



# Visualization of Digital Transformation Initiatives Elements through ArchiMate Viewpoints

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## Abstract

Digital transformation stems from a mix of personal and corporate IT environments and involves integrating digital technologies and business processes in a digital economy. As such, organizations expect that digital transformation improves performance, increases their reach, and ensures better business results. However, there is still a lack of (i) conceptual models to provide an accurate representation of the digital transformation elements; and (ii) standard visualizations of such elements to specific stakeholders. In a previous work, a reference model to support digital transformation initiatives using ArchiMate was proposed. In this paper, we address the second part of this problem regarding the need for specific visualizations. We followed the Design Science Research approach to learn how to identify the needs of the stakeholders, extending and improving the reference model through the design of a set of architectural viewpoints. We used the well-known ArchiSurance case to demonstrate the application of the viewpoints and semi-structured interviews to evaluate the proposal, providing insights to the discussion of the results obtained.

**Keywords** Digital transformation · ArchiMate · Viewpoint · Reference model · Ontology · Business transformation

## 1 Introduction

The advancements in technology and their impact on society have changed how organizations and individuals operate, work, and live. As a result, new cultures have emerged, and organizations have adapted to these changes by offering new products

and services (Kirchmer et al., 2016). Digital transformation has challenged many organizations, disrupting how companies compete, interact, and create value (Assar & Hafsi, 2019). To meet the requirements of digital change, organizations must undergo structural shifts by using digital platforms to improve performance and increase reach (Hinings et al., 2018). Digital transformation is the integration of digital technologies and business processes into personal and corporate IT environments, which changes the rules within organizations across different domains in a digital economy (Ismail et al., 2017).

On the other side, over the years, Enterprise Architecture (EA) has been utilized as a blueprint for organizations to analyze, design, and make decisions (Steen et al., 2004) in order to tackle various challenges. EA combines and describes various aspects of an organization aligned with business elements (Anthony Jnr., 2020). Some authors have explored the connection between EA and digital transformation as new organizational opportunities in different contexts. For instance, digital transformation poses new challenges for Enterprise Architecture Management (EAM) (Kaidalova et al., 2018). The evolution of EA considers newly-defined value-oriented mappings between digital strategies, digital business models, and an improved digital EA (Zimmermann et al., 2018). Additionally, EA approaches aim to address integration and coherence amidst the complexities of digital ecosystems (Korhonen & Halen, 2017).

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Technology- and agents-centric aspects play a central role in digital transformation. The changes brought about by digital technologies impact an organization's business model, leading to transformations in products, organizational structures, and processes (Nadkarni & Prügl, 2021). In particular, the relationships between these processes are crucial during digital transformation because they are subject to change. It is essential to have different types of processes, such as operational and transactional, planning, design, and innovation, to ensure an organization's success and viability. Business offerings define the scope requirements of a digital transformation initiative, consolidating the business processes, their relationships, and agents affected by the initiative (Babar & Yu, 2015). For example, some product design decisions can be deferred closer to the usage time by allowing customization, user configuration, or even automated personalization. Other examples are the products and services that are dematerialized, reinvented, or recombined in new digital business models. For instance, in the case of a bank, its branches have many processes and human interactions; however, its operating processes are slower than the internet and mobile channels. In this scenario, the nature of product and service offerings varies across these channels.

These dynamics cannot be entirely evident to a casual observer. Thus, current EA modeling approaches will need to be extended to better acknowledge and support today's highly dynamic environments. Enterprise architects should be more involved in strategizing, planning, and executing digital transformation (Babar & Yu, 2015).

Based on the above observations, there is still a lack of (i) conceptual models to provide an accurate representation of the digital transformation elements within EA approaches; and (ii) standard visualizations for such elements to specific stakeholders. To address the first part of the problem, a DT&I-BPM-onto, which presents a conceptual foundation for this knowledge domain, was proposed to support identifying and characterizing business contexts involving digital transformation and innovation. The DT&I-BPM-onto is intended to support the modeling of DT initiatives. This ontology may help to represent the digital transformation from the perspectives of different roles played by agents with diverse backgrounds. The DT&I-BPM-onto was combined with ArchiMate (Band et al., 2016) to represent such initiatives in EA models. This mapping of the two metamodels was used to create a reference model for digital transformation and innovation, ensuring a standardized visualization (Bogea Gomes et al., 2019).

In the current paper, using the reference model previously developed as a conceptual background, we address the second part of the problem related to the demand of the stakeholders for specific visualizations of such aspects applied to their interests in the digital initiative. A standard but flexible approach is necessary.

When undergoing digital transformation, it is crucial to involve and consider the perspectives of all stakeholders involved, both within and outside of the corporation. It includes CEOs and heads of digital transformation and key stakeholders from various departments such as IT, Marketing, Strategy, Sales, Communication, HR, and Innovation. Each stakeholder brings a unique functional lens to the digitalization challenges (Brunetti et al., 2020).

After the clients and end-users, the consultants, advisors, contractors, and suppliers are the most significant project stakeholders (Karlsen, 2002). We draw a parallel between ArchiMate (Band et al., 2016) and Karlsen's (2002) definitions to understand the stakeholders' roles better. From Karlsen's perspective, CxOs, Enterprise Architects, and Business Architects of ArchiMate can be considered DT Initiative clients. In contrast, the Business Managers and Newcomers of ArchiMate can be considered DT Initiative end-users from Karlsen's perspective. Architects, Designers, Requirements Managers, and Business Analysts of Archi-Mate can be considered consultants, advisors, contractors, and suppliers from Karlsen's perspective. Proactive stakeholder management methods and guidelines can be implemented to avoid uncertainty and problems during a project, as proposed by (Karlsen, 2002).

Similarly, (Brunetti et al., 2020) suggest that organizations must create a strategic rationale to navigate digital transformation effectively and manage the multitude of transformational activities, considering cultural and political contexts, market dynamics, stakeholder profiles, and readiness for change. This approach helps stakeholders understand and communicate the rationale for change. In the digital context, agile organizations collaborating with stakeholders in the business ecosystem are essential. Traditional linear processes and vertical structures may not be suitable for these initiatives. Co-creation efforts, open innovation architectures, and participation in multi-stakeholder platforms are crucial to connect stakeholders in the external business ecosystem, breaking functional and divisional silos, and establish relationships with stakeholders and markets.

It is helpful to present specific visualizations that address their interests to the main stakeholders to cope with stakeholders' diverse concerns and interests. Considering what these stakeholders need, as discussed in Section 4, we propose a set of viewpoints. Thus, we formulate the following research questions:

RQ1: What is the extent to which the proposed viewpoints model can satisfy the demand of different stakeholders in a DT initiative?

RQ2: What is the extent to which the viewpoints' visualization is adequate for the different stakeholders in a DT initiative?

Viewpoints define abstractions on the set of EA models, each addressing a particular type of stakeholder and a particular set of concerns. Viewpoints can be used to visualize certain aspects of the model in isolation and to relate two or more aspects (Steen et al., 2004). This paper shows that the original ArchiMate viewpoints cannot answer the RQs formulated above. Moreover, based on an extensive literature review (see Section 2), we have yet to find any other approach that addresses this problem.

As a novel contribution, we refined the reference model (Bogea Gomes et al., 2019), relating it to the ArchiMate viewpoint mechanism and proposing a set of viewpoints related to representing digital transformation elements to the main stakeholders involved in such an initiative. Moreover, it is important to highlight that the proposal does not cover the identification of the stakeholders but presents the information needed by the types of stakeholders that are usually related to digital transformation initiatives. Also, the proposal needs to address how to discover which type of information is needed by any stakeholders; it assumes what is given in the literature.

We adopted the Design Science Research methodological approach (Peffers et al., 2007; Wieringa, 2009) to extend and improve the reference model by designing a set of architectural viewpoints. We used the digital transformation change scenario of the well-known ArchiInsurance case (Jonkers et al., 2016) to demonstrate the application of the viewpoints and semi-structured interviews to evaluate the adequacy and relevance of the proposal, providing insights to discuss the results obtained.

The paper is structured as follows: Section 2 provides the Literature Review on ArchiMate, the Reference Model, and Systematic Literature Mapping. Section 3 presents our methodological approach: Design Science Research. Section 4 introduces the proposed digital transformation viewpoints based on the Reference Model, demonstrates the application of our proposal using the ArchiInsurance digital transformation scenario, and validates the proposal by comparing our four viewpoints proposed for Digital Transformation (DT) initiatives with the existing standard ArchiMate viewpoints, using semi-structured interviews to evaluate the proposal. Section 5 discusses the results obtained. Section 6 summarizes our results and implications. Finally, Section 7 concludes the paper by highlighting our research questions and answers, besides pointing out future research perspectives.

## 2 Literature Review

### 2.1 ArchiMate

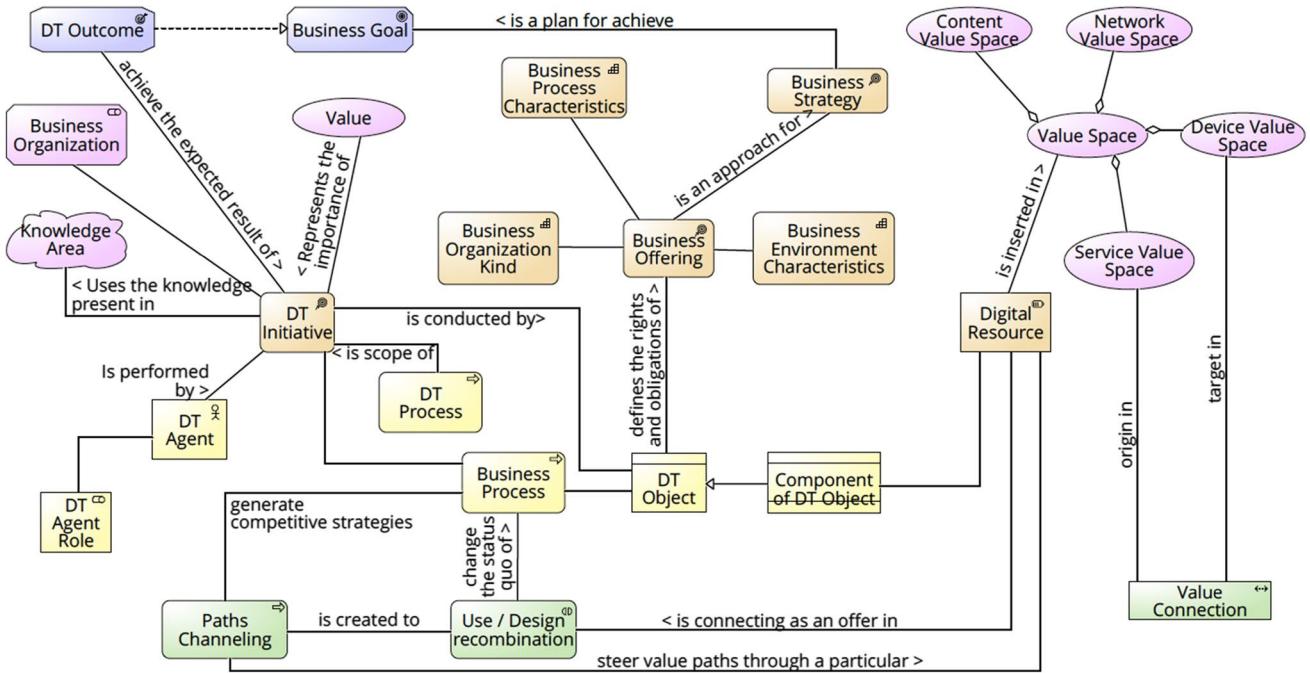
ArchiMate is a language that supports enterprise architecture frameworks through graphical notation concepts. These concepts represent various Enterprise Architecture

elements and relationships, including behavioral, structural, motivational, and composite elements that can participate in various layers. ArchiMate provides detailed insights into the structure and coherence of different architectures, while the viewpoint mechanism is used to convey information that addresses the concerns of specific stakeholders. A viewpoint is a selected subset of ArchiMate concepts that expresses and represents a portion of the architecture geared toward the needs of particular stakeholders. The ArchiMate language and its viewpoint mechanism assist architects in defining and classifying governing viewpoints, enabling them to design and construct views for communication with different stakeholders. ArchiMate presents a classification framework for viewpoints to assist architects and others in finding suitable viewpoints given the purpose that a view must serve and the content it should display. ArchiMate defines the following abstraction levels to characterize the content of a view: Details, Coherence, and Overview.

