Unlocking Enterprise Value: A Comprehensive Review of ArchiMate's Value Modelling Landscape and Stakeholder Perspectives

Karthickeshwar Shankaravelu
School of Business
Maynooth University
Maynooth, Ireland
karthickeshwar.shankaravelu.2023@mumail.ie

Hao Wu
Department of Computer Science
Maynooth University
Maynooth, Ireland
wu.hao@mu.ie

Markus Helfert
Innovation Value Institute
Maynooth University
Maynooth, Ireland
markus.helfert@mu.ie

2024 26th International Conference on Business Informatics (CBI) | 979-8-3315-2909-3/24/$31.00 ©2024 IEEE | DOI: 10.1109/CBI62504.2024.00012

***Abstract*— There are many attempts to perceive and represent value creation which spans across disciplines. Modelling gives a detailed insight into the areas of value creation and practical applicability in testing its validity. ArchiMate, an internationally recognised standard language for enterprise architecture modelling, offers a structured approach to represent and analyse value within the context of enterprise architecture. Although being predominantly used as an enterprise language and framework, ArchiMate still faces deficiencies in representing the value aspects. Through a comprehensive review of existing literature, this review identifies key challenges, issues, and opportunities in value modelling practices within ArchiMate. The paper aims to improve the value-centric enterprise modelling practice and contributes to ArchiMate's value representations.**

Keywords*— *ArchiMate, stakeholder theory, value, review, stakeholder value, value modeling, enterprise architecture.

I. Introduction

Value creation has been critical in formulating organisational strategies and enhancing the decision-making process in this dynamic organisational landscape [1], [2]. Value, broadly is classified into two major forms, value-in-use and value-in-exchange [3] [4]. The exchange value is both subjective and objective and predominantly focuses on the financial exchange [3]. The use value which is subjective in nature, focuses on the usefulness of a good or service to organisations or individuals [4]. In the enterprise context, the value was previously restricted to the company's overall value to the investors [5] along with shareholders representing the enterprise's market value of its equity and debt [6]. Moreover, the enterprise context's value perception has evolved significantly, incorporating the nature of stakeholder's needs [7].

In the wake of that, several models were developed focusing on specific aspects and detailed insights into a particular area, such as the e3value model focusing on value exchange among stakeholders [8], the Business Process Model and Notation (BPMN) [9], which focuses on process flow in specific business processes, Value Stream Mapping (VSM) analysing the flow of materials and information in business operations [10], Balanced Scorecard (BSC) for measuring organisational performance, etc [11]. Translating this nuanced understanding of value into actionable insights within enterprise modelling languages poses significant challenges [12]. As organisations strive to articulate and manage value propositions across diverse domains, the need for robust value modelling frameworks becomes increasingly apparent [12].

ArchiMate is primarily used in Enterprise Architecture (EA) to describe, analyse, and visualise architecture across domains [13]. ArchiMate serves as both a modelling language and a framework for EA, providing standardised symbols and relationships for modelling and a structured approach to organising and analysing complex architectural landscapes [14]. ArchiMate has been widely used by practitioners and in literature as a de-facto enterprise modelling language in many cases, the inclusion of value modelling within ArchiMate enables practitioners to capture the holistic value propositions of architectural decisions [15]. Practitioners find it difficult to align business objectives with architectural decisions without understanding how value is modelled within the Enterprise Modelling language [16].

This leads to difficulty in communicating value to stakeholders, leading to a lack of product clarity, inefficient resource allocation, and poor decision-making [17]. Therefore identifying how the existing research perceived or modelled value in ArchiMate is essential in bringing this forward. Exploring how value is conceptualised and operationalised within ArchiMate can contribute to theoretical discussions within both the EA and business management domains [15].

The paper's objective is a comprehensive examination of the value representations in ArchiMate. The paper positions itself to contribute to improving the value-centric architectural practice through ArchiMate. This comprehensive review aims to identify issues and key challenges faced by ArchiMate in its attempts to represent value. We conducted our literature review and presented the results in three phases, which will be explained in detail in the methodology and findings sections. For the first phase, to understand the ArchiMate language's capability to represent value, we establish this research question ***(RQ1): Where are the value concepts being mapped in ArchiMate?*** The second set of analyses includes understanding the conceptualisation of value within ArchiMate. It is essential to understand different ways the existing research perceived value in ArchiMate. After finding where value is predominantly mapped in ArchiMate, we set to understand how value is perceived in ArchiMate. So we proposed our second research question ***(RQ2): How are value concepts being conceptualised in ArchiMate?***

After understanding value conceptualisation in ArchiMate which explains how value is perceived, defined and understood in modelling, we delve a layer deep into understanding value nature. Value nature defines the inherent characteristics of value. We take the use value or the subjective value into consideration. We argue that ArchiMate can be used best in representing the subjective value nature. The objective nature or exchange value is less suited to ArchiMate and more to modelling languages such as the e3value model, due to its measurable and quantifiable aspects.

2378-1971/24/$31.00 ©2024 IEEE
DOI 10.1109/CBI62504.2024.00012

Therefore, we focus on the value-in-use case, which focuses on the subjective nature. Our focus of the study is understanding the perceived usefulness of the goods or services to the stakeholders. Along with understanding the context-specific and diverse perspectives of values stakeholders hold. To understand the stakeholder's needs and the value creation associated with it, we incorporate the theoretical lenses of the stakeholder theory [36]. The application of the stakeholder theory provides a robust framework for analysing the value nature. It also grants an avenue to narrow the scope of subjective value lenses. The theory provides the interconnected relationships between different stakeholders and organisations [38]. The theory also specifies insights into different value dimensions not restricted to financial, exchange value [39]. Stakeholder theory emphasises different dimensions of value creation associated with stakeholder engagements [36]. Hence we choose the stakeholder theory due to its structured framework, defining of different value perspectives, and grounding to the subjective value nature. Therefore, we conduct our analysis with the following research question ***(RQ3): How is the nature of the stakeholder value modelled in ArchiMate?***

In the subsequent sections, we provide the background of the ArchiMate and its ability to be a framework and a modelling language. We then present the inherent challenges ArchiMate faces in representing value, followed by the description of Stakeholder theory. Afterwards, we discuss our methodological approach of conducting research in three phases answering the three research questions. Based on our analysis, we discuss our identified issues and research challenges ArchiMate faces in modelling and representing value. At the end of this paper, we propose a value gap analysis representation of our identified issues and challenges and we conclude on how we intend to address these issues further.

II. BACKGROUND

A. ArchiMate

ArchiMate is a standard architectural modelling language for EA widely used by many practitioners to describe and understand complex systems [14]. ArchiMate consists of core layers, extensions and aspects. The core layers of the ArchiMate are Business, Application and Technology, followed by extension layers, such as Motivation, Physical, and Implementation & Migration layers as seen in Figure 1. The aspects of the ArchiMate overlap within each layer which can be explained through ArchiMate's metamodel [14]. ArchiMate's generic metamodel explains the structure/s, the nouns, the behaviour, and the verbs. The generic model consists of passive, internal and external active structure elements. Along with internal and external behavioural elements and events [18].

