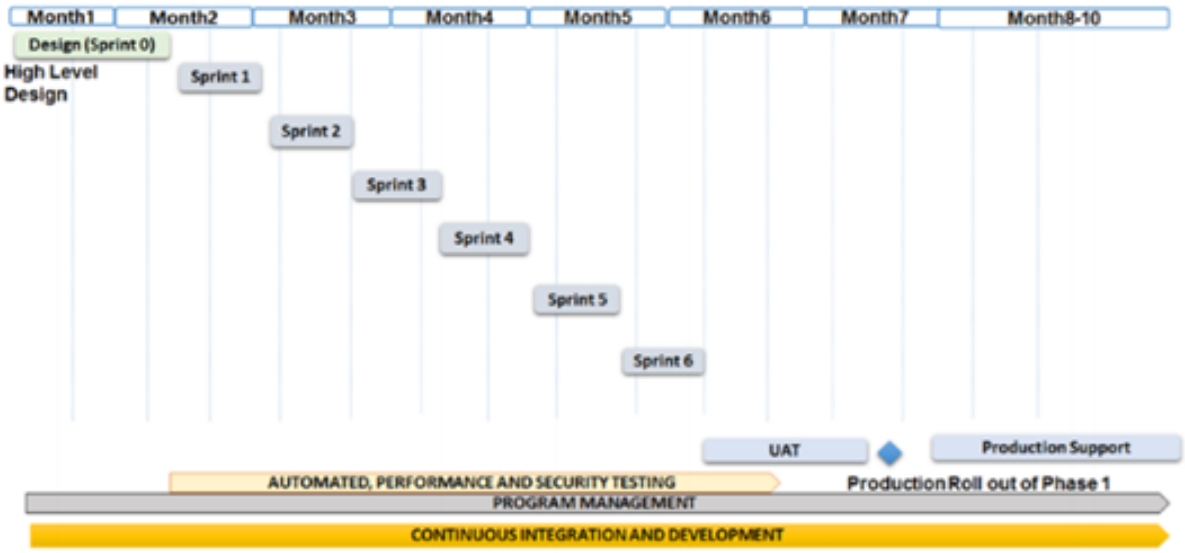

Figure 41: Sprint based execution

5.7.2 Digital Transformation Road map

During project management, the project manager created a road map for the overall digital transformation, as depicted in Figure 42.

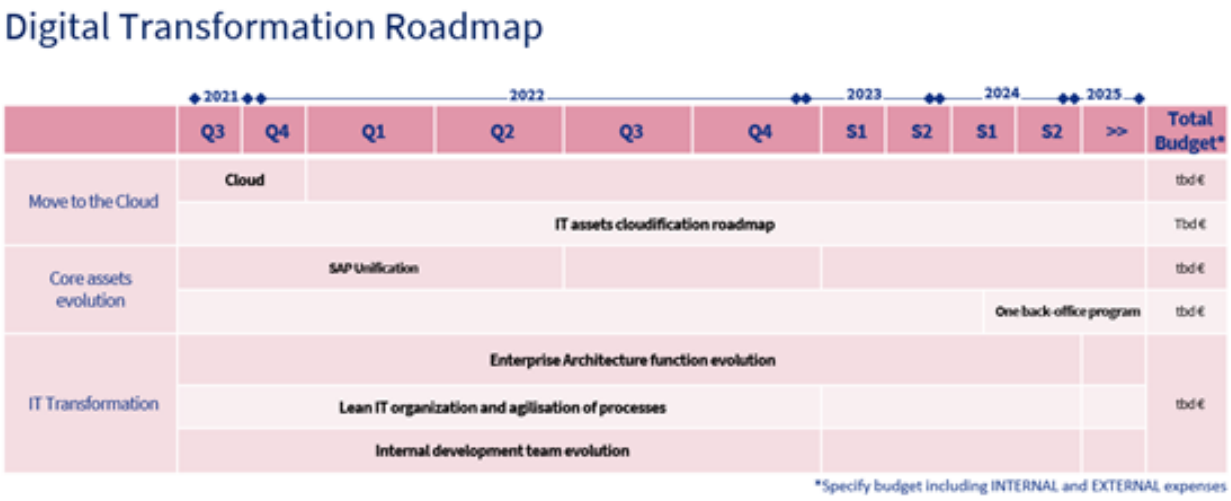

Figure 42: Digital Transformation Road map

5.7.3 Summary

This chapter covered a case study involving project management and touched on the following points:

- Common drivers for digital transformation are digitization of business, chat bots, cloud computing, AI, RPA, and business agility.
- Main challenges in digital transformation are niche digital skillsets, resistance to change, and governance changes.
- Common best practices in digital transformation programs are enabling services, platform approach, process optimization, customer touch point optimization, iterative transformations, harnessing collective intelligence, and success metrics tracking.
- The case study discussed has the following vision elements: application legacy, infrastructure legacy, move to the cloud, data foundations, IT security, AI and Emerging Technologies, Identity and access management, Servicing, Distribution and Employee Benefits.
- Key solution tenets of the solution are security and single-sign-on, standards-based design and development, services-based integration, performance, availability and scalability, reusability, and automation.
- Agile success factors included cohesive team structure, self-organizing teams, stakeholder commitment, using the right tools, and continuous improvements.

6 General Limitations

6.1 Barriers of Digital Transformation

Numerous barriers to change and transformation were recognized: Ambiguous Company Vision and Goal of the Transformation; Top Management, Leaders, and their Leadership style; Project management, Organizational set up, and Agility; Change and Middle managers lacking expert knowledge; Inconsistent Measurement processes, Lack of HR involvement, and a deep Learning culture missing.

A significant percentage of digital transformation failures can be attributed to the wide range of barriers faced by enterprises, as cited in figure 43, (Journal, 2021). These obstacles provide a sense of the complexity of digital transformation and explain why so many enterprises struggle to take advantage of digital opportunities, (Journal, 2021).

Barriers	Hartl[a]	Fitzgerald[b]	Hoberg[c]	Baskin[d]
Lack of urgency		X		
Lack of digital talent			X	X
Gaps in cross-functional knowledge			X	
Lack of digital culture	X	X		X
Poor communication				X
Constant competition				X
Insufficient funding		X		
Unclear roles and responsibilities		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		

Source: (a.) Hartl, E.; T. Hess; "The Role of Cultural Values for Digital Transformation: In-sights From a Delphi Study," 23rd Americas Conference on Information Systems (AMCIS), Boston, Massachusetts, USA, 2017. (b.) Fitzgerald, M.; N. Kruschwitz; D. Bonnet; M. Welch; "Embracing Digital Technology: A New Strategic Imperative," MIT Sloan Management Review, 2013. (c.) Hoberg, P.; H. Krcmar; G. Oswald; B. Welz; "Skills for Digital Transformation—Research Report," Initiative for Digital Transformation at the Technical University of Munich, Germany, 2015. (d.) Baskin, K.; "5 Reasons Companies Struggle With Digital Transformation," Webinar MIT Sloan Management Review, 2018.

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Figure 43: Barriers to Digital Transformation

Also, the three biggest reasons why companies have trouble defining how to successfully define KPIs, lack of management skills to carry through on KPIs, and needing cultural changes to make KPIs work, (Fitzgerald et al., 2014).

6.2 Digital Transformation During Pandemia: Covid-19

According to Google, (Google, 2021), Google Trends data also reveals that the interest in digital transformation has reached its peak during pandemic, see figure 44.