Furthermore, ArchiMate defines useful combinations of concepts as a set of basic viewpoints based on common architectural practices and experiences. The basic viewpoints can be categorized into Composition, Support, Cooperation, and Realization, and some viewpoints have a scope limited to a single ArchiMate layer or aspect. In contrast, others link multiple layers and aspects. Finally, ArchiMate defines standard viewpoints for certain aspects, including motivational, strategic, and implementation and migration aspects.

### 2.2 Reference Model for Digital Transformation and Innovation

DT&I-BPM-onto is a conceptual model that aims to share a common understanding and to establish the connection between digital transformation, innovation, and Business Process Management (BPM) by examining the interaction between them and to which extent the characteristics of the BPM initiatives affects, and are affected by, digital transformation and innovation (Bogea Gomes et al., 2020). In previous research (Bogea Gomes et al., 2019), a reference model for digital transformation and innovation was defined by extending the ArchiMate with the main concepts of DT identified in the DT&I-BPM-onto (Bogea Gomes et al., 2020) as shown in Fig. 1. There, we proposed to use the ArchiMate language and framework to model the main concepts of the DT&I-BPM-onto, in order to benefit from the integration of such new concepts and many others related to enterprise architecture, e.g., the systems implementation, the entire set of enterprise capabilities, and the roadmap from as-is to to-be situation. In this paper, the underlined words refer to the DT&I-BPM-onto



**Fig. 1** The reference model for digital transformation and innovation – created with Signavio (All the diagrams presented in the paper were designed with Signavio (2022)) tool (Bogea Gomes et al., 2019)

classes, and the ArchiMate Classes are represented in italic immediately after the DT&I-BPM-onto classes.

### 2.3 Systematic Literature Mapping Approach

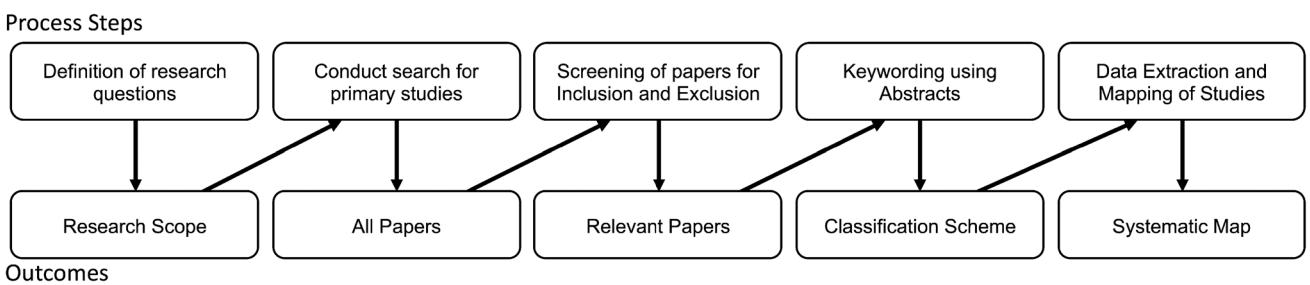
Systematic mapping is a literature review technique aimed at classifying and counting contributions concerning some classification category to give an overview of a research area. It involves identifying which topics have been covered in the literature and where they have been published. A systematic mapping study and a systematic literature review share some commonalities, e.g., searching and selecting studies. However, they differ in terms of goals and approaches to data analysis. While systematic reviews aim at synthesizing evidence and considering the strength of evidence, systematic mappings are primarily concerned

with structuring a research area (Petersen et al., 2015). We followed the essential process steps of a systematic mapping study proposed by (Petersen et al., 2008), as presented in Fig. 2.

### 2.4 Systematic Literature Mapping Planning and Conducting

The systematic literature mapping aimed at identifying the use of ArchiMate in the design and management of Digital Transformation initiatives. Therefore, we formulated the following research question: “What are the ArchiMate approaches for designing and managing of Digital Transformation initiatives?”.

We aimed to search for primary studies in academic journals and conference proceedings. The search string



**Fig. 2** Essential process steps of a systematic mapping study (Petersen et al., 2008)

was elaborated in terms of PICOC—population, intervention, comparison, outcome, and context (Kitchenham & Charters, 2007), as presented in Table 1. The search considered papers made available through the following source engines: EBSCO (which includes publishers like ACM, AIS, Emerald, IEEE, and Springer Nature) and Elsevier (which includes Scopus and ScienceDirect).

Based on the research scope, we conducted the search for primary studies that aims to detect as much of the relevant literature as possible. We used the keywords Digital transformation and ArchiMate, considering papers with these terms in their abstracts (AB) (string AB digital transformation AND AB ArchiMate). As a result, we found a total of 35 papers (13 in EBSCO and 22 in Elsevier). Excluding the 11 duplicated papers, and one that was already used as the background knowledge for our work, the search resulted in 23 papers.

The inclusion criteria are design or management of digital transformation Initiatives, modelled in ArchiMate. The exclusion criteria applied are (e1) not published in academic journals or conference proceedings, (e2) not a primary study, (e3) not in the scope of design or management, (e4) full text not available and (e5) not DT Initiative. Based on those criteria, we excluded 9 papers by analyzing their abstracts—two (e1), three (e2), two (e3), one (e4), and one (e5), which resulted in 14 relevant papers.

While analyzing the 14 papers identified in the systematic mapping, we realized that only 7 are in fact about digital transformation initiatives (Baptista & Barata, 2021; Gils & Proper, 2019; Hafsi & Assar, 2018; Oberhauser & Pogolski, 2019; Anthony Jnr. et al., 2020; Ilin et al., 2021; Anthony Jnr. et al., 2021a, b).

In Appendix 1, we present the 7 resulting papers related to ArchiMate approaches used to represent the design and management of Digital or Transformation initiatives. Out of those 7 papers, 4 have examples of viewpoints.

ArchiMate, a widely accepted industry standard (Gils & Proper, 2019), is a metamodel that relies on a set of relatively unique generic ideas and opts for a relatively unique language (UML) to model every architecture layer, supporting communication teams responsible for different layers in their collaboration (Hafsi & Assar, 2018). It was the selected language to model specific digital transformation initiatives, for example, the Industry 4.0 in SMEs with RAMI 4.0 Pilot

(Baptista & Barata, 2021) and interacting with BPMN to create a virtual reality (VR) hypermodel solution concept (Oberhauser & Pogolski, 2019). In addition, ArchiMate was the basis for developing a modern enterprise metamodel within the framework of the Industry 4.0 concept (Ilin et al., 2021) and a visual model proposal.

ArchiMate is considered an easily understood language by experts and non-experts in both IT and business, able to visualize models in views and personalizable for specific stakeholders with definite information requirements (Anthony Jnr. et al., 2020). Therefore, it was the language chosen to support smart urban transformations (Anthony Jnr. et al., 2021a, b).

We studied four of the works applying ArchiMate views or viewpoints. Two of them (Anthony Jnr. et al., 2020, 2021a, b) use ArchiMate views or viewpoints in a digital or transformation initiative in a specific domain, which is smart cities. The views developed for those contexts were very useful for their purposes but cannot be applied elsewhere.

The other two works (Hafsi & Assar, 2018; Oberhauser & Pogolski, 2019) are domain-independent. The Virtual Reality (VR) hypermodel solution from (Oberhauser & Pogolski, 2019) displays existing enterprise architecture models in the ArchiMate and BPMN format and addresses aspects of VR in views, whereas (Hafsi & Assar, 2018) allows managers to visualize the impact of the digital transformation initiative on the rest of the IS.

On the contrary, three other works do not explicitly specify views or viewpoints to different stakeholders: (Baptista & Barata, 2021) – an SME case, (Ilin et al., 2021) – an enterprise meta-model, and (Anthony Jnr. et al., 2021a, b) – an enterprise architecture framework. This last work does not present examples of views or viewpoints, although it cited views in the text: “ArchiMate provides views on heterogeneous domains, such as stakeholders, business processes, application, data, and technological infrastructure”.

Our proposal is a set of viewpoints focused on digital transformation initiatives regardless of domain, considering issues that influence the success of digital transformation delivery. These issues are for example organizational value motivation, relevant processes and capabilities, major roles needed to support the business processes, and the value connection between the information systems and technology components that compound the digital platform to support the digital business processes involved.

**Table 1** PICOC for ArchiMate’s use in digital transformation initiatives

Population	Digital transformation initiatives
Intervention	Representation of digital transformation initiatives with ArchiMate
Comparison	Different ArchiMate approaches used to represent the design and management of digital transformation initiatives
Outcomes	The analysis and classification of ArchiMate approaches applied in the digital transformation initiatives
Context	Academic journals and conference proceedings papers in English

We argue that these proposed DT viewpoints can be reused in any DT initiative, as long as the types of elements needed in the viewpoints are mapped to the ArchiMate model. For example, from the 7 papers on digital transformation, the DT viewpoints can be fully applied in 4 (Ilin et al., 2021; Anthony Jnr. et al., 2021a, b; Oberhauser & Pogolski, 2019), i.e., all the elements are present in those cases and could be represented in the viewpoints. Meanwhile, they can be partially applied in the other three (Anthony Jnr. et al., 2020; Baptista & Barata, 2021; Hafsi & Assar, 2018), i.e., they do not have certain ArchiMate elements in this model (e.g., Value). In the Section 4.1, we describe the set of viewpoints proposed.

### 3 Methodology

The methodological approach adopted in this work is the Design Science Research. We followed the method proposed by (Peffers et al., 2007; Wieringa, 2009): the Design Science Research Methodology (DSRM). The Systematic Literature Mapping method was used in the literature review. The evaluation was made in two steps: (i) a well-known case was used to demonstrate the applicability of the viewpoints, and (ii) semi-structured interviews provide evidence to validate the proposal.

#### 3.1 Design Science Research

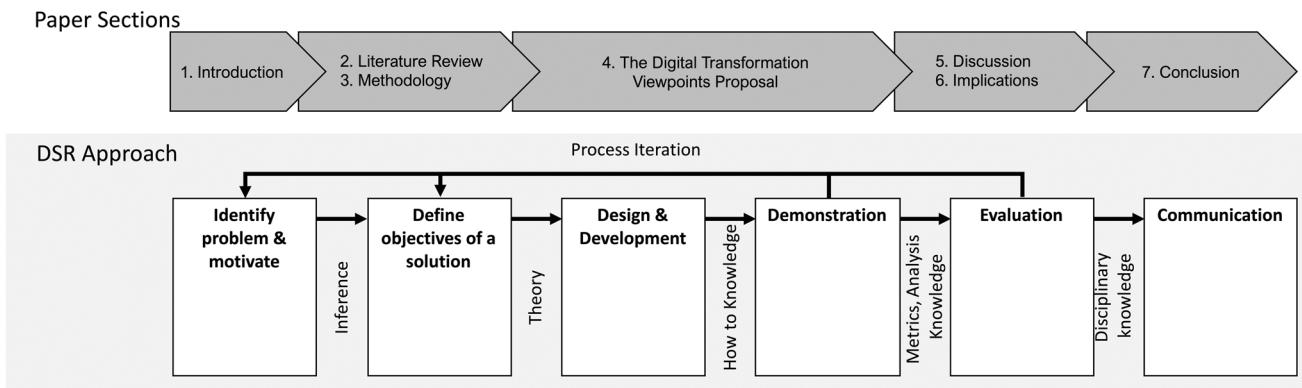
Design Science Research (DSR) is an approach in which the research answers relevant questions through creating artifacts and contributing new knowledge to the body of scientific evidence (Peffers et al., 2007). DSR emphasizes the connection between knowledge and practice by showing that we can produce scientific knowledge by designing useful things (Wieringa, 2009). In this context, designed artifacts are essential in understanding a real-life problem (Peffers et al., 2007).