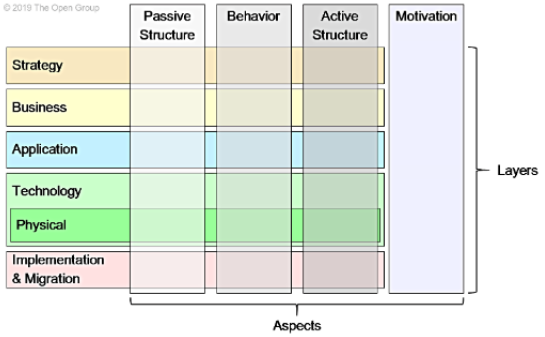

Fig. 1. ArchiMate Full Framework

In addition to being a structured framework with its defining of concepts and different viewpoints. ArchiMate also functions as a modelling language through graphical notations, its ability to create a visual representation and communicate with diverse audiences [19], [20]. ArchiMate defines a common language for stakeholders to design, assess, and communicate [21]. It is used for describing the construction and operation of business processes, technical infrastructure, information flows, organisational structures, and IT systems [20], [22]. Moreover, ArchiMate is linked with the TOGAF (The Open Group Architecture Framework), which provides a structured approach to designing and managing EA [14]. The ArchiMate metamodel balances both the generic and specific views [18]. The language provides a general framework for modelling enterprise architectures across various industries [23], [24]. To domain-specific concepts through its layered approach and standardised notation [25].

B. Value in ArchiMate

Predominantly, the value is modelled or mapped in the motivational and business layers [26]. The value concept in the ArchiMate language is an element in the motivational part which represents "*… the relative worth, utility, or importance of a concept."* [27]. In ArchiMate, the motivational aspect does not align with the ArchiMate layers that are used to model the structural aspects of an organisation as seen in Figure 1 [28]. This leads to difficulty in integrating the elements of the motivational aspects, 'Value' in our case, with the rest of the architecture [29], [30]. Value modelling aims to identify how specific processes create value for an organisation, stakeholders, or ecosystem [12]. The motivational aspect of the ArchiMate consists of stakeholders, goals, and value elements, due to its incomplete integration, modelling value becomes challenging [24]. Hence ArchiMate inherently faces deficiency in value modelling since the 'value' element in the motivational aspect is incoherently aligned with different layers [31], [32]. Architects may struggle to articulate how business processes, IT systems, and technological infrastructures contribute to achieving stakeholder or organisational goals and objectives [33], [34].

Another shortcoming faced by ArchiMate's native value concept is that it is restricted to represent only the qualitative nature of nature which leads to difficulty in capturing the detailed numeric calculations. The relationships of the value element are not properly defined in the ArchiMate language which has not been concentrated in the existing literature [11]. The mapping is done in the motivational and business layers without changing the characteristics of the existing value element in ArchiMate. This abstraction leads to oversimplified value models that may not be able to capture intricate value dynamics present in real-world enterprises. For changing the characteristics of the existing element or adding a new value element [30] there should be an extension of ArchiMate's metamodel through concept introduction or changing the relationships [35]. [19] attempts to extend ArchiMate's metamodel for modelling value, but falls short by not incorporating the different value concepts.

III. THEORY

A. Stakeholder Theory

Since we focus on the subjective nature of value, which focuses on the perceived usefulness to an organisation or individual, we incorporate stakeholder theory [36]. The theory emphasises the consideration of diverse stakeholder perspectives in the organisational decision-making process [37]. In value modelling within EA, understanding these perspectives is critical for accurately capturing and representing various dimensions of subjective value [12]. The theory proposed by [38] postulates the strong linkage of organisational objectives to stakeholder behaviour. The major constructs of the theory include stakeholders, their interests, engagement, long-term orientations, ethical considerations and value creation [38], [39].

The theory defines three types of stakeholder (inside, outside, and externalities) based on their relationship with the firm [40]. The theory also defines what is considered as values to the identified stakeholders and how it can be captured [41]. Value is perceived as a conjunction of organisational objectives and individual perceptions [42]. Therefore the stakeholder theory posits its inclusion in the identification of issues along with the thematic analysis and the inclusion of its value constructs into the review analysis [43]. The theory defines stakeholders' value perceptions and defines six types of values namely, Economic extrinsic value, Psychological Intrinsic Value, Intangible Extrinsic Value, Operational Learning Value, Transcendent Value, and Value Externalities [40]. ArchiMate recognises stakeholders as key actors within the EA ecosystem and is flexible in incorporating the key constructs of the Stakeholder theory through extensions. Through this integration value models can be more accurately represented in reflecting diverse value creation outcomes..

IV. METHODOLOGY

This paper follows the guidelines set by [44], and [45] including active planning, conducting and reporting the results, and exploring research challenges. We are particularly focused on ArchiMate's value aspects, we base our primary search strings on "archimate" AND "valu*". We use variations of value such as "IT value", "business value", "stakeholder value", and "enterprise value" to gather our results. We derive our search terms from the keywords of the paper we select, which goes through an iterative refinement process.

We chose our search databases (Scopus, IEEE Xplore, DBLP, EBSCO host, and ACM Digital library) due to their prominent relevance to our research scope, i.e., value in ArchiMate and the interdisciplinary setting in different disciplines such as Computer Science, Information Systems, and Business Management, ArchiMate is studied and used upon. Using our keywords, we get an initial of 223 hits, with databases such as Scopus (n=92) and ACM Digital Library (n=105) contributing more. We then incorporate the first set of exclusion criteria of removing papers that do not focus on the value aspect, papers that do not incorporate ArchiMate, and also excluded the reviews on conferences. After reading the title and the abstracts excluding the duplicates, we select a total of 42 papers for reading. The papers selected for review for this paper are included in the appendix section (Table IV) to ensure the transparency and traceability of the materials used for this study. After checking the access and skimming the papers, we selected 36 papers for comprehensive reading. From there, we incorporated our next exclusion criteria of papers that do not focus either on value mapping or value modelling and papers that focus on the value of EA, which is not the focus of our research. Finally, we arrived at the final set of papers (n=19) chosen for analysis. Figure 2 provides a comprehensive understanding of our literature review process. The first author undertook the review process. The second and third authors; both independently reviewed the review process to ensure accuracy and reduce bias. Any inconsistencies in the review process and categorisation were resolved through discussions and consensus between the authors. Additionally, the review process and the results were cross-checked through discussions and presentation of results with peers.