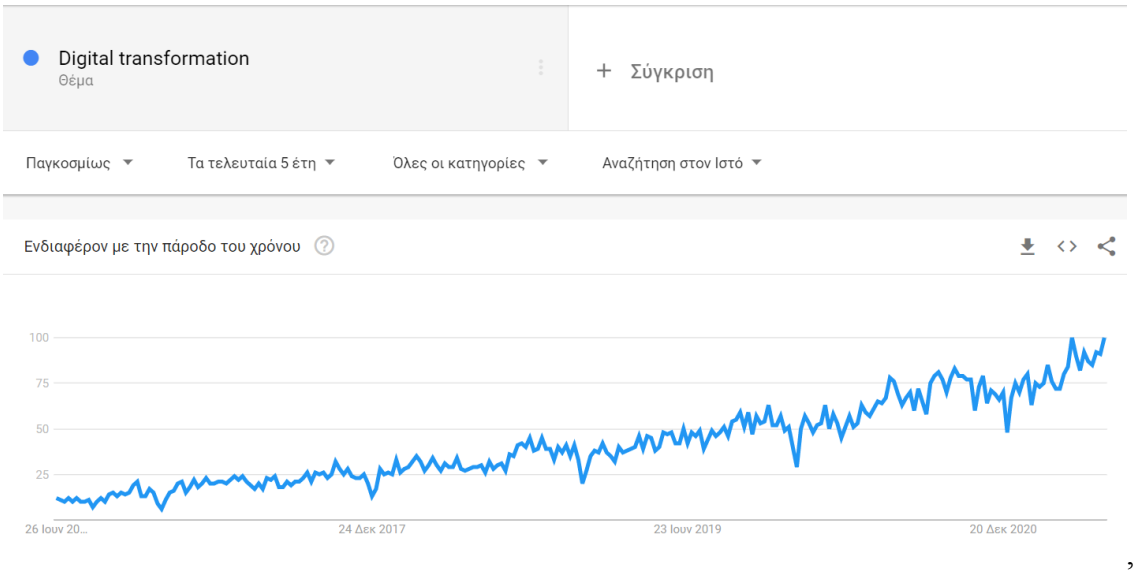

Figure 44: Google Trends: Digital Transformation

Also, according to a recent Statista survey, the global impact on digital transformation speed due to COVID-19 2020, by country is reflected in Figure 45, (Statista, 2020). In response to the global pandemic, 78 percent of German respondents say that their organizations accelerated digital transformation by a great deal. Digital transformation requires investments in technologies as well as people and processes to increase business value. Since the onset of the COVID-19 pandemic, digitization processes have sped up due to an increase in demand to work remotely and access information from different locations. Generally, many organizations have undergone a re-negotiation of their relationship to and use of technology because of the pandemic.

Digital transformation is considered to help turn the challenge of the COVID-19 crisis into an opportunity, (Nagel, 2020). During the crisis, the use of digital technologies turned into an imperative to ensure continuity of work and private life.(of the Regions, 2020) In order to ensure an effective response to the COVID-19 crisis, the European Commission EU provided a stimulus package worth EUR 2.018 trillion in current prices, as it depicts in Figure 46. It consists of the EU's long-term budget for 2021 to 2027 of EUR 1.211 trillion (EUR 1.074 trillion in 2018 prices), topped up by EUR 806.9 billion (EUR 750 billion in 2018 prices) through NextGenerationEU, a temporary instrument to power the recovery.(Union, 2021)

According to (Nagel, 2020), the result of the research shows that the basis for digital change in the time of COVID-19 is solid. The pandemic has increased the number of people working remotely, and people view it as an Influence of the COVID-19 pandemic accelerator of digital transformation. In addition, people perceive that their experience with the pandemic has made them more likely to work digitally exclusively, especially people who perceive that the pandemic has caused rapid change. Furthermore, the importance of digital work as a secure source of income

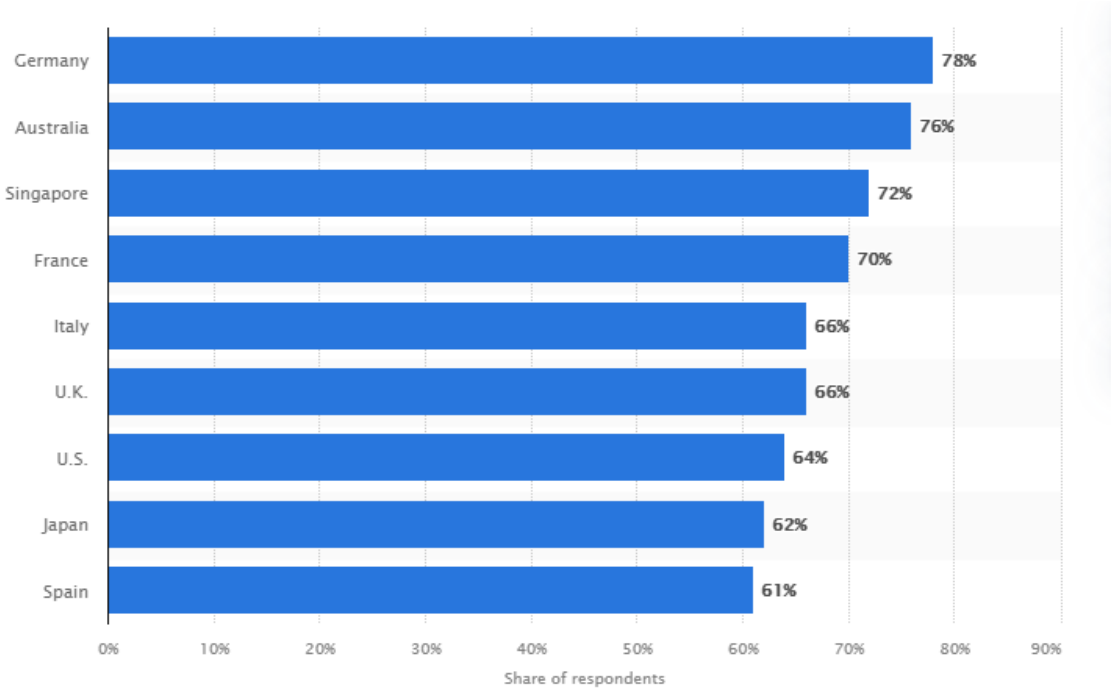

Figure 45: Global impact on digital transformation speed due to COVID-19 2020, by country - Statista