The real world is changed to suit human purposes, to solve a practical problem, but to solve a knowledge problem, we acquire knowledge about the world without necessarily changing it. These two kinds of problems in design science are mutually nested, although their problem-solving and solution-justification methods are different. Practical problems call for a change in the world to better align with some stakeholder goals. Knowledge problems, by contrast, call for a change in our knowledge about the world (Wieringa, 2009). RQ1 is a Practical problem. In this specific case, it calls for confirming a design of a change in the world to better agree with some stakeholder goals. In contrast, RQ2 is a knowledge problem. In this specific case, it asks for information about the extent to which the viewpoints' proposal is adequate for the different stakeholders in the DT initiative. The Design Science Research Methodology (DSRM) proposed by (Peffers et al., 2007) provides a commonly accepted framework for successfully carrying out DS research and a mental model for its presentation.

The Design Science Research Methodology (DSRM) proposed by (Peffers et al., 2007) provides a commonly accepted framework for successfully carrying out DS research and a mental model for its presentation. The paper is organized according to the DSR process, as presented in Fig. 3. It is worth mentioning that only one design cycle was developed so far at this stage of the research. We argue that there are sufficient results to be communicated.

#### 3.2 Evaluation Criteria in Design Science Research

The evaluation of an artifact in a DSR approach should consider what to evaluate (object and criteria of evaluation) and how to conduct the evaluation (Prat et al., 2014). According to the authors, artifacts are systems, and viewing them as such provides a holistic view of their evaluation, organizing the evaluation criteria along the fundamental dimensions of systems. The criteria for IS artifact evaluation are



**Fig. 3** Paper sections aligned with DSRM (Peffers et al., 2007)

typically organized along the five system dimensions: goal, environment, structure, activity, and evolution. We chose the validation dimensions of efficacy goals, utility (organization consistency), structural simplicity, and structural homomorphism since they are related to the intended answers to the research questions formulated.

We relate RQ1 with the goal efficacy (viewpoint produces its desired effect, i.e., achieves the goal of identifying proper stakeholders in a DT initiative) and utility, which is the adequacy of the artifact in practical use, i.e., the viewpoints deliver the adequate information needed by each stakeholder. The adequate information needed is associated with the stakeholders' concerns. For instance, the CEO is related to expected costs and outcomes in the DT Initiative Motivation viewpoint, whereas the business analysts are related to the communication of the results to the organization. RQ2 is related with simplicity (viewpoint simplifies the intended understanding of DT, i.e., the stakeholders are not overwhelmed with the information provided) and homomorphism (there is not a standard viewpoint with an equivalent perspective—no redundancy).

We also selected evaluation criteria (or sub-criteria, which are the most detailed criteria) for each system dimension criteria chosen. For the dimension goal, we selected efficacy: the degree to which the artifact produces its desired effect. Consequently, our criterion for evaluating the viewpoints is that the proposed viewpoints produce their desired effect, i.e., achieve their goal. For the dimension environment, we selected the evaluation criteria of consistency with the organization, with the sub-criteria being utility, which measures the quality of the artifact in practical use. Our criterion for evaluating the viewpoint is that the proposed viewpoint generates relevant information for practical use in a DT initiative. Finally, we selected two evaluation criteria for the dimension structure: simplicity and homomorphism. The evaluation criteria simplicity is used for constructs. Our proposed viewpoint has to simplify the intended understanding of the Viewpoint DT subject. For homomorphism, the sub-criteria selected is "correspondence with another model", which measures the viewpoint's redundancy. With this sub-criterion, if there are no standard viewpoints with equivalent perspectives to our proposed viewpoint, then there is no redundancy.

## 4 The Digital Transformation Viewpoints Proposal

A DT Initiative is a combination of interacting elements organized to achieve one or more stated purposes in the digital environment. It results in new / transformed products (asset or service), processes, or business models for DT and digital platform design. Due to these characteristics, different agents participate in a DT Initiative with diverse roles

and interests. Agents is a type of stakeholders. Stakeholders are individuals, groups or organizations holding any interest in the system, i.e., the objective for which a model is used for the system.

Innovative business models, a type of DT initiative outcome, is in a business environment where critical assumptions about integrating the technologies and the business model need to be tested, system adjustments will be made, and concepts will be demonstrated to stakeholders (Johnson & Suskewicz, 2009). We can extrapolate it to the other types of DT Initiative outcome (product and process).

The collaboration with stakeholders in the business ecosystem is essential in the digital context. This dimension involves co-creation efforts, open innovation architectures, participation in multi-stakeholder platforms, and more (Brunetti et al., 2020). A DT initiative can be seen as a Project. Project stakeholders include clients, end users, contractors, consultants, labor unions, line organizations, public authorities, financial institutions, insurance organizations, controlling organizations, media, third parties, and competitors. The research results of (Karlsen, 2002) indicate that clients and end users are significantly more important than all the other stakeholders in the project.

In the ArchiMate specification, stakeholders and concerns are mentioned as a basis for the specification of viewpoints. The DT viewpoint is a selection of a relevant subset of the reference model concepts geared towards representing the needed information for different stakeholders. As explained before, in the Introduction Section, CxOs, Newcomers, Architects (Enterprise Architects, Business Architects, and Architects), Designers, Managers (Business and Requirements Managers), and Business Analysts are the types of stakeholders identified that together gather the concerns to implement a digital transformation initiative.

CxOs are mainly concerned with the capabilities needed to successfully plan and execute DT, specifically involving expected costs and outcomes. Newcomers are responsible to acquiring DT knowledge to start contributing with the necessary motivation elements, roles and responsibilities, and capabilities. Enterprise Architects address the planning and preparing the target environment (such as changes in business management, skills needed, asset management, migration planning, SLAs, fraud, besides skills needed, asset management) and facilitating communication between the technical and business areas. Business Architects are mainly concerned with the capabilities needed for the efficient design, customization, and maintenance of the process and system platform. Architects are mainly concerned with maintaining the system architecture description and facilitating communication between an organization's technical and business areas, besides the roles and responsibilities needed for the efficient design, customization, and maintenance of the process and system platform. Designers are concerned

mainly with designing system components. Business Managers are concerned mainly with the capabilities and, roles and responsibilities needed for the DT strategy, organization, processes, functions, information issues, and the communication of results to the organization. Requirements Managers are mainly concerned about the motivation elements that drive the initiative to the efficient requirements management of the DT Initiative. Business Analysts deal with the motivation elements that drive the initiative to design the DT strategy, organization, processes, functions, information issues, and the communication of results to the organization.

Furthermore, the main challenge faced during the development of these viewpoints approach was to realize that, although the DT Initiative materializes the transformation, the organization needs to examine its self-assumptions (Lagstedt et al., 2020) and the available capabilities before executing the initiative. These viewpoints were designed to address this demand.

We considered a set of viewpoints that could be used to represent, analyze, and manage a DT Initiative in different but complementary perspectives. The DT Initiative Motivation, DT Capability, DT Agents, and Digital Platform Design are organized as four viewpoints regarding DT, as shown in Fig. 4.

Before detailing the viewpoints, we describe the association between DT&I-BPM-onto and ArchiMate Elements, which was the starting point for designing the viewpoint proposal.

The DT Object is the subject, topic and purpose of DT as a contract object (Fichman et al., 2014). It comprises the

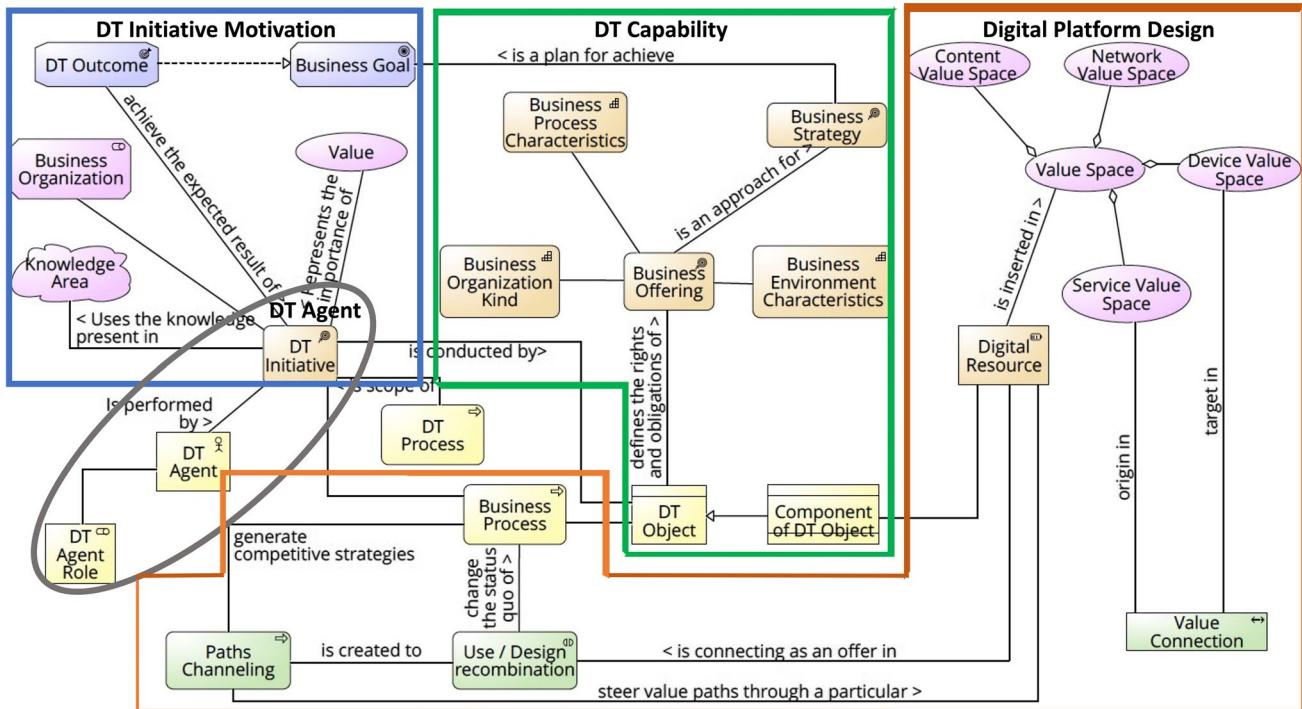
Components of a DT Object. Some of these components may already exist and others might be new.

The DT Object and its Components have been associated with the concepts of “Business Object” and “Contract” in ArchiMate because they specify the rights and obligations associated with a product and establish functional and non-functional parameters for interaction, i.e., the description of the object and its components in the case of a DT initiative.

Business Offering designs an offer proposed to achieve the business strategy defined. Business Strategy describes the goal focus: a traditional focus on increasing business efficiency and effectiveness through standardization or automation (exploitation) including digitization, or an innovation focus on bringing new opportunities for the business (exploration).

Business Environment Characteristics include characteristics of the market and high level socio-cultural or political factors. Rapidly changing environments increase the need for capabilities, defined as an organization's capacity, to create, extend, or modify its resource base purposefully (Helfat et al., 2009) cited by (Brocke et al., 2016).

A Business Organization is a firm, such as a corporation, limited liability company, or partnership that sells goods or provides services to make a profit. The term firm is often used interchangeably with organization, enterprise and company. Business Process Characteristics are the features or qualities that typically represent the corresponding Business Process.



**Fig. 4** The scope of the four DT&I viewpoints proposal

Business Environment Characteristics, Business Organization Kind and Business Process Characteristics have been associated with the concept of “capability” in ArchiMate.

#### 4.1 DT Initiative Motivation Viewpoint

The reference model presented in Fig. 4 depicts the motivational aspects that drive the DT initiative: the expected outcomes, their value and meaning, how these contribute to the organization’s goal, and support from the business object and stakeholders. The CxOs need this information to help them sell the idea of the DT Initiative to the organization. This makes it possible to model an overview of the *Value* and *Meaning* considered, including the *Business Object* and *Stakeholders* supporting them, the envisaged *Outcomes*, and how these contribute to the organization’s *Goal*.