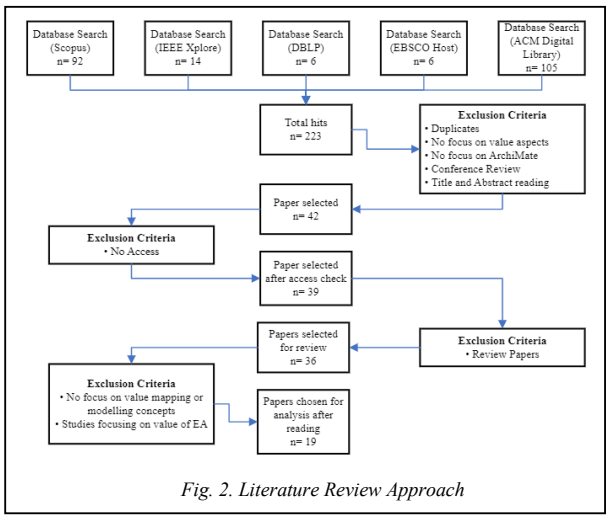

Fig. 2. Literature Review Approach

For the scope of our research project, we conducted a literature analysis in three phases. The phased approach allows for an iterative approach to the topic, with each building upon the insights gained from the previous one. Dividing our review process into these phases enhances clarity and structure of understanding of the results.

V. REVIEW FINDINGS

A. RQ1: First Phase

Understanding where the value concepts are being mapped or modelled is crucial in identifying the existing value representations [46]. This phase aims to provide an overview of how value is currently integrated into ArchiMate's architecture. In our review of value representations in ArchiMate, we identified existing attempts focused on mapping value concepts from different frameworks into ArchiMate. We identified predominantly value concepts from the e3value model used to map to ArchiMate [42], [47], [48]. Other sources of ontological mapping of value concepts to ArchiMate include Balanced Scorecard (BSC) [11], Business model canvas [49], [50], BDN Framework [51], Value Management Platform (VMP) [52], Common Ontology of Value and Risk (COVER) [35], Unified Foundational Ontology (UFO) [30], Value CoCreation (VCC) [53], and Design and Engineering Methodology for Organizations (DEMO) [8].

ArchiMate's metamodel primarily allows modelling value as a motivation element [27]. The difference between value mapping and value modelling is that mapping helps visualise the value exchanges between stakeholders and organisations

TABLE I. ARCHIMATE VALUE MAPPING AND MODELLING OVERVIEW

Paper	Mapping/Modelled							
	Motivation Element	*Strategy Element*	*Business Element*	*Application Element*	*Technology Element*	*Relationships*	*New Element*	*Meta model extension*
[29]								
[54]	×							
[47]								
[48]						×		
[42]			×					
[52]								
[52]	×							
[11]			×					
[55]								
[35]	×	×	×				×	
[30]	×					×	×	×
[53]	×							×
[19]			×			×		
[49]								
[50]								
[8]								
[26]			×					
[56]				×				
[57]								

[30]. While, modelling which also provides the visualisation, additionally provides a deeper understanding of how value is delivered, and captured within the stakeholders and organisation [52]. Predominantly the value concepts are mapped or modelled in the motivation or the business layer to understand and represent the aligning of value to business strategies and stakeholder requirements [27]. Mapping value in the motivation and business layer is also used to clarify value propositions at the management and process levels. Some attempts are made to represent value through the Relationship connectors [19], principally due to mapping the concepts from the e3value model.

Metamodel in ArchiMate refers to the fundamental structure defining the elements, their properties and their relationships [14]. Only two studies [30] and [53] approached

TABLE II. ARCHIMATE VALUE CONCEPTUALISATION

Paper	ArchiMate Value Concept						
	Goal	*Capability*	*Object*	*Event*	*Experience*	*Causality*	*Context*
[29]			×	×	×		
[54]							
[47]				×			
[48]	×						
[42]							
[52]	×						
[52]	×	×					
[11]	×						
[55]							
[35]		×	×	×	×	×	
[30]				×			×
[53]	×	×	×				×
[19]	×			×			
[49]							
[50]							
[8]							
[26]		×	×				
[56]	×						
[57]	×						

the value modelling at a meta-level. That is, formally defining the elements, properties and the underlying relationship with other architectural elements. Studies [35] and [30] introduced new value elements in their attempts to conceptualise different types of value. ArchiMate's value element with its fundamental structure faces challenges in representing value. Therefore, it is pivotal to establish new value concepts at a meta-level defining its properties and relationships.

B. RQ2: Second Phase

After understanding layers and elements, the value concepts are being mapped or modelled in ArchiMate, it is essential to analyse how value is being conceptualised in ArchiMate. This refers to how existing research defined the properties of the value elements. The first phase looks at where the value has been mapped or modelled, this phase looks into how existing research perceived value in ArchiMate. ArchiMate's native value concept is designed to represent value the relative worth or utility of an outcome or service. We analyse how existing research represents the value apart from considering it a utility or an outcome. This phase also uncovers what are the relationships between value elements to the other architectural elements. Through this, we develop an idea of the value conceptualisation. For example, if the value element is linked to a stakeholder or an organisational element's goal [52], then the value element is conceptualised as a goal. We use the same understanding for other concepts such as capability [52], objects [35], etc.

Through the thematic lenses of [58], we identified seven different types of value conceptions. Primarily, value is conceptualised as an outcome of a Goal [51], [53], reflecting the desired organisational outcomes or objectives. This is because ArchiMate's metamodel inherently allows value to be represented as an outcome of a goal through its modelling constructs [18]. Apart from goal-based, there is Capability conceptualisation, where value is represented as an outcome of an organisation's capacity to perform specific functions or activities [52], [53]. Studies [19], [29], viewed value as an Event representing significant milestones that impact an organisation's value proposition. Attempts were made by [26], [35] to treat value as an object within ArchiMate models, representing tangible or intangible assets that contribute to the individual or an organisation's value proposition. [30] and [53] explores representing the subjective nature of value linking to stakeholder's Experience and differing Contexts. [35] sees value as a result of causal relationships between different elements within the architecture. This includes identifying the cause-and-effect relationships that drive value creation.

C. RQ3: Third Phase

The first two phases give us the foundational concepts of ArchiMate's value capabilities. With a solid understanding of how value concepts are mapped and conceptualised within ArchiMate, Phase 3 specifically focuses on modelling the nature of stakeholder value [41]. Through our previous analysis and studying ArchiMate in general, we conclude that the value is not solely determined by the organisation's goals or objectives but is co-created through interactions with various stakeholders [29], [35]. The stakeholder theory provides the theoretical foundations for understanding value from different perspectives of the stakeholders involved in an enterprise [38]. The theory provides a comprehensive framework for stakeholders' engagement in the collaborative nature of value creation [39]. Therefore, in this phase, we focus on how existing works incorporate the stakeholder theory's value dimensions.

Out of the Stakeholder theory's six proposed value dimensions [40], we can see existing studies attempted to map or model mostly three dimensions. First, the economic extrinsic dimension [40] refers to the tangible benefits a stakeholder perceives through collaboration. This includes financial gains such as profits, capital gains, etc [8], [49].