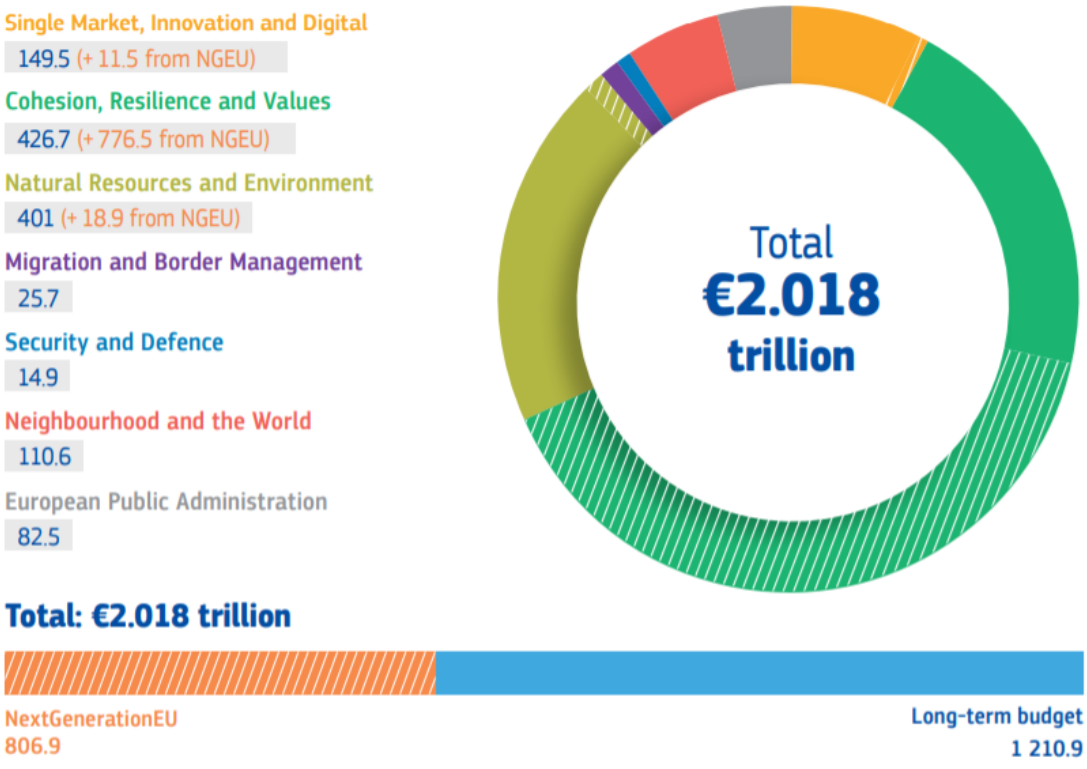

Figure 46: EU's long-term budget for 2021 to 2027

has increased. Job satisfaction does not differ between people who work remotely and those who continue to work at their workplace; satisfaction with personal income has a great influence. The results show that people perceive a change in the importance of different job forms through COVID-

19. Based on respondents' assessments, it appears that more people are willing to switch from a job exclusively to digital work. Given the assessments of the respondents and the promotion of digital transformation, it appears that more people are willing to switch from going to a workplace to exclusively living from digital work. Although the results confirm the influence of the COVID-19 pandemic on the acceleration of digital transformation, further studies are necessary to confirm this statement in the long run.

7 Conclusions

The rise of digital transformation, which is now and will continue to be one of the most critical challenges and opportunities for businesses, is a remarkable phenomenon. Most companies and organizations today see digital transformation as a goal, so they have developed specific strategies to achieve it. Companies and organizations are always trying to strengthen and transform their services, but only a small number of them succeed. However, by giving this phenomenon the attention it deserves, established companies can prepare for these transitions and take advantage of all the features of digital transformation. Moreover our study revealed, that successful digital transformation projects need to be carried out with a flexible approach, due to the rapid pace of change and the increasing complexity of technologies. Finally, this thesis shows the real-world digital transformation project management scenarios and case studies so that project managers can gain insights from these scenarios and case studies and apply the insights to their current engagements.

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