The DT Initiative Motivation viewpoint makes it possible to model an overview of the *Value* (*Value*) and *Knowledge Area* (*Meaning*) considered, the *DT Object* (*Business Object*) and *Business Organization* (*Stakeholders*) supporting them, the envisaged *DT Outcomes* (*Outcome*), and how they contribute to the *Business Goal* (*Goal*). The description of this viewpoint is presented in Table 2.

#### 4.2 DT Capability Viewpoint

The DT Initiative is aligned with the direction and focus provided by strategic goals and objectives, with the aim of

delivering the value proposition. It is essential for the CxOs, business managers, and business architects to know what abilities the organization possesses and on whom they can count to achieve the planned DT objective.

A business capability is a widely used and generally understood term, but its definitions vary significantly. The definition of capabilities can be separated into the capabilities of intelligent resources or agents (e.g., people and intelligent machines) and the capabilities of inanimate objects or passive resources (Michell, 2011). The skills embodied in agents are nominated by their internal or intrinsic capabilities (Heckman & Corbin, 2016). The DT Capability viewpoint focuses on the motivations and strategies for undertaking a DT Initiative in the company, as shown in this part of Fig. 4, presented above.

The DT Capability viewpoint presents the Business Goals (*Goals*) and DT Outcomes (*Outcome*) that motivated the DT initiative (*Course of Action*). It also shows the DT Strategies (*Course of Action*) the organization can apply to complete the DT initiative (*Course of Action*) and the *capabilities* necessary to achieve the purpose of the DT initiative (*Course of Action*). The purpose is explored in the DT Object (*Contract*) class that represents the topic, scope, and characteristics of the purpose detailed as a contract object.

The advantage of this viewpoint is to relate the major *capabilities* and its high-level dependencies to achieve a goal (including its Business Strategy (*Course of Action*))

**Table 2** Description of the DT initiative motivation viewpoint

Viewpoint	The DT initiative motivation viewpoint
Stakeholders	Enterprise Architects are concerned mainly with the motivation elements that drive the initiative in planning and preparing of the target environment and facilitate the communication between the technical and business areas Business Analysts are concerned mainly with the motivation elements that drive the initiative to design the DT strategy, organization, processes, functions, information issues, and the communication of results to the organization Requirements Managers are mainly concerned about the motivation elements that drives the initiative to the efficient requirements management of the DT Initiative Newcomers are new personnel that are concerned mainly with the motivation elements that drive the initiative to acquire DT knowledge to start contributing
Concerns	What are the desired results that a stakeholder wants to achieve? What are the stakeholder’s interests in the outcome and the meaning of the DT initiative? What is the Value offered by the DT Initiative?
Purpose	Designing, Deciding, Informing
Abstraction level	Overview
Layers	Motivation Layer Business Layer
Aspects	Behavior, active structure
Concepts & Relationships	See Fig. 4
Example	Examples of model types: A family of diagrams representing the goals, abilities, processes, or knowledge that a business may possess or exchange, whose combination enables it to achieve a specific purpose (i.e., deliver the DT object defined) successfully Examples of diagrams: cross-reference tables, landscape maps, lists and reports

and Business Offering (*Course of Action*) and, at the same time, to influence a successful delivery of the DT object (*Contract*) defined. The description of this viewpoint is presented in Table 3.

### 4.3 DT Agent Viewpoint

Agents have an intrinsic capability to act on the environment themselves, and very often, they actively drive the process and coordinate the value-added transformation (Michell, 2011). However, Agents have external capabilities that inhibit or promote the expression of skills, depending on the social and political institutions (Heckman & Corbin, 2016). Passive resources, meanwhile, only add value when an agent uses them. For instance, Agents have the potential to interact with the environment to create value, drive resources, orchestrate and trigger the transformation process, whereas passive resources require agents to realize their capability (Michell, 2011).

In the reference model proposed (Bogea Gomes et al., 2019), these capabilities are personified through the internal or external DT Agents (*Business Actor*) that perform the specific DT Agent Roles (*Business Role*) needed to execute the DT Initiative (*Course of Action*). Business managers and business architects will need to map in the DT Agent viewpoint the DT Agents Roles and DT Agents required to structure the project and implement the DT Initiative.

The DT Agent viewpoint is a coherent viewpoint of the internal or external organizational entities, i.e., DT Agents (*Business Actor*), and their responsibilities for performing specific behaviors, i.e., DT Agent Roles (*Business Role*), which are involved in executing a DT Initiative (*Business Object*) and Business Processes (*Business Process*). The purpose of this viewpoint is to show the actors and roles needed, as well as their skills, to achieve the DT Initiative planned through their business processes. The description of this viewpoint is presented in Table 4.

### 4.4 Digital Platform Design Viewpoint

To show how applications and technology components are interacting with the business process regarding the deployment of the DT initiative, we propose the Digital Platform Design viewpoint. To support the business processes involved in the DT initiative, it is necessary for architects and designers to first design a digital platform.

The Digital Platform viewpoint encompasses the technology elements, including applications, that support the business processes involved in the DT initiative. The purpose of this viewpoint is to show how applications and technology components are interacting with the business processes to deploy digital transformation and innovation. The description of this viewpoint is presented in Table 5.

**Table 3** Description of the DT capability viewpoint

Viewpoint	The DT capability viewpoint
Stakeholders	CxOs are chief officers within a particular function of the business (e.g., Chief Executive Officer, Chief Financial Officer, Chief Information Officer, Chief Technology Officer, etc.) and are mainly concerned with the capabilities needed for the successful planning and execution of DT, specifically involving expected costs and outcomes Business managers are mainly concerned with the capabilities needed for the DT strategy, organization, processes, functions, information issues, and the communication of the results to the organization Enterprise architects are mainly concerned with the capabilities needed to plan and prepare the target environment (e.g., changes in business management, skills needed, asset management, migration planning, SLAs, fraud, etc.), and they facilitate the communication between the technical and business areas Business architects are mainly concerned with the capabilities needed for the efficient design, customization, and maintenance of the process and system platform Newcomers are new personnel who are mainly concerned with the capabilities needed for the acquisition of DT knowledge to start contributing
Concerns	What are the major capabilities that influence a successful delivery of the DT object defined? What are the high-level dependencies that pair with the major capabilities? What capabilities are relevant to configuring an approach or plan to achieve a goal?
Purpose	Designing, Deciding
Abstraction level	Overview
Layers	Strategy layer Business layer
Aspects	Behavior, active structure
Concepts & Relationships	See example in Fig. 4
Example	See section—DT Capability viewpoint of ArchiSurance

#### 4.5 Proposal Application Scenario

The goal of the demonstration was to show the applicability of the proposal, i.e., that the set of viewpoints can be used for the visualization of digital transformation initiative elements, regardless of the domain. The ArchiSurance case (Jonkers et al., 2016) is an application scenario used to demonstrate the applicability of the proposal. Moreover, the models built based on this case were provided as a scenario to the real validation with experts during the interviews. The results and analysis obtained from the interviews supported answering the research questions formulated.

The ArchiSurance case study is a well-known fictitious case presented in the literature to illustrate the use of the ArchiMate modeling language in the context of the TOGAF framework (Jonkers et al., 2016). ArchiSurance is an insurance company resulting from the merge of three previously independent companies. The case study describes the Baseline Architecture of the company incorporating two change scenarios: rationalization and digital transformation. In this paper, we explore the digital transformation change scenario. An extended description of the ArchiSurance case is presented in Appendix 2.

Prior assessments of ArchiSurance show that its profitability is suffering from customers defecting to competitors with superior digital experiences or lower premium costs. Considering the rapid pace of technology as both a challenge and an opportunity, ArchiSurance defined a new digital customer intimacy strategy (Jonkers et al., 2016).

In this strategy, ArchiSurance intends to acquire more detailed customer data by employing a combination of Big Data and the Internet of Things (IoT). This data will then be used to improve customer interaction and satisfaction, and to adjust insurance premiums based on risk. The proposal involves real-time insurance products, where customers receive direct feedback on the financial consequences of their behavior and advice on adjusting this behavior to lower their insurance premiums.

To this end, ArchiSurance intends to use customers' data from smart, connected devices such as fitness trackers, vehicle tracking systems, and home automation gateways. Additionally, in various B2B markets, ArchiSurance aims to use data from sources such as fleet management systems, energy networks, in-store RFID devices, and smart building sensors. In addition to using eight of the twenty-three viewpoints, (application usage, application cooperation, stakeholder, requirements realization, strategy, capability map, resource map, and migration), (Haren, 2011) provided ArchiSurance models with six new views: principles, goal refinement, business function, business process, data dissemination, and infrastructure.

##### 4.5.1 DT Initiative Motivation Viewpoint of ArchiSurance

Based on the results of prior assessments that show that ArchiSurance's profitability is suffering from customers defecting to competitors with superior digital experiences or lower premium costs, ArchiSurance defines cost reduction as its goal, which could be partitioned into maintenance cost reduction and personnel cost reduction (Jonkers et al., 2016).

**Table 4** Description of the DT agent viewpoint

Viewpoint	The DT agent viewpoint
Stakeholders	Business Managers are concerned mainly with the roles & responsibilities needed for the DT strategy, organization, processes, functions, information issues, and the communication of results to the organization Enterprise Architects are concerned mainly with the roles & responsibilities needed for planning and preparing of the target environment (such as skills needed, asset management, etc.), and facilitate the communication between the technical and business areas Architects are concerned mainly with the roles & responsibilities needed for the efficient design, customization, and maintenance of the process and system platform Newcomers are new personnel concerned mainly with the roles & responsibilities needed for the acquisition of knowledge areas involved to start contributing
Concerns	What are the major roles needed that realize the DT Initiative and business processes? What are the responsibilities coupled with the DT Initiative and business processes? What are the typical responsibilities (and authority level) assigned to each role?
Purpose	Designing, Deciding, Informing
Abstraction level	Coherence, addressing both single layer (business) and multiple aspects
Layers	Business layer
Aspects	Behavior, active structure
Concepts & Relationships	See Fig. 4
Example	Examples of model types: Diagrams representing the roles, responsibilities, skills, and abilities needed to execute the business processes, whose combination enables it to achieve a specific purpose (i.e., deliver the DT Object) successfully. Examples of diagrams: RACI Matrix

Then, ArchiInsurance introduces “increase in revenue” as a main Business Goal to carry out a digital transformation. This main business goal is related to other ArchiInsurance Business Goals, such as “increase the market share”, which is in turn associated with “competitive premium setting” and “higher customer retention”, which are then linked to “improved customer satisfaction”.

The expected DT Outcomes are “excellent online customer interaction” and “detailed insights into customer behavior”. They were motivated by the purpose of detailing the motivation elements that drive the DT Initiative, as presented in Fig. 5. The Value offered by the DT Initiative, i.e., Be Insured, represents the importance of the DT Initiative.

#### 4.5.2 DT Capability Viewpoint of ArchiInsurance

The digital customer intimacy strategy requires ArchiInsurance to develop several new capabilities and resources, including digital customer management, data acquisition, and data analysis. First, new capabilities are needed. The needed capabilities require personnel with the proper knowledge and skills for the digital age, smart devices for data acquisition, and the customer data itself (Jonkers et al., 2016).

The capability elements are linked to three DT&I-BPM-onto elements: Business Environment Characteristics, Business Organization Kind, and Business Process Characteristics, as shown below. The first two were not identified in the ArchiInsurance case. The last one, Business Process Characteristics, corresponds to seven ArchiInsurance case elements related to the Digital Customer Intimacy Strategy.

Figure 6 shows the DT Capability viewpoint for the digital customer intimacy strategy in the ArchiInsurance case study. The DT Capability viewpoint allows us to relate the major capabilities (“Claim management”, “Customer care”, “Data acquisition”, “Data analysis”, “Data-driven insurance”, “Digital channel management”, “Digital customer management”) and their high-level dependencies to achieve a goal (“Digital Customer Intimacy” and its Strategy Offering). At the same time, it has the potential to successfully influence the delivery of the DT object type depending on the DT Business Processes involved. In the ArchiInsurance case, these processes are the “customer care” and “claim management”.