TABLE III. IDENTIFYING STAKEHOLDER THEORY'S VALUE REPRESENTATION

Paper	Stakeholder Theory Value					
	Economic Extrinsic value	***Intangible Extrinsic Value***	***Psychological Intrinsic Value***	***Operational Learning Value***	***Transcendent Value***	***Externalities Value***
[29]				×		
[54]						
[47]	×					
[48]	×					
[42]	×	×		×		
[52]				×		
[52]		×		×		
[11]						
[55]						
[35]		×	×	×		
[30]	×					
[53]		×		×		×
[19]		×				
[49]	×					
[50]	×					
[8]	×					
[26]				×		
[56]	×					
[57]	×					

Second, the intangible extrinsic value, unlike the economic extrinsic value, refers to the non-monetary benefits the stakeholders receive from collaboration [40]. This includes recognition, brand value, training, etc [19], [42]. Third, the operation learning value is created within a stakeholder through the cooperation of other stakeholders [40]. This value is intrinsic in nature and can contribute to economic value creation. Examples of this value include learning, skills, and capabilities [26], [29]. Apart from these commonly identified patterns, [35] attempted to map the psychological value [40]. This value being intrinsic in nature, relates to the emotional and psychological benefits the stakeholders derive from their relationships with their peers or organisation [40]. Examples include work satisfaction, work fulfilment, etc [35]. [53] modelled the positive value externalities of representing the consequences of an organisation's activities on external stakeholders or the ecosystem [40]. In [53], the study modelled how the ecosystem derives value from the interactions of a partnership (bank and data centre in their example).

VI. DISCUSSIONS AND IMPLICATIONS

Based on the analysis of our findings, we identified many challenges that hinder the effective and efficient modelling of value in the ArchiMate framework. We grouped the identified issues from our review into three main research challenges. Figure 3 summarises the findings of this review. The identified challenges are not pertinent just to the previous research, but also to the larger deficiency of the ArchiMate itself in its ability to model value.

A. Clarity and Precision Challenge

The first two issues focused on the representation and interpretation of value within ArchiMate.

1. Lack of traceability of value element: From our review, we find that studies that attempt to integrate the value concepts from other frameworks face difficulties in tracing their dependencies and the relationship of their value element to other architectural elements [13]. This raises traceability issues in value modelling in ArchiMate. For example, [42] attempted to model the value activity of a digital ticket collection of a circus show. Due to ArchiMate's traceability issues, there lacks an explicit link in representation to how the value transfer mechanism of the ticketing process provides value to the customers.

2. Modelling value at an abstract level: Abstractness means the level at which the value elements in ArchiMate are represented. This identified issue is on the specificity of the ArchiMate's value element properties. This resonated throughout the literature we reviewed [42] [55] [22] [36]. This is an inherent problem within ArchiMate's architecture on value representation [31] [32]. Since the 'value' element which is in the motivational aspect is not properly integrated with the elements in the other layers (strategy, business, etc.) [14]. This issue makes any attempts to model value elements fall short of what it is intended to achieve. We take the same example as the traceability issue to explain this issue. [55] and [42] when attempting to model the value exchange of the ticketing process to different stakeholders, due to the inherent deficiency of the ArchiMate language falls short in its representation. The circus' ticketing business process and the goal of different stakeholders from the process are modelled separately. This representation fails to accurately capture what is the nature of the value exchanged and how the specific ticketing process facilitated the value exchange.

B. Scope of Modelling

These issues focus on the conceptualisation and contextualisation of value within ArchiMate.

3. Lack of focus on the different contexts: Value, as discussed before, revolves around different contexts

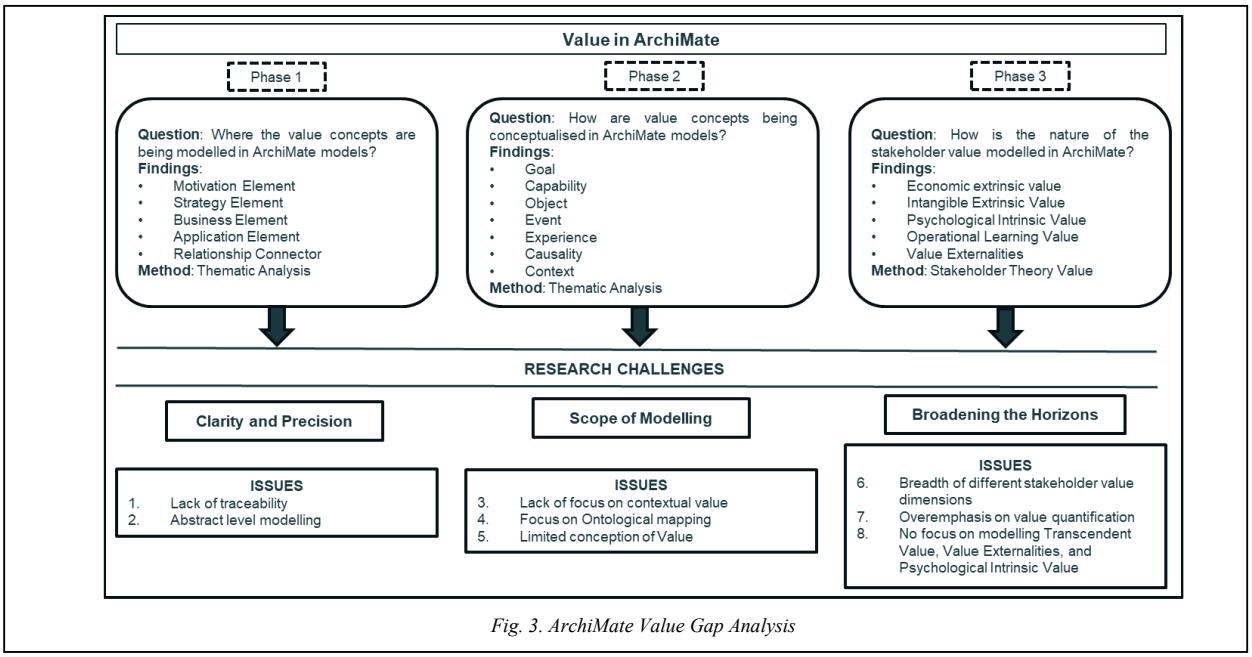

Fig. 3. ArchiMate Value Gap Analysis

and takes diverse forms [3][4]. The majority of the existing works and ArchiMate's architecture in general focus value predominantly on an organisational context [14][48]. This value is achieved through the 'goal' element in ArchiMate [52]. This leads to a unidimensional representation of the value within the context of an organisational goal [19][53]. Architects when attempting to model a scenario of incorporating different contexts such as environmental, social and cultural, face difficulty with their representation. This restricts the scope of the modelling. When modelling complicated market dynamics and different stakeholders' preferences, it is essential to consider different contexts into consideration [53][11]. For example, [53] models a value cocreation scenario for banks and a data centre using ArchiMate. With the traditional ArchiMate architecture, the model falls short in explaining how specific value cocreation process affects the contextual interests of different stakeholders (bank and data centre). This leads to an inaccurate representation of the nature of the value context realised by different stakeholders in an ecosystem [53].

4. Ontological mapping focus: Existing research largely focused on the ontological mapping concepts from different frameworks such as BSC [11], Business model canvas [49], [50], BDN [51], VMP [52], COVER [35], UFO [30], etc, to ArchiMate. However, ontological value mapping provides a static integration of two concepts with the traditional architecture's predefined properties and relationships. Without extending the ArchiMate's metamodel, the exploration of the formalised mapping of concepts results in minimal integration of the value concept within the ArchiMate language. For example, [52] integrates the value concepts from VMP to model an aircraft process using ArchiMate. Value is represented using ArchiMate's predefined relationships and structure. Therefore, with this integration, the model faces difficulties in capturing how value is conceptualised and how value flows affect different architectural elements. This makes the value element not have any relationship with the stakeholders or any entity for that matter [52].

5. Limited value conception: Existing attempts focused primarily on economic and utilitarian aspects [47][48]. This makes it difficult to capture the multifaceted nature of the value in enterprise models [2][3]. [47] attempts to model the ticketing systems of a train company using the concepts from the e3value models. They attempt to represent the value transfers using the structural relationships provided by the ArchiMate. Although the focus of the model was intended to represent a value model, due to ArchiMate's deficiency and not extending value capabilities of ArchiMate's metamodel, [47] managed to model only the monetary aspect, i.e., the payment and ticketing costs and volume in their model. This makes an unintentional neglect of representing how the value transfers enable the social, environmental or ethical impact.

C. *Broadening the Horizons*

The underlying issues are the result of our third review phase. We address issues in this challenge through the theoretical lens of stakeholder theory's constructs. This challenge highlights the need for encompassing diverse value dimensions beyond the traditional value notation in ArchiMate.

6. Breadth of value dimensions: Value encompasses different dimensions and these dimensions vary within changing contexts. For example, the impact of developing a skill (an operational learning value) might have a different perception in an organisational or stakeholder context [53]. Another example is if an organisation attempts to introduce a sustainable business practice, there arises an issue if ArchiMate models can capture the value created from environmental sustainability the same value as in a goal-based economic extrinsic value [7]. To incorporate a comprehensive view of the value dimensions, we integrate the core constructs of the stakeholder theory that provide an answer to the stakeholders' interests, perceived value, power and proximity. This will help to understand the varied dimensions of value in its evolving context.

7. Value quantification: When attempting to model value using ArchiMate, many studies attempt to model the quantifying aspect of value [47][48][50][8]. We argue there is an inherent fault in these attempts. ArchiMate is mainly a static entity representing organisations' structures and flows, with quantified value (value-in-exchange) dynamically fluctuating within a short period of time. Modelling a dynamic aspect with a static entity develops a mismatch in representation. Moreover, the quantified value, such as financial metrics is represented at a very high strategic level without any linkage to the underlying business processes. This makes the existing attempts not utilise the very strength of the ArchiMate, that is, representing systems, people and processes. For example, [47] models the value flow of a train ticketing company, integrating the value concepts of e3value models into ArchiMate. The e3value models predominantly focused on modelling the quantitative value transfer. When attempting to integrate these two concepts, they modelled a dynamic aspect (volume of tickets and payments) in a static ArchiMate model. This is one of the major reasons why modelling value in ArchiMate is restricted to demonstrating an example in the literature rather than widely utilised in practice.

8. No focus on different stakeholder value dimensions: Using the traditional infrastructure of ArchiMate it is difficult to capture the different value dimensions informed by the Stakeholder theory [35][53]. This is a fundamental issue in ArchiMate's metamodel and

can be rectified by redefining the properties and relationships of 'stakeholder' and 'value' elements. The value element with the properties of capturing the relative worth or importance of an organisational goal cannot be used to represent the Transcendent value, which represents the cultural value or symbolic significance of a brand [40].

VII. CONCLUSION AND FUTURE DIRECTION

This paper provides a comprehensive overview of challenges identified from the existing research's attempts to develop a value-centric architecture using ArchiMate. We also discuss the fundamental limitations the ArchiMate language faces in its ability to capture and represent value through its traditional architecture and metamodel. However, ArchiMate provides flexibility in adapting its architecture and extending its metamodel to capture diverse aspects [13]. This is one of ArchiMate's intricate strengths and one of the reasons it is widely used in industry and academia for demonstrating different domains [32][48]. ArchiMate has its evolution with its different versions [57][29]. By not restricting our review to a single version, we could get a complete picture of the language's evolution and different ways value has been attempted to represent.

We found eight major issues through the thematic and theoretical lenses. These issues can be grouped into three broad challenges, this EM language faces in value modelling. We focus solely on ArchiMate's capabilities due to its standardised and flexible aspect along with its widespread usage in both industry and academia, across domains. This leads to inadvertently excluding value approaches in other enterprise modelling languages which we identify as a limitation of this study. Through the identification of these issues, we plan to extend the study by developing an ArchiMate metamodel value extension. With this extension, we aim to develop a robust and effective value model incorporating the constructs of the Stakeholder theory.

We identify two areas of contribution. The findings will be useful to the practitioners who use ArchiMate. Developing value-specific design principles addressing our identified issues can guide practitioners in improving value-centric architectural modelling practices. The findings also contribute to the theoretical discussion of developing a practical orientation of value perception. The stakeholder theory is mostly used in high-level discussions on stakeholder perception and value creation. While studies like [43] created a framework for understanding the stakeholder theory's value creation, there has not been much light shed on the practical usage. The findings also shed light on what issues the theory may face when the constructs of the theory are tested in a practical setting.

VIII. ACKNOWLEDGEMENTS

This research was conducted with the financial support of Science Foundation Ireland at ADAPT, the SFI Research Centre for AI-Driven Digital Content Technology at Maynooth University 13/RC/2106_P2.

IX. REFERENCE

[1] P. Johannesson, The Role of Business Models in Enterprise Modelling. 2007. [Online]. Available: https://people.dsv.su.se/~pajo/papers/ISE07_PaulJohannesson.pdf

[2] A. G. Bruzzone, F. Longo, G. Franzinetti, A. De Paoli, and E. Ferrari, 'Data Value as the basis for Human Behavior Modeling', in International Conference on Harbour, Maritime and Multimodal Logistics Modelling and Simulation, I3M Conference, 2021, pp. 83–89. doi: 10.46354/i3m.2021.hms.011.