#### 4.5.3 The DT Agent Viewpoint of ArchiInsurance

The purpose of the DT Agent viewpoint is to show the DT Agents and Roles needed, as well as their skills, to achieve the DT Initiative planned through their business processes. In the case of ArchiInsurance as presented in Fig. 7, the business process “Handle Claim” is involved in the DT Initiative “Digital Claim”, and it counts on the DT Agent “Client” who has the role of “Insurant” assigned.

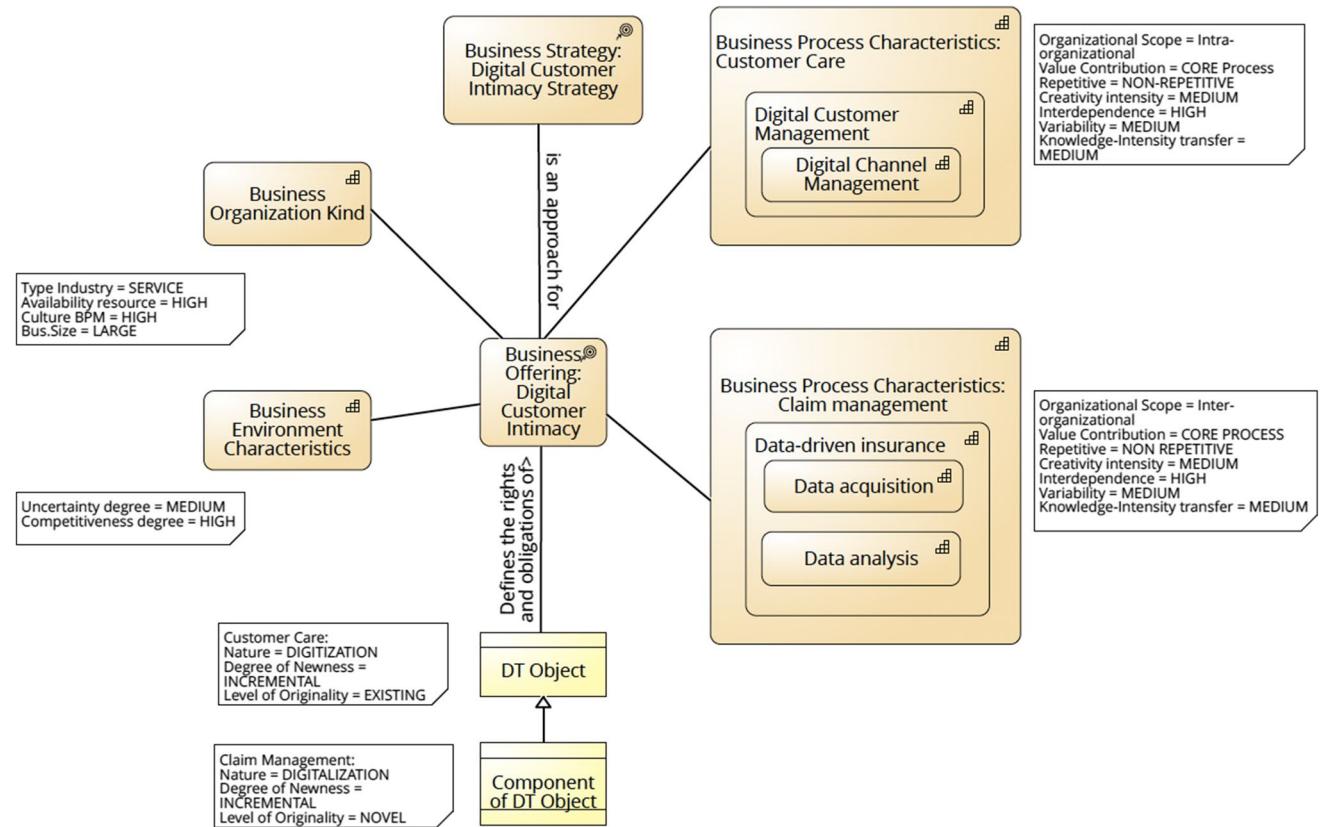
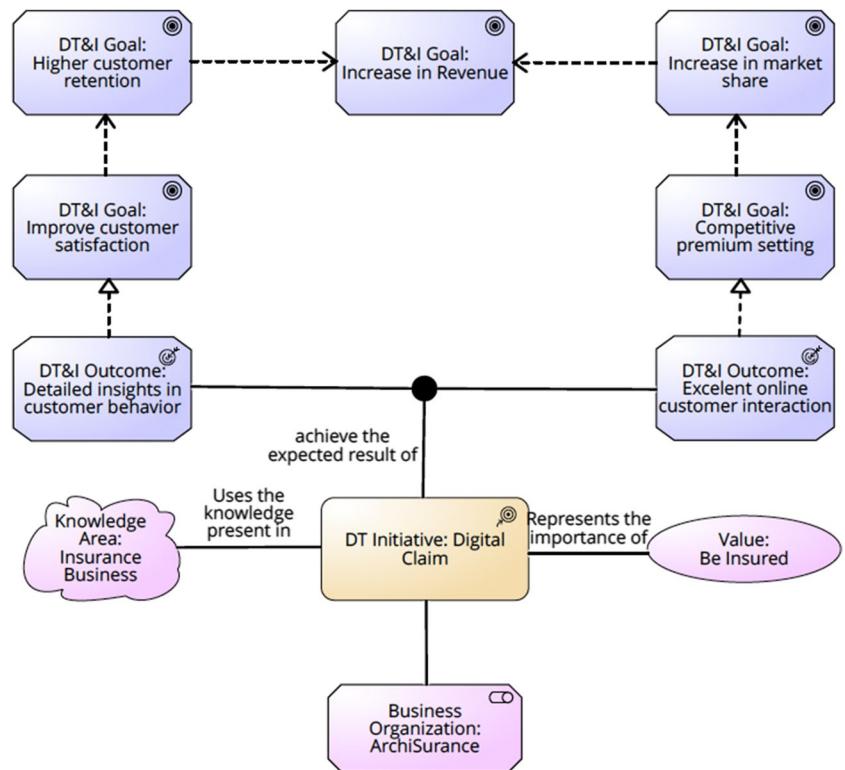
#### 4.5.4 The Digital Platform Design Viewpoint of ArchiInsurance

ArchiInsurance intends to use more detailed customer data to improve customer interaction and satisfaction and to customize insurance premiums based on customer behavior insights. The company will capture this data with smart, connected devices such as personal fitness trackers, black boxes

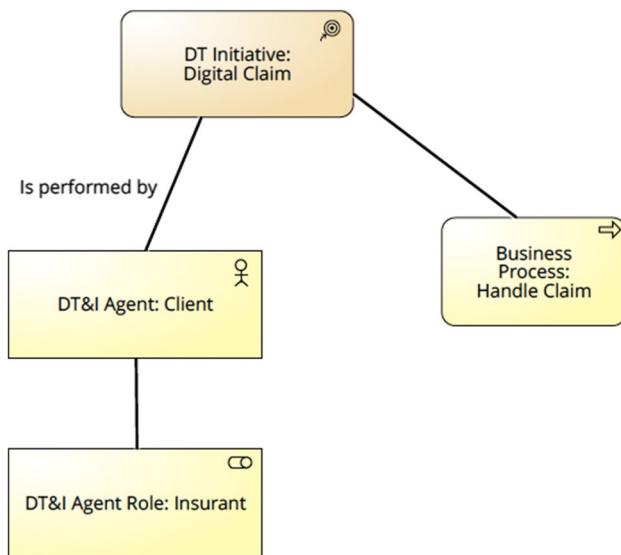
**Table 5** Description of the digital platform viewpoint

Viewpoint	The digital platform viewpoint
Stakeholders	Architects are concerned mainly with maintaining the system architecture description and facilitating communication between the technical and business areas of an organization Designers are concerned mainly with designing system components
Concerns	What is the scope of the applications and technologies that compose the digital platform in the DT Initiative? What are the value paths through one particular digital resource, or a combination of them, in the digital platform of the DT Initiative? How are the value connections between the digital platform components?
Purpose	Designing, Deciding
Abstraction level	Overview
Layers	Business Layer Application Layer Technology Layer
Aspects	Behavior, passive, and active structure
Concepts & Relationships	See Fig. 4
Example	Examples of model types: A family of diagrams representing the application’s main function models, applications and technology integration models, technology components distributed in the layers, whose combination enables it to achieve a specific purpose (i.e., deliver the DT object defined) successfully Examples of diagrams: models representing application sets and their main functions, models representing technology components, models representing components in layers and the integration among them

**Fig. 5** DT initiative motivation viewpoint of ArchiInsurance



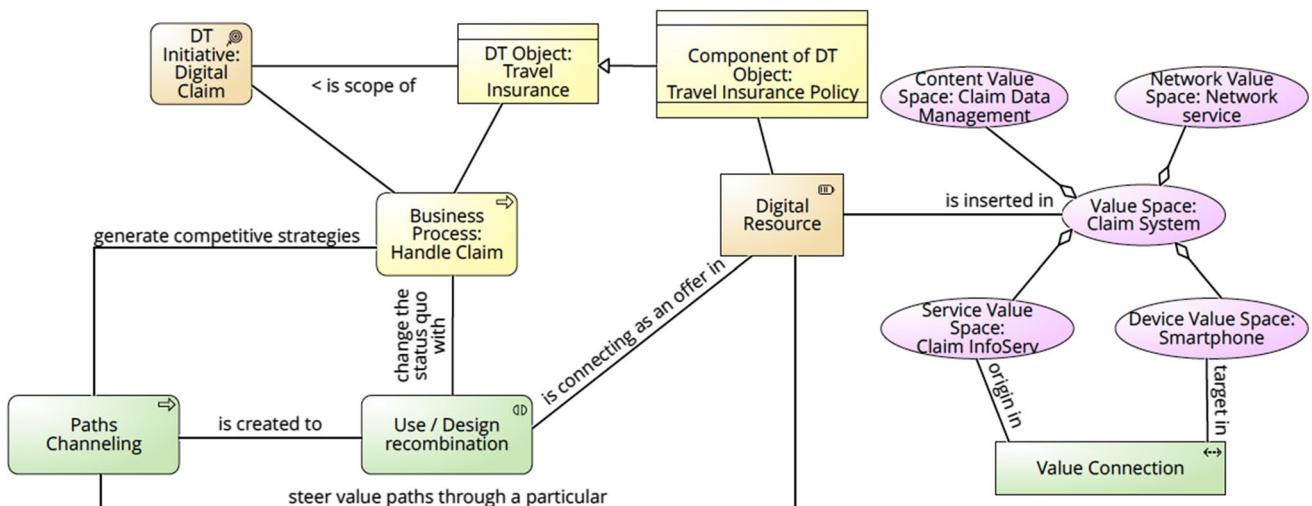
**Fig. 6** DT capability viewpoint of ArchiInsurance



**Fig. 7** DT agent viewpoint of ArchiSurance

The Digital Platform Design viewpoint, shown in Fig. 8, focuses on the design level of the systems that support the digital initiative. This viewpoint shows how one or more applications are embodied in the IT infrastructure. The Digital Platform Design viewpoint comprises mapping the use/design recombination of the digital resource and the resource insertion onto the value space, linking its use/design with the business process part of the DT object. This viewpoint allows an organization to identify which IT infrastructure components will be affected (i.e., created, changed, or deleted) by the DT initiative, considering the business processes impacted.

In the case of ArchiSurance, a DT object is the “travel insurance”, with components being “travel insurance policy”, which is part of the scope of the DT Initiative “Digital Claim”. One of the business processes involved is “Handle Claim”. The DT Initiative “Digital Claim” generates competitive strategies by creating “Path Channeling” through the “use / design recombination” of “Digital Resource”. The “use / design recombination” changes the business process status quo and is connecting as an offer in “Digital



**Fig. 8** Digital platform design viewpoint of ArchiSurance

in vehicles, home automation gateways, fleet management systems, in-store RFID devices, or smart building sensors. The target situation infrastructure proposed for the technical infrastructure landscape is the IoT-based data acquisition, as outlined in its new Digital Customer Intimacy strategy. To support this, ArchiSurance establishes a data acquisition gateway that can connect to all kinds of smart devices that generate relevant data. These devices are modelled as equipments. In turn, the equipments can be located at a Facility, for example, a home alarm system and smart thermostat within a smart home. Finally, the smart thermostat is connected to the Energy Network, modelled as a distribution network in the ArchiMate language (Jonkers et al., 2016).

Resource”, which is inserted in the “Claim system” value space. Claim InfoServ (Service), Claim Data Management (Content), Network Service (Network) and Smartphone (Device) are the parts of this value space.

The purpose of the Proposal Application Scenario was to show the applicability of our proposed viewpoints in a case. In the case of ArchiSurance, the adequate information needed to present in the viewpoint was existing, relevant and associated with the stakeholders’ concern in this case. The set of DT viewpoints attends to the stakeholders’ demands and the standard viewpoints does not attend to them in a consolidated view. The set of DT viewpoints proposed is

neither redundant with ArchiMate's standard viewpoints, nor with the ArchiSurance viewpoints.

#### 4.6 Proposal Evaluation

The goal of the evaluation was to validate the proposal by comparing our proposed set of four viewpoints for digital transformation initiatives with the existing standard ArchiMate viewpoints.

We adopted a qualitative approach, as proposed by (Runeson & Höst, 2009). We gathered data through interviews with nine digital transformation experts and utilized ArchiMate as the basis for our qualitative analysis. Our interviewees comprised a diverse group of stakeholders, including EA, BPM, Digital Transformation, and innovation consultants, with the majority also serving as professors. The profile of the participants is presented in Table 6. The average duration of the interviews was one hour. All interviews were performed in a one-on-one conversational style using video calls and were recorded and noted. To evaluate the validation criteria, we collected feedback from the interviewees through the ArchiSurance case study (Jonkers et al., 2016). The results and data analysis are presented as follows.

Each interview session was divided into the following phases: the presentation of the objectives of the interview and the proposal, an explanation about how the interview's data will be used, a set of preliminary questions about the interviewees' experience and knowledge, and the main interview questions, which constitute the most significant part. The interview questions were related to the comparison of the proposed set of DT viewpoints with the existing standard set of ArchiMate viewpoints. The participants were asked to evaluate the four sentences, using the 5 Likert Scale (1-Strongly disagree; 2-Disagree; 3-Neither agree nor disagree; 4-Agree; 5-Strongly agree), besides

explaining and justifying their classification for each viewpoint and sentence.

The sentences that guided the interviewees to evaluate the viewpoints were: (1) About goal efficacy: the proposed viewpoint produces its desired effect (i.e., achieves its goal). (2) About utility (organization consistency): the proposed viewpoint generates relevant information for practical use in a DT initiative. (3) About structural simplicity: the proposed viewpoint simplifies the intended understanding of the DT Viewpoint's subject. (4) About structural homomorphism: the proposed viewpoint does not share an equivalent perspective with a standard viewpoint (i.e., no redundancy).

The part of the interview where the respondent explains / justifies his/her classification was open, allowing and inviting a broad range of answers and issues from the interviewed subject, and unstructured. Findings from the interviews were consolidated to make sense of the collected data. We classified the findings with the aim of confirming the goal efficacy, utility, simplicity and no redundancy of each viewpoint presented before.

The best evaluated viewpoint was the DT Capability Viewpoint, followed closely by the DT Initiative Motivation and Digital Platform Design viewpoints. The interviewees demonstrated excellent theoretical and practical knowledge about digital transformation initiatives and ArchiMate, and they were very participative during the interviews. Overall, they considered the viewpoints relevant to DT initiatives. Additionally, they provided interesting inputs that will be used in future work.

## 5 Discussion

The set of DT viewpoints has been analyzed through the argumentation process, that a more flexible and standard approach is needed to present different perspectives of digital

**Table 6** Interviewees' profile

Interviewee	Present title	Qualification	Experience
I1	Head of Enterprise Architecture at a Telecom Business	PhD	Technology Demand Management, Transformation Initiative Leader, Enterprise Architecture, Value Oriented Enterprise Engineering
I2	Professor and Consultant	PhD	Enterprise Architecture, Enterprise Governance of IT, IT Service Management, Digital Transformation, Enterprise Architecture, Business Process Management
I3	Professor and Consultant	PhD	Information Systems, Information Management, Enterprise Architecture, Digital Libraries and Archives
I4	Professor and Innovation Consultant	PhD	Innovation
I5	Professor and DT Consultant	PhD	Information Systems, Digital Business and Enterprise Architecture
I6	Professor and ArchiMate Consultant	PhD	Information Systems and Enterprise Architecture
I7	Professor and DT Consultant	PhD	Sustainable Digital Transformation, Data Management, Architecture, People, Community
I8	Professor and Consultant	PhD	Enterprise Architecture, Information Systems, Information System Architecture, Information Systems Evaluation
I9	Professor and Consultant	PhD	E-gov, Enterprise Architecture, IT Entrepreneurship

transformation to stakeholders with diverse concerns and interests. As we saw before, a viewpoint adopting a particular combination of constraints can determine the level of abstraction on the set of EA models addressing which a particular type of stakeholder and a particular set of concerns is evaluated. For this, we proposed different viewpoints contemplating a set of elements suitable for the perspective of different stakeholders. Viewpoints allow for switching between different levels of abstraction on the set of EA models, referring to how a particular type of Stakeholder with a particular set of concerns should perceive information in a DT Initiative. Different stakeholders, with varying skills, responsibilities, and interests, may view the same DT Initiative information from different perspectives. The set of DT viewpoints proposed aimed at answering the two research questions: RQ1: What is the extent to which the proposed viewpoints model can satisfy the demand of different stakeholders in a DT initiative? RQ2: What is the extent to which the viewpoints' visualization is adequate for the different stakeholders in a DT initiative?

Creating a completely accurate model is always a difficult task. Our artifact, the set of DT viewpoints, is illustrated in reference to the current version of the viewpoints and reference model. This illustration will be used to enhance the next version of the DT viewpoints and may also include refining the reference model. We understand that simply creating an instance of the viewpoints to demonstrate their proposed use is not sufficient to fully evaluate their usefulness. However, the confirmation of this perception by specialists reinforces the evaluation. The evaluation is based on interviews with experts who verified that the set of DT viewpoints is able to present the right information to the identified stakeholders in an appropriate manner.

The answer to RQ1, which explores the extent to which the proposed viewpoints model meets the needs of various stakeholders in a DT initiative, is that the set of DT viewpoints identifies the key stakeholders as CxOs, business managers, architects, analysts, and more. This set of DT viewpoints successfully addresses the demands of these stakeholders and incorporates ArchiMate's reference model elements for digital transformation and innovation to support their information needs. Moreover, the interviewed experts generally agree that these viewpoints are producing their desired effects.

In general, they agree that these viewpoints are producing their desired effects in the evaluation. However, the DT Agent viewpoint was partially criticized for its efficacy by some participants who pointed out that agents could be more distinguished in this view. For instance, even if an artificial agent is always responsible for a human agent, we must have roles to which an artificial agent can be permanently assigned. However, the DT Agent viewpoint was partially criticized for its efficacy by some participants who pointed out that agents could be more distinguished in this view. This viewpoint should explain the self-relationship between agents and the relationship between a role and a process. However, we disagree that Agents and

Stakeholders are equivalent, as we can have human and artificial agents. For instance, even if an artificial agent is always responsible for a human agent, we must have roles to which an artificial agent can be permanently assigned. In this case, an agent is different from a stakeholder. The DT Agent's viewpoint was the principal offender in the evaluation. It is partially criticized here for its utility in the same line of direct relationships. After reviewing the interviews related to DT Agents, we have decided to improve the DT Agents Viewpoint's utility to increase its goal effectiveness, and we consider RQ1 answered.

The answer to RQ2 (about whether the visualization of viewpoints is suitable for all stakeholders involved in a DT initiative) is based on interviews conducted. The results show that the viewpoints generally simplify the intended understanding of DT, and there is no standard viewpoint with an equivalent perspective. However, regarding the Digital Platform viewpoint, after reviewing the interviews, we decided to improve this viewpoint on structural simplicity and considered RQ2 answered.

Moreover, we compared the proposal with the existing ArchiMate viewpoints, which would provide evidence that strengthens the arguments about all the criteria.

The DT Initiative Motivation viewpoint aims to show the motivation elements that drive the DT Initiative. Together, the standard ArchiMate viewpoints answered the DT Initiative Motivation purpose. The Stakeholder viewpoint's purpose is to support analysts in modeling the stakeholders, the drivers for change, and the assessments of these drivers associated with the high-level goals. The Goal Realization viewpoint assists the designer in modeling the refinement of goals into requirements or constraints for realizing the goals, and the Requirements Realization viewpoint explores how the core elements meet requirements or refine them into more detailed requirements. Finally, the Motivation viewpoint allows a designer or analyst to model the motivation aspect without focusing on certain elements within this aspect (Band et al., 2016).

The capability element appears in the following five viewpoints in the ArchiMate model: Layered (from the composition viewpoints set), Strategy, Capability Map, Outcome Realization, and Resource Map. Thus, we analyze those viewpoints in comparison with the DT Capability viewpoint proposed in this paper. The Layered viewpoint provides an overview and can be used as support for impact of change analysis and performance analysis or for extending the service portfolio. The Strategy viewpoint shows an overview of the enterprise strategies, the capabilities and resources supporting them, and the envisaged outcomes. The Outcome Realization viewpoint shows how the capabilities and underlying core elements produce the business-oriented results. The Resource Map viewpoint shows two or three levels of resources across the entire organization.

The only existing capability-related standard viewpoint – the Capability Map viewpoint (an overview of the course of action and capability elements existing in the company to

achieve the planned DT object)—presents all the capabilities of a company, its resources, and its outcomes, not only the capabilities related to the DT Initiative. However, the DT Capability viewpoint presents only the capabilities of a company (*Capabilities*) needed to achieve the DT object planned (*Contract*) considering the Business Strategy and the Business Offering (both *Course of Action*).

Besides, the DT Capability viewpoint is connected to the other existing DT viewpoints by their common elements. The relationship between Business Goal and Business Strategy classes is the connection between DT Capability and DT Initiative Motivation viewpoints. The relationship between DT Object (through DT Initiative) and DT Agent classes is the connection between DT Capability and DT Agent. The relationship between Component of DT Object and Digital Resource classes is the connection between DT Capability and Digital Platform Design. These connections provide traceability of the impact of a transformation and innovation initiative on an architecture.

According to (Brocke et al., 2016), the context involved in DT, like the environment that the business is within (Business Environment Characteristics), the business organization characteristics (Business Organization Kind), and the business processes characteristics (Business Processes Characteristics), directly influence the DT objects and their characteristics.

The DT objects and their characteristics are, in turn, designed to answer the Business Strategy and Business Offering. Therefore, the CxOs, business managers, enterprise architects, and business architects can analyze the context as a whole, given the available capabilities, and plan a Business Strategy to achieve the business goal established. In ArchiSurance, the new digital customer intimacy strategy involves “customer care”, which includes “digital customer management” and “digital channel management”. It also includes “claim management”, which is “data-driven insurance” with “data acquisition” and “data analysis”.

Figure 9 highlights the common elements between a standard viewpoint (in this case, the Capability Map viewpoint) and a proposed DT viewpoint (the DT Capability viewpoint) for the ArchiSurance case. These two viewpoints have the following capabilities in common: “Digital Channel Management” in “Digital Customer Management”, in the “Customer Care” capabilities. Furthermore, they also have in common the capabilities “Data acquisition” and “Data analysis” in “Data driven insurance” in the “Claim management” capabilities.