[3] L. D. Molm and G. Peterson, 'The Value of Exchange', 2001. [Online]. Available: https://academic.oup.com/sf/article/80/1/159/2234331

[4] A. Eggert, W. Ulaga, P. Frow, and A. Payne, 'Conceptualizing and communicating value in business markets: From value in exchange to value in use', Industrial Marketing Management, vol. 69, pp. 80–90, Feb. 2018, doi: 10.1016/j.indmarman.2018.01.018.

[5] D. Walters, M. Halliday, and S. Glaser, 'Added value, enterprise value and competitive advantage', Management Decision, vol. 40, no. 9, pp. 823–833, Nov. 2002, doi: 10.1108/00251740210441045.

[6] H. N. Dang, V. T. T. Vu, X. T. Ngo, and H. T. V. Hoang, 'Study the Impact of Growth, Firm Size, Capital Structure, and Profitability on Enterprise Value: Evidence of Enterprises in Vietnam', Journal of Corporate Accounting and Finance, vol. 30, no. 1, pp. 144–160, Jan. 2019, doi: 10.1002/jcaf.22371.

[7] X. Hao, Fanglin Chen, and Zhongfei Chen, 'Does green innovation increase enterprise value?', Bus Strategy Environ, 2022, [Online]. Available: https://doi.org/10.1002/bse.2952.

[8] S. de Kinderen, K. Gaaloul, and H. A. Proper, 'Bridging value modelling to ArchiMate via transaction modelling', Softw Syst Model, vol. 13, no. 3, pp. 1043–1057, 2014, doi: 10.1007/s10270-012-0299-z.

[9] M. Kocbek, G. Jošt, M. Heričko, and G. Polančič, 'Business process model and notation: The current state of affairs', Computer Science and Information Systems, vol. 12, no. 2, pp. 509–539, Jul. 2015, doi: 10.2298/CSIS140610006K.

[10] P. Hines and N. Rich, 'The seven value stream mapping tools', International Journal of Operations & Production Management, vol. 17, no. 1, 1997, [Online]. Available: https://doi.org/10.1108/01443579710157989.

[11] Z. Zhou, Q. Zhi, S. Yamamoto, and S. Morisaki, 'A Proposal for Developing EA Models toward Innovation', in Proceedings - 2019 8th International Congress on Advanced Applied Informatics, IIAI-AAI 2019, Institute of Electrical and Electronics Engineers Inc., Jul. 2019, pp. 853–858. doi: 10.1109/IIAI-AAI.2019.00173.

[12] H. H. Olsson and J. Bosch, 'The Five Purposes of Value Modeling', in Proceedings - 46th Euromicro Conference on Software Engineering and Advanced Applications, SEAA 2020, Institute of Electrical and Electronics Engineers Inc., Aug. 2020, pp. 110–119. doi: 10.1109/SEAA51224.2020.00027.

[13] M. M. Lankhorst, H. A. Proper, and H. Jonkers, 'The Anatomy of the ArchiMate Language', 2010. [Online]. Available: DOI: 10.4018/jismd.2010092301.

[14] 'ArchiMate and TOGAF Layers'., n.d., [Online]. Available: https://pubs.opengroup.org/architecture/archimate301-doc/apdxd.html

[15] A. E. A. Sanyoto and M. C. Saputra, 'ArchiMate's Strengths and Weaknesses as EA Modeling Language: A Systematic Mapping Study', in 2023 8th International Conference on Informatics and Computing, ICIC 2023, Institute of Electrical and Electronics Engineers Inc., 2023. doi: 10.1109/ICIC60109.2023.10381985.

[16] Forbes Expert Panel, '20 Hurdles Organizations Face When Implementing A New Business Model', Forbes, 2024.

[17] J. Wray, 'How to create value in an evolving business environment', EY. [Online]. Available: https://www.ey.com/en_gl/insights/strategy/how-to-create-value-in-an-evolving-business-environment

[18] 'ArchiMate 3.1 Generic Metamodel', n.d., [Online]. Available: https://pubs.opengroup.org/architecture/archimate31-doc/chap04.html

[19] A. Aldea, M. E. Iacob, J. Van Hillegersberg, D. Quartel, and H. Franken, 'Modelling value with archimate', in Lecture Notes in Business Information Processing, Springer Verlag, 2015, pp. 375–388. doi: 10.1007/978-3-319-19243-7_35.

[20] Q. Zhi and Z. Zhou, 'Empirically modeling enterprise architecture using archimate', Computer Systems Science and Engineering, vol. 40, no. 1, pp. 357–374, 2022, doi: 10.32604/CSSE.2022.018759.

[21] 'ArchiMate® Library', The Open Group library, 2023 [Online]. Available: https://publications.opengroup.org/archimate-library

[22] M. M. Lankhorst, H. A. Proper, and H. Jonkers, 'The architecture of the ArchiMate language', in Lecture Notes in Business Information Processing, Springer Verlag, 2009, pp. 367–380. doi: 10.1007/978-3-642-01862-6_30.

[23] R. Pérez-Castillo, D. Caivano, F. Ruiz, and M. Piattini, 'ArchiRev—Reverse engineering of information systems toward ArchiMate models. An industrial case study', Journal of Software: Evolution and Process, vol. 33, no. 2, Feb. 2021, doi: 10.1002/smr.2314.

[24] S. Jiang and T. B. Ræder, 'Experience on Using ArchiMate Models for Modelling Blockchain-Enhanced Value Chains', in ACM International Conference Proceeding Series, Association for Computing Machinery, Jun. 2022, pp. 375–382. doi: 10.1145/3530019.3531346.

[25] H. Zhang, Y. Matsubara, and H. Takada, 'A Quantitative Approach for System of Systems' Resilience Analyzing Based on ArchiMate', in Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), Springer Science and Business Media Deutschland GmbH, 2023, pp. 47–60. doi: 10.1007/978-3-031-40953-0_5.

[26] P. M. Singh, H. Jonkers, M. E. Iacob, and M. J. Van Sinderen, 'Modeling value creation with enterprise architecture', in ICEIS 2014 - Proceedings of the 16th International Conference on Enterprise Information Systems, SciTePress, 2014, pp. 343–351. doi: 10.5220/0004883903430351.

[27] 'ArchiMate Motivation Elements', n.d., [Online]. Available: https://pubs.opengroup.org/architecture/archimate31-doc/chap06.html#_Toc10045334

[28] 'ArchiMate - Motivation Extension', n.d., [Online]. Available: https://pubs.opengroup.org/architecture/archimate2-doc/chap10.html

[29] Í. Oliveira, T. P. Sales, J. P. A. Almeida, R. Baratella, M. Fumagalli, and G. Guizzardi, 'Ontology-based security modeling in ArchiMate', Softw Syst Model, 2024, doi: 10.1007/s10270-024-01149-1.

[30] M. U. Albab and A. A. Arman, Resource-Based and Value-Based Extension for ArchiMate. 2018.

[31] Garcia, Ines, André Vasconcelos, and Bruno Fragoso, 'Alignment between Organization Projects and Strategic Objectives.' In ICEIS (2), 2018, pp. 599-606.

[32] A. S. Elsheikh, 'Blockchain Analytics Reference Architecture for FinTech-A Positioning Paper Advancing FinTech with Blockchain, Data Analytics, and Enterprise Architecture', in ACM International Conference Proceeding Series, Association for Computing Machinery, Jun. 2022, pp. 1–7. doi: 10.1145/3531056.3531068.

[33] A. S. Elsheikh, 'A Brief Outlook of Enterprise Architecture Role in the Digital Age', in ACM International Conference Proceeding Series, Association for Computing Machinery, Jun. 2022, pp. 51–58. doi: 10.1145/3531056.3542772.

[34] S. M. M. Joosten and R. Ella. E, 'Constraint formalization for automated assessment of enterprise models', in The 24th International Conference on Enterprise Information Systems, 2022, pp. 430–431.

[35] T. P. Sales, B. Roelens, G. Poels, G. Guizzardi, N. Guarino, and J. Mylopoulos, 'A Pattern Language for Value Modeling in ArchiMate', in Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), Springer Verlag, 2019, pp. 230–245. doi: 10.1007/978-3-030-21290-2_15.

[36] J. S. Harrison and A. C. Wicks, 'Stakeholder Theory, Value, and Firm Performance', Business Ethics Quarterly, vol. 23, no. 1, pp. 97–124, Jan. 2013, doi: 10.5840/beq20132314.

[37] R. E. Freeman, R. Phillips, and R. Sisodia, 'Tensions in Stakeholder Theory', Bus Soc, vol. 59, no. 2, pp. 213–231, Feb. 2020, doi: 10.1177/0007650318773750.

[38] B. L. Parmar R Edward Freeman Jeffrey S Harrison and R. Edward, 'Stakeholder Theory: The State of the Art', 2010. [Online]. Available: https://doi.org/10.5465/19416520.2010.495581

[39] R. K. Mitchell, B. R. Agle, and D. J. Wood, 'Toward a Theory of Stakeholder Identification and Salience: Defining the Principle of Who and What Really Counts', The Academy of Management Review, vol. 22, no. 4, p. 853, Oct. 1997, doi: 10.2307/259247.

[40] A. Argandoña, 'STAKEHOLDER THEORY AND VALUE CREATION', 2011.

[41] R. Mahajan, W. M. Lim, M. Sareen, S. Kumar, and R. Panwar, 'Stakeholder theory', J Bus Res, vol. 166, Nov. 2023, doi: 10.1016/j.jbusres.2023.114104.

[42] W. Engelsman, R. Wieringa, M. Van Sinderen, J. Gordijn, and T. Haaker, 'Transforming e3value models into ArchiMate diagrams', in Proceedings - 2020 IEEE 24th International Enterprise Distributed Object Computing Conference, EDOC 2020, Institute of Electrical and Electronics Engineers Inc., Oct. 2020, pp. 11–20. doi: 10.1109/EDOC49727.2020.00012.

[43] B. Freudenreich, F. Lüdeke-Freund, and S. Schaltegger, 'A Stakeholder Theory Perspective on Business Models: Value Creation for Sustainability', Journal of Business Ethics, vol. 166, no. 1, pp. 3–18, Sep. 2020, doi: 10.1007/s10551-019-04112-z.

[44] B. Kitchenham, O. Pearl Brereton, D. Budgen, M. Turner, J. Bailey, and S. Linkman, 'Systematic literature reviews in software engineering - A systematic literature review', Information and Software Technology, vol. 51, no. 1. pp. 7–15, Jan. 2009. doi: 10.1016/j.infsof.2008.09.009.

[45] B. Kitchenham et al., 'Systematic literature reviews in software engineering-A tertiary study', Information and Software Technology, vol. 52, no. 8. Elsevier B.V., pp. 792–805, 2010. doi: 10.1016/j.infsof.2010.03.006.

[46] Proper, Henderik Alex, Marija Bjekovic, Christophe Feltus, and Iván S. Razo-Zapata, 'On the Development of a Modelling Framework for Value Co-creation.' In VMBO, 2018, pp. 122-132.

[47] W. Engelsman, J. Gordijn, T. Haaker, M. van Sinderen, and R. Wieringa, 'Quantitative Alignment of Enterprise Architectures with the Business Model', in Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), Springer Science and Business Media Deutschland GmbH, 2021, pp. 189–198. doi: 10.1007/978-3-030-89022-3_16.

[48] W. Engelsman, J. Gordijn, T. Haaker, M. van Sinderen, and R. Wieringa, 'Traceability from the Business Value Model to the Enterprise Architecture: A Case Study', in Lecture Notes in Business Information Processing, Springer Science and Business Media Deutschland GmbH, 2021, pp. 212–227. doi: 10.1007/978-3-030-79186-5_14.

[49] J. Granjo, M. Bakhshandeh, J. Pombinho, M. M. Da Silva, and A. Caetano, 'Validating value network business models by ontologies', in BMSD 2014 - Proceedings of the 4th International Symposium on Business Modeling and Software Design, SciTePress, 2014, pp. 142–147. doi: 10.5220/0005425201420147.

[50] M. E. Iacob, L. O. Meertens, H. Jonkers, D. A. C. Quartel, L. J. M. Nieuwenhuis, and M. J. van Sinderen, 'From enterprise architecture to business models and back', Softw Syst Model, vol. 13, no. 3, pp. 1059–1083, 2014, doi: 10.1007/s10270-012-0304-6.

[51] F. Antunes and S. Guerreiro, 'Integrating benefits dependency network in ArchiMate', 2020.

[52] G. Poels, K. Nollet, B. Roelens, H. De Man, and T. Van Donge, 'The Value Management Platform and ArchiMate-Towards an Integration? An Illustrative Example for Value Stream Mapping', 2020. [Online]. Available: http://ceur-ws.org/Vol-2574/paper2.pdf.

[53] C. Feltus, E. H. Proper, and K. Haki, 'Towards a language to support value cocreation: An extension to the ArchiMate modeling framework', in Proceedings of the 2018 Federated Conference on Computer Science and Information Systems, FedCSIS 2018, Institute of Electrical and Electronics Engineers Inc., Oct. 2018, pp. 751–760. doi: 10.15439/2018F27.

[54] N. Tounaka, S. Yamamoto, and B. Shirnen, 'Data Driven Process-Based Unicage Architecture', in Procedia Computer Science, Elsevier B.V., 2023, pp. 609–616. doi: 10.1016/j.procs.2023.10.046.

[55] W. Engelsman, R. J. Wieringa, M. van Sinderen, J. Gordijn, and T. Haaker, 'Realizing traceability from the business model to enterprise architecture', in Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), Springer, 2019, pp. 37–46. doi: 10.1007/978-3-030-34146-6_4.