In the Proposal Application Scenario section, we showed that the DT Capability viewpoint allowed the identification of gaps in the ArchiSurance case. It also showed the business strategy and offerings that demand a digital transformation, besides their detailed purpose and characteristics. For example, in the case of ArchiSurance, what would be the object of the DT initiative? In the presentation of the case through the original viewpoints, we were not able to understand the DT object and its characteristics. Therefore, one question that the stakeholders might ask would

be: What was the purpose of creating this digital customer intimacy? The reference model addresses this issue by:

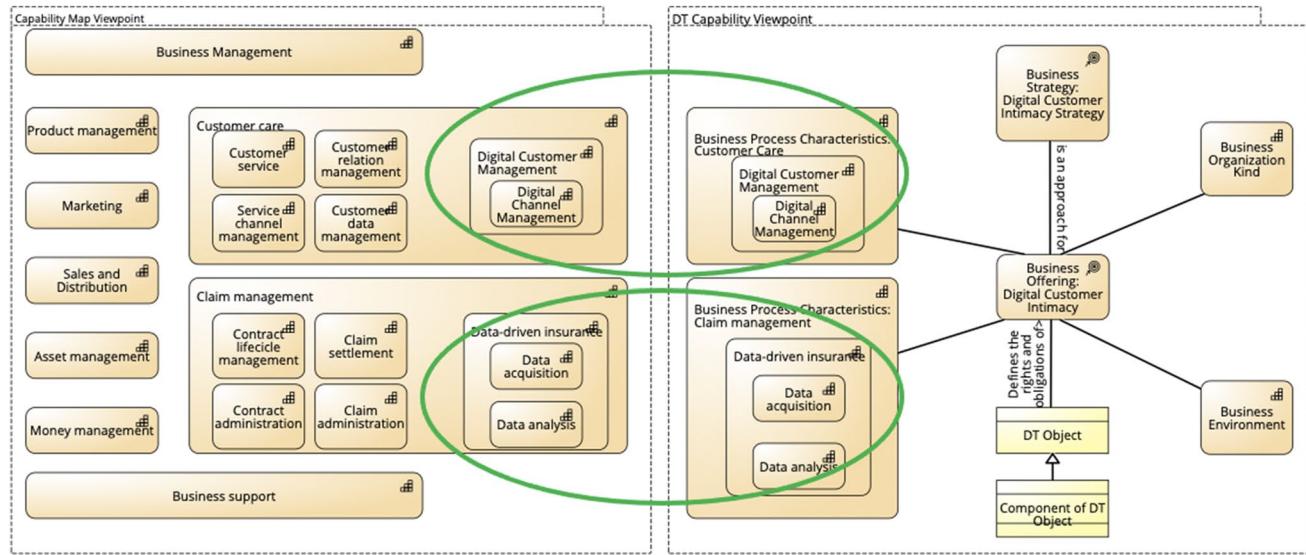
- Exploring DT’s purpose as a contract object (the topic, scope, characteristics, conditions, and other possible agreements to achieve the purpose detailed as a contract object),
- Clarifying the DT object type (product, process, or business model),
- Mapping the components of the DT object with the impacts in the organization digital resources: which are the new ones, and, from the existing ones, which has the potential to be reused while maintaining the same use or by creating a new use or tweaking the design? Furthermore, concerning the new ones, which are innovations, and which already exists in the market (i.e., used by other insurers) but is nevertheless new in ArchiSurance’s solution?

The DT Capability viewpoint allows the analysis of the strategic goal (or courses of action) that motivates the DT initiative when the business’ capabilities need to achieve the DT object planned, which is different from the existing viewpoints: capability map, outcome realization and resource map. The capability map viewpoint is concerned with all the resources and capabilities needed to support the strategy, and how to show a structured overview of the capabilities of the organization. The Outcome Realization viewpoint only selects the business-oriented results produced by the capabilities, while the Resource Map viewpoint is restricted to a structured overview of the resources of the organization.

If we compare, for example, the DT Capability viewpoint with the existing ArchiMate Capability Map viewpoint, the DT Capability viewpoint can be used to identify innovation opportunities to achieve the business goals defined using the capabilities the organization has. It is different from the Capability Map viewpoint that provides an overview of the capabilities of the organization. For example, it can be used to identify areas of investment and show specific outcomes delivered by these capabilities.

In the ArchiSurance case, the DT Capability viewpoint can support the stakeholder CXO in analyzing the capabilities in a consolidated way. In the ArchiSurance case, the DT Capability viewpoint can support the stakeholder CXO in analyzing the capabilities in a consolidated way. They must consider the use of capabilities according to the characteristics of ArchiSurance. For example, the business environment in which the ArchiSurance organization operates is a medium uncertainty degree and high competitiveness degree. Its type of organization is a service industry, high resource availability, high culture BPM, and large business size. And its business processes involved with DT are customer care and claim management.

Based on the exposed above, it becomes evident to the CXO-level stakeholders whether this set of DT viewpoints



**Fig. 9** Common elements in the capability map and DT capability viewpoints of ArchiInsurance

has the sufficient and necessary characteristics to implement the established DT Object successfully. The customer care process and the claim management process include digitalization and an incremental degree of newness for ArchiInsurance business; the customer care process includes the existing level of originality, whereas the claim management process has a novel level of originality. Together, they achieve the business goals and create digital customer intimacy.

The closest viewpoint to DT Agent is the Organization viewpoint. Comparing these two viewpoints, the Organization viewpoint focuses on the organizational structure of a company, department, network of companies, and other entities, so it is very useful for identifying competencies, authority, and responsibilities in an organization (Band et al., 2016). On the other hand, the DT Agent viewpoint focuses on the organization of the DT Initiative (Course of Action), including the business process (Business Process), DT Agents (Business Actor), and roles (Business Role) involved in the DT Initiative. The purposes of these two viewpoints are different, which can be confirmed by just looking at the lists of their elements — for the organization viewpoint, the elements are Business actor, Business role, Business collaboration, Location and Business interface elements, whereas for the DT Agent viewpoint, the elements are DT Initiative, Business Process, Business Actor and Business Role.

The Digital Platform Design viewpoint focuses on the design level. It comprises the use/design recombination of the digital resource and its insertion into the value space, linking these use/design with the business process part of the DT object. Its closest ArchiMate viewpoint is the Information Structure Viewpoint, which is comparable due to the information models created in the development of

almost any information system. The Information Structure Viewpoint shows the structure of the information used in a specific business process or application, in terms of data types or class structures. Furthermore, it may show how the information at the business level is represented at the application level in the form of the data structures used there, and how they are then mapped onto the underlying technology infrastructure, e.g., by means of a database schema. Its elements are: Business object, Representation, Data object, Artifact, and Meaning (Band et al., 2016). As we can notice, although both of these viewpoints deal with technology, they have different main purposes. The DT Digital Platform Design viewpoint is concerned with the value brought by the digital platform, while the Information Structure Viewpoint is concerned about the structure of the information used in a specific business process or application.

Finally, we could also observe that this new set of ArchiMate viewpoints presents (i) particular characteristics in an organization's digital products and services through the DT Capability viewpoint; (ii) how digital business processes deliver these digital products through the joint between the DT Capability and DT Initiative Motivation viewpoints; and (iii) how a platform combining information systems and technology supports these digital business processes through the Digital Platform Design viewpoint. The evaluation confirmed that the proposed viewpoints could help the stakeholders of a digital transformation initiative and pointed out possible improvements in the structure and communication of the viewpoints.

This research involved a learning process in producing an artefact (the set of viewpoints) that deliver the desired outcomes: presenting the needs of the stakeholders for

digital transformation through a case instantiation of the set of viewpoints and its validation with specialist interviews.

## 6 Implications

Digital transformation can be defined as the use of technology to improve organizations' performance or reach radically. ArchiMate is a widely accepted industry standard that is considered an easily understandable language by IT/business experts and non-experts to visualize models.

Although the literature discusses the use of ArchiMate to represent digital transformation initiatives, even with viewpoints, we observed that it is not mature yet. Thus, as implications for research, this study allowed us to learn and evaluate the information needed for different stakeholders starting from a conceptual reference model such as defined by (MacKenzie et al., 2006), providing a reusable and adaptable blueprint for a domain class. Therefore, this research extends the body of knowledge both in the fields of DT and EA, from the theoretical perspective of DT initiatives (the reference model) as well as in the ArchiMate framework and structure.

The reference model deals with what motivates an organization to make a digital transformation initiative; who is involved in the initiative; and what business knowledge and the technology are needed for a successful initiative.

For example, the point related to the business knowledge is the capabilities needed for a given digital transformation initiative and stakeholders identified. ArchiMate's Capability Map Viewpoint already presents some of those capabilities, but it does not clarify how the demand originated. Hence, our research showed the part of the DT initiative with which each capability is associated. The rationale is to start from the end of a digital transformation initiative (the business offering which will be provided by the organization) to the beginning (the capabilities needed to develop this business offering).

On the one hand, the business offering, as described in the reference model, results from the business strategy, the type of organization, and the environment in which the business operates. On the other hand, the business offering results from the object of digital transformation and its components. Together they compose the business offering context. Then, we return to the reference model to look for the other relationships around the business offering. We identify the business processes of the digital transformation initiative (existing, modified, or newly created ones). With this, we have the context and related activities set that produce the business offering. Moreover, we could discover the source of the capability list generated, i.e., the capabilities needed to perform those processes.

From the practical perspective, the main contribution of this work is the possibility for organizations to use the new DT viewpoints of ArchiMate as a concrete modeling language to organize and present information to different stakeholders. It opens

the path for companies to discuss the issues related to digital transformation initiatives more easily, based on visualizing the core elements and gathering the diverse stakeholders involved.

## 7 Conclusion

In this paper, we proposed a set of viewpoints to address concerns related to digital transformation and innovation based on the reference model and ArchiMate. ArchiMate is a mainstream model in the enterprise architecture field. Viewpoints are well-known artifacts within the ArchiMate model. Despite their relevance, proposals of ArchiMate viewpoints for DT have received moderate attention in the existing research literature.

The set of viewpoints can be summarized starting with the DT Initiative Motivation, which encompasses the goals to achieve a specific purpose of business organization, driving the DT Initiative. DT Capabilities identify the skills that influence a successful DT, i.e., the ones that are relevant to achieve the goal, and the high-level dependencies between them. Moreover, the DT Agent relates the types of agents (i.e., stakeholders) involved in the DT Initiative to the roles they can play. Finally, the model comprises the set of components (i.e., the set of applications and technologies) representing the DT initiative digital platform.

We demonstrated the proposed viewpoints in the ArchiInsurance case study. The ArchiInsurance capability elements are linked with three different reference model elements: Business Environment, Business Organization Kind, and Business Process Characteristics. The evaluation of the proposed approach provided evidence of the need to detail the concept of the capability element type in digital transformation.

We evaluated the proposed viewpoints based on the results of a set of interviews. The findings suggested reviewing the DT Agent viewpoint regarding its goal efficacy and utility, and the Digital Platform viewpoint regarding its structural simplicity. New DT viewpoints were suggested, for example a roadmap of DT capabilities, a roadmap of DT initiatives and DT governance.

Although we are not evaluating our proposal with a real case, which is the main limitation of this paper, the fictitious ArchiInsurance case study illustrates very well the practical use of the ArchiMate enterprise modeling language in the context of the TOGAF framework (ArchiInsurance). It has been sponsored and published by TOGAF (The Open Group Architecture Framework). It is in Version 2 and has been applied as a case study in different situations by several researchers. Therefore, the evaluation made using this case study was adequate to show the results and contributions of our proposed viewpoints, which can be used as a basis for further evaluations.

Future work includes performing further evaluations by considering real cases and diverse domain of industries. Moreover, we will improve and extend the viewpoints based on the results obtained so far.