[56] M. E. Iacob, D. Quartel, and H. Jonkers, 'Capturing business strategy and value in enterprise architecture to support portfolio valuation', in Proceedings of the 2012 IEEE 16th International Enterprise Distributed Object Computing Conference, EDOC 2012, 2012, pp. 11–20. doi: 10.1109/EDOC.2012.12.

[57] S. De Kinderen, K. Gaaloul, and E. Proper, 'Integrating Value Modelling into ArchiMate', IESS 2012. Lecture Notes in Business Information Processing, vol 103, 2012. [Online]. Available: https://doi.org/10.1007/978-3-642-28227-0_10

[58] Webster, Jane, and Richard T. Watson, 'Analyzing the past to prepare for the future: Writing a literature review.', MIS Quarterly, Vol. 26, No. 2, 2002, pp. xiii-xxiii.

X. APPENDIX

TABLE IV. SELECTED PAPERS

No	Title	Year	Source Title	Document Type
1	Personalized Big Data Access: Value for Medical Staff	2024	Smart Innovation, Systems and Technologies	Conference Paper
2	Ontology-based security modeling in ArchiMate	2024	Software and Systems Modeling	Article
3	Strengthening the Resilience and Perseverance of Rural Accommodation Enterprises in the Iberian Depopulated Areas through Enterprise Architecture	2024	Sustainability (Switzerland)	Article
4	Evaluating ArchiMate for Modelling IoT Systems	2024	Lecture Notes in Business Information Processing	Conference Paper
5	Data Driven Process-Based Unicage Architecture	2023	Procedia Computer Science	Conference Paper
6	ArchiMate's Strengths and Weaknesses as EA Modeling Language: A Systematic Mapping Study	2023	2023 8th International Conference on Informatics and Computing, ICIC 2023	Conference Paper
7	A Quantitative Approach for System of Systems' Resilience Analyzing Based on ArchiMate	2023	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)	Conference Paper
8	Experience on Using ArchiMate Models for Modelling Blockchain-Enhanced Value Chains	2022	ACM International Conference Proceeding Series	Conference Paper
9	Blockchain Analytics Reference Architecture for FinTech-A Positioning Paper Advancing FinTech with Blockchain, Data Analytics, and Enterprise Architecture	2022	ACM International Conference Proceeding Series	Conference Paper
10	A Brief Outlook of Enterprise Architecture Role in the Digital Age	2022	ACM International Conference Proceeding Series	Conference Paper
11	Constraint Formalization for Automated Assessment of Enterprise Models	2022	International Conference on Enterprise Information Systems, ICEIS - Proceedings	Conference Paper
12	Empirically modeling enterprise architecture using archimate	2022	Computer Systems Science and Engineering	Article
13	ArchiRev—Reverse engineering of information systems toward ArchiMate models. An industrial case study	2021	Journal of Software: Evolution and Process	Article
14	Value Modeling for Digital Platform	2021	Lecture Notes in Information Systems and Organisation	Conference Paper
15	Quantitative Alignment of Enterprise Architectures with the Business Model	2021	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)	Conference Paper
16	Traceability from the Business Value Model to the Enterprise Architecture: A Case Study	2021	Lecture Notes in Business Information Processing	Conference Paper
17	Transforming e3value models into ArchiMate diagrams	2020	Proceedings - 2020 IEEE 24th International Enterprise Distributed Object Computing Conference, EDOC 2020	Conference Paper
18	Conceptualising Capabilities and Value Co-Creation in a Digital Business Ecosystem (DBE): A Systematic Literature Review	2020	Journal of Information Systems Engineering and Management	Article
19	Integrating benefits dependency network in archimate	2020	CEUR Workshop Proceedings	Conference Paper
20	Value oriented business modeling	2020	IDIMT 2020: Digitalized Economy, Society and Information Management - 28th Interdisciplinary Information Management Talks	Conference Paper
21	The value management platform and archimate – towards an integration? An illustrative example for value stream mapping	2020	CEUR Workshop Proceedings	Conference Paper
22	IMAF: A visual innovation methodology based on archimate framework	2020	International Journal of Enterprise Information Systems	Article
23	A Proposal for Developing EA Models toward Innovation	2019	Proceedings - 2019 8th International Congress on Advanced Applied Informatics, IIAI-AAI 2019	Conference Paper
24	Realizing traceability from the business model to enterprise architecture	2019	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)	Conference Paper
25	A Pattern Language for Value Modeling in ArchiMate	2019	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)	Conference Paper
26	Resource-Based and Value-Based Extension for Archimate	2018	Proceeding - 2018 International Conference on ICT for Smart Society: Innovation Toward Smart Society and Society 5.0, ICISS 2018	Conference Paper
27	Towards a language to support value cocreation: An extension to the ArchiMate modeling framework	2018	Proceedings of the 2018 Federated Conference on Computer Science and Information Systems, FedCSIS 2018	Conference Paper
28	On the development of a modelling framework for value co-creation	2018	CEUR Workshop Proceedings	Conference Paper
29	Enterprise modelling in the age of digital transformation	2018	Lecture Notes in Business Information Processing	Conference Paper
30	Alignment between organization projects and strategic objectives	2018	ICEIS 2018 - Proceedings of the 20th International Conference on Enterprise Information Systems	Conference Paper
31	Towards conceptual meta-modeling of ITIL and COBIT 5	2017	Lecture Notes in Business Information Processing	Conference Paper
32	Enterprise architecture analysis and network thinking: A literature review	2016	Proceedings of the Annual Hawaii International Conference on System Sciences	Conference Paper
33	Modelling value with archimate	2015	Lecture Notes in Business Information Processing	Conference Paper
34	Validating value network business models by ontologies	2014	BMSD 2014 - Proceedings of the 4th International Symposium on Business Modeling and Software Design	Conference Paper
35	From enterprise architecture to business models and back	2014	Software and Systems Modeling	Article
36	Bridging value modelling to ArchiMate via transaction modelling	2014	Software and Systems Modeling	Article
37	Modeling value creation with enterprise architecture	2014	ICEIS 2014 - Proceedings of the 16th International Conference on Enterprise Information Systems	Conference Paper
38	The Value of ITIL in Enterprise Architecture	2013	Proceedings - IEEE International Enterprise Distributed Object Computing Workshop, EDOC	Conference Paper
39	Capturing business strategy and value in enterprise architecture to support portfolio valuation	2012	Proceedings of the 2012 IEEE 16th International Enterprise Distributed Object Computing Conference, EDOC 2012	Conference Paper
40	Integrating value modelling into archimate	2012	Lecture Notes in Business Information Processing	Conference Paper
41	Application and project portfolio valuation using enterprise architecture and business requirements modelling	2012	Enterprise Information Systems	Article
42	IT portfolio valuation: Using enterprise architecture and business requirements modeling	2010	Proceedings - IEEE International Enterprise Distributed Object Computing Workshop, EDOC	Conference Paper