## Appendix 1

**Table 7** Resulting papers list

Reference paper	Organization	Stakeholders	Paper goal	DT initiative	View or viewpoints	Comparison with our model and viewpoints
Piloting Industry 4.0 in SMEs with RAMI 4.0: an enterprise architecture approach (Baptista & Barata, 2021)	A SME coating company	The coating company and the Reference Architectural Model Industrie 4.0 (RAMI 4.0) Users	Instantiate an SME pilot project adopting mobile technologies in manufacturing and quick response code identification for product traceability	A pilot project adopting mobile technologies in manufacturing and quick response code identification for product traceability	Although the paper has a model represented in ArchiMate, they do not explicit the viewpoints design in ArchiMate model. The difference is that in this pilot project using RAMI 4.0 And it seems they do not have viewpoints representing specific stakeholders' concerns Our viewpoints can be used in this model partially. The ArchiMate type of elements presented in this model is not correspondent to all of our model's type of elements (as for instance, Value, they do not have)	The Reference architectures for Industry 4.0 (RAMI 4.0) has an equivalent role of our reference model for digital transformation. Both were design in ArchiMate model.
Towards a visual modeling approach to manage the impact of digital transformation on information systems (Hafsi & Assar, 2018)	Numan-Gardens case study	Not specified different stakeholders	Focus on simplified visualization within the Enterprise Modeling to deal with the design and management of IS evolution in the context of Digital Transformation endeavors	The authors use a case study model that allows the managers visualize the impact of the new channel acquisition on the rest of the IS	[a] “process” view [b] “business organization” view [c] Production components view [d] Distribution components view	Their Visual DTO model is equivalent to our Reference Model. Although they present viewpoints, they do not present them to specific stakeholders' concerns Our viewpoints can be used in this model partially. They do not have some ArchiMate elements in this model (as for instance, Value)
VR-EA: Virtual Reality Visualization of Enterprise Architecture Models with ArchiMate and BPMN (Oberhauser & Pogolski, 2019)	ArchiSurance case study	Not specified different stakeholders	Present a virtual reality (VR) hypermodel solution concept for visualizing, navigating, interacting with ArchiMate and Business Process Modeling Notation (BPMN) models in VR	A visual model proposal based on the ArchiMate metamodel, the Digital Transformation-Oriented (DTO) model considers digital transformation properties	[a] Actor Cooperation View [b] Technical Infrastructure View [c] Business Cooperation View [d] Implementation and Installation View [e] Customer interview	VR-EA hypermodel showing BPMN models in the same vertical layer as the Business Process View in the Archi-Mate model (ArchiSurance) in a 3D visualization. It is not comparable with our DT viewpoints Our DT viewpoint can be presented in this VR-EA hypermodel

**Table 7** (continued)

Reference paper	Organization	Stakeholders	Paper goal	DT initiative	View or viewpoints	Comparison with our model and viewpoints
Digital Transformation of Virtual Enterprises (VE) Virtual Enterprises for Providing Collaborative Services in Smart Cities (Anthony Jnr. et al., 2020)	Citizens and stakeholders in smart cities	Propose a model of how Virtual Enterprises (VE) can be digitalized to provide collaborative services in smart cities	To employ ArchiMate as the modeling language to demonstrate how Virtual Enterprises (VE) collaborates in smart cities operating services	[a] ArchiMate meta-model view for the operation phase of VE—The creation and operation phase of VE	Their ArchiMate model is around the Virtual enterprise life cycle. The model's center is the operation. VE is a momentary network of independent establishments to share costs, knowledge, and access to members market based on a common business understanding	Their ArchiMate meta-model view for the operation phase of VE—The creation and operation phase of VE
Enterprise architecture modeling in digital transformation era (Ilin et al., 2021)	Enterprises in general	Owners, Market (customers, competitors, suppliers, partners), State / Government	Propose an enterprise meta-model and demonstrate how different digital technologies transform it	Develop a modern enterprise meta-model within the framework of the industry 4.0 concept, exploring the representation of technologies as Big Data, Cloud computing, IoT, Blockchain, Digital Twins and AI	They present an enterprise meta-model considering main elements as stakeholders, strategic complex, business architecture, IT architecture (Data and Application Arch), and IT Infrastructure, besides their respective services Our DT viewpoint can be presented in this the DT Initiative since it seems to be inserted in the Project Portfolio. Our DT viewpoints could be used to present the concerns of different stakeholders	They present an enterprise meta-model considering main elements as stakeholders, strategic complex, business architecture, IT architecture (Data and Application Arch), and IT Infrastructure, besides their respective services Our DT viewpoint can be presented in this the DT Initiative since it seems to be inserted in the Project Portfolio. Our DT viewpoints could be used to present the concerns of different stakeholders

**Table 7** (continued)

Reference paper	Organization	Stakeholders	Paper goal	DT initiative	View or viewpoints	Comparison with our model and viewpoints
Modeling pervasive platforms and digital services for smart urban transformation using an enterprise architecture framework (Anthony Jnr. et al., 2021a, b)	An organization and municipality in Norway	Not specified different stakeholders	Present an Enterprise Architecture Framework (EAF) to support smart urban transformation	An Enterprise Architecture Framework (EAF) to support smart urban transformation	They do not present examples of views or viewpoints	The developed EAF to support pluggability and integration of different pervasive platforms needed to provide digital services for smart urban transformation based on seven layers (context, service, business, application and data processing, data space, technologies, and physical infrastructures), and perspectives (stakeholder and data). EAF models provide views for communication between stakeholders with different backgrounds
Digital transformation with enterprise architecture for smarter cities: a qualitative research approach (Anthony Jnr. et al., 2021a, b)	A municipality in Norway	Not specified different stakeholders	To employ Enterprise Architecture (EA) in digital transformation of cities by developing an architecture to address system alignment and data integration in digital transformation of cities	An e-Mobility case is modelled in ArchiMate language based on data collected from interviews and discussion to depict the relevance of the architecture in exposing cross platform, and/or cross-domain utilizing different data sources from different partners to enable integrated resource sharing in aligning multiple systems	To provide a detailed view of digital transformation for sustainable e-Mobility:	Same model of Modeling pervasive platforms and digital services for smart urban transformation using an enterprise architecture framework (Anthony Jnr. et al., 2021a, b)

## Appendix 2 –ArchiInsurance Digital Transformation Study Case

### ArchiInsurance Case Study

This fictitious Case Study illustrates the practical use of the ArchiMate enterprise modeling language in the context of the TOGAF framework. The ArchiInsurance Case Study concerns the insurance company ArchiInsurance, resulting from a merger of three previously independent companies based in different metropolitan areas. This Case Study shows Baseline and Target Business, Application, Data, and Technology Architectures, using the appropriate ArchiMate or TOGAF viewpoints. It incorporates two change scenarios: Rationalization and Digital Transformation. In this work, we use the Digital Transformation change scenario to demonstrate the DT viewpoints application for the interviews to evaluate the proposal providing insights to discuss the results obtained.

### Digital Transformation Scenario

In addition to the more immediate goals related to post-merger integration, ArchiInsurance also sees the rapid pace of technology as both a challenge and an opportunity. As a long-term vision, it wants to embark on a digital transformation defining a new Digital Customer Intimacy strategy, which employs a combination of Big Data and the Internet of Things (IoT). ArchiInsurance intends to acquire more detailed customer data, improve customer interaction and satisfaction, and adjust insurance premiums based on risk. To this end, for insurance products sold to consumers, ArchiInsurance intends to use data from smart, connected devices such as fitness trackers, vehicle tracking systems, or home automation gateways.

In various B2B markets, ArchiInsurance intends to use data from sources such as fleet management systems, energy networks, in-store RFID devices, or smart building sensors. Ultimately, this may result in real-time insurance products where customers receive direct feedback on the financial consequences of their behavior and advice on adjusting this behavior to lower their insurance premium.

### Phase A: Architecture Vision

This phase identified two stakeholders (the ArchiInsurance board of directors and its current and potential customers) and their concerns, modelled as drivers. Customer satisfaction is a shared concern of both stakeholders. Stakeholder satisfaction can be refined into more detailed concerns, e.g., profitability.

Drivers motivate the development of specific business goals. The two assessments show that the profitability of ArchiInsurance is suffering from customers defecting to competitors with superior digital experiences or lower premium costs. Goals such as reducing costs have a positive influence

on this driver. This goal can, in turn, be partitioned into the reduction of maintenance costs and the decrease in personnel costs.

### Longer-Term Vision

Besides the short-term need for rationalization, ArchiInsurance has defined a longer-term digital customer intimacy strategy that combines Big Data and the Internet of Things (IoT). ArchiInsurance intends to use more detailed customer data to improve customer interaction and satisfaction and customize insurance premiums based on customer behavior insights. The company will capture this data with smart, connected devices such as personal fitness trackers, black boxes in vehicles, home automation gateways, fleet management systems, in-store RFID devices, or smart building sensors. The digital customer intimacy strategy requires ArchiInsurance to develop several new capabilities and resources, including digital customer management, data acquisition, and data analysis.

### Solution Concept

The Target Architecture demands requirements and outcomes derived from both the rationalization and the Digital Customer Intimacy strategies:

- Enterprise-wide CRM automation in the front-office to replace individual CRM systems.
- Integrated back-office automation will replace the separate back-office applications for the different lines of business.
- The outcome: Detailed insights in customer behavior will be supported by acquiring customer behavior data from external data sources, which will be fed into a solution for automated data analysis, which will deliver customer profiles to the new back-office solution. The business intelligence gained from that will be used in setting insurance premiums for individual customers as part of the Claim management capability and the development of new insurance products. This will also require the development of organizational competencies in data analysis.
- Various social media apps in combination with the requisite social media competencies of the organization will realize the envisaged excellent online customer interaction.

### Phase B: Business Architecture

The digital customer intimacy strategy of ArchiInsurance also requires changes to the Business Architecture. First, new capabilities are needed. The needed capabilities require personnel with the proper knowledge and skills for the digital age, smart devices for data acquisition, and the customer

data itself. For instance, the new capability of Digital Customer Management that ArchiSurance wants to establish as part of their Digital Customer Intimacy strategy. This capability will, in part, be realized by the Customer Relations business function, but also by a (yet-to-be-realized) business function Business Intelligence, and by various resources such as data analysts, risk managers, data acquisition and analysis applications, and customer behavior data.

### **Phase C: Information Systems Architectures—Application and Data**

Since the merger, the three divisions (Home & Away, PRO-FIT, and Legally Yours) have adopted a common web portal, contact center software suite, and document management system. Also, the company has selected a strategic CRM solution and implemented it for both Home & Away and PRO-FIT. However, the core business application rationalization has not begun. Many challenges remain. Home & Away still uses its pre-merger policy administration and financial application packages, while PRO-FIT and Legally Yours still use their own pre-merger custom monolithic applications.

After ArchiSurance has met post-merger performance expectations, investors expect substantial IT cost savings by adopting a common set of product and customer-focused applications, ArchiSurance defined its target architecture. Several application components in the Baseline Architecture are no longer present in the Target Architecture: the separate back-office applications and the separate Legal Expense insurance CRM system. The general CRM system takes over the CRM functionality for Legal Expense insurance customers. Therefore, this does not require new components (although it may be necessary to adapt or reconfigure the existing general CRM system, this is not shown in the gap analysis). In addition, a completely new back-office application suite and new data warehousing solution are introduced.

### **Phase D: Technology Architecture**

The target situation infrastructure proposed for the technical infrastructure landscape is the IoT-based data acquisition, as outlined in its new Digital Customer Intimacy strategy. To support this, ArchiSurance establishes a data acquisition gateway that can connect to all kinds of smart devices that generate relevant data. These devices are modelled as equipment. In turn, the equipment can be located at a Facility; For example, a home alarm system and Smart thermostat within a Smart home. Finally, the Smart thermostat is connected to the Energy Network, modelled as a distribution network in the ArchiMate language.

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### **Declarations**

**Ethics Approval and Consent to Participate** All the invited experts consented to partake in the interviews aimed to evaluate the proposal to be published in an article without revealing their identity, but only including their qualifications.

**Consent for Publication** All the authors have confirmed their consent for publication in the Information Systems Frontiers Journal.

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