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Towards a Language to Support Value Cocreation: An Extension to the ArchiMate Modeling Framework

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***Abstract*—Value cocreation is gaining momentum as organizations' underlying business logic and encompasses tools and techniques for discovering new valuable and necessary artefacts to support inter-organizational and network-centric business activities. To cocreate value, organizations must talk to each other using a clear and easy to use language. In the course of the ValCoLa (Value Cocreation Language) project, we aim at elaborating such language. To that end, in previous work, we developed a value cocreation metamodel based on three dimensions: the nature of the value, the object concerned by the value and the method to cocreate value. In this paper, we first extend ArchiMate to the domain of value cocreation to provide our metamodel with a dedicated modeling language. Second, we illustrate the language with a case study from the financial sector.**

I. Introduction

Business collaboration is a process that requires a considerable examination of the jointly created value among the parties involved in these exchanges. Value cocreation (VCC) is a notion mostly associated to the paradigm of service-dominant logic (S-DL), rooted in the marketing theories and whose aim is to *jointly create value during business exchanges among two or more partners* [1], [2]. A first example of VCC between a company and its customers is PowerDrive, a Swedish manufacturer of hydraulic drive systems that cocreates value with three of its customers based on the collection and analysis of data from an existing remote monitoring system [3]. Another example is Starbucks that has developed an online community platform to allow its customers, around the globe, to suggest innovative ideas and to allow the most voted ones to be deployed in practices [4]. In those examples, but also in other ones like those reported in [17], VCC is made possible thanks to the interconnections between the involved parties' information systems (IS). Accordingly, depicting value cocreation processes is paramount for IS designers but also to support the communication between IS designers and developers. Therefore, in our previous work, we designed an abstract language (metamodel) to support VCC exchanges [16], [21], [22].

To construct this abstract language, we first observed that the creation of value is an integration of three dimensions [16]: the nature of the value (e.g., financial value, quality, and security [5]-[8]), the object concerned by the value (e.g., a service, a contract, and a database [9]-[11]) and the method used to create the value (e.g., model-based, by design, chunk [12]-[15]). We also observed that, in practice, each of these dimensions is expressed using a specific language and that none of them alone allows expressing all dimensions at once. This lack of shared language is a problem when IS designers want to communicate together, especially when there is a shift from a local creation of value to a cocreation of value in a network of organizations. Indeed, in this context, communication among the IS designers from each of the involved organizations is essential. Due to the different languages that may be used by the different organizations engaged in value cocreation, however, communication can become extremely complex.

To address this problem, our approach consisted in building a value creation metamodel that simultaneously captures and abstracts all the dimensions of value cocreation. By abstracting the value propositions (originating from each organizations of the network), our goal was *to support the IS designers* from those organizations to communicate with each other using a shared language, expressed by means of common elements, having the same semantic (definitions of the concepts), the same structure (associations between concepts) and the same syntax (modelling language). Practically, and as demonstrated in [16], while being instantiable with specific languages, the VCC metamodel is suited to play the role of binding element between the modelling languages (i.e., the language has been designed at an abstraction layer appropriated to be instantiated to various types of value, like the security or the quality).

In this paper, we have exploited an enterprise architecture (EA) model to express VCC using only one language. EA consists in approaches which enable illustrating the interrelations between a company's different layers and between its different aspects such as behavior, information, or people. EA metamodels provide views that are understandable by all the stakeholders and that allow making decisions and trace the impact of such decisions. Although the concept of value exists in some EA metamodels, this concept (and its relationship with other concepts), is not appropriate to express value cocreation. As a result, we acknowledge that existing EA metamodels are not dedicated to accurately model value cocreation. However, we consider that the EA metamodels

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provide a good basis for modelling VCC since they model the most significant concepts of a company's information systems. To reap the benefits of the enterprise architecture metamodel for value cocreation engineering and management, we have opted for focusing our research on integrating the value cocreation metamodel with the ArchiMate EA metamodel. We have decided to focus on ArchiMate because it does not address VCC at all yet and because it is an open standard published by The Open Group[1].

All along the paper, the usage of the ArchiMate extension to the value cocreation is illustrated with a case study related to knowledge-intensive business services in the financial sector [21]. This case study concerns the cocreation of value between a bank and a datacenter. The context is that because both organizations have been collaborating for a long time, the datacenter has good knowledge of the bank's information system. For that reason, the bank has decided to outsource the improvement of the privacy of the customers' data to the datacenter. Both have hence started to cooperate in designing the privacy improvement service of the customers and therefore the bank has agreed to give information about its information system (architecture, functions, etc.) to the datacenter. In turn, the datacenter enhances its offer of services and thereby stabilizes its own business. The enhancement is possible as a result of the bank's feedback.

In the following, we first present the state of the art in VCC as well as our previous work in VCC modeling in Section II. Then, we introduce ArchiMate, its language and its extension mechanisms in Section IIIa, b, and c, and we extend it for expressing value cocreation in Section III.d. The financial case study is presented in Section IV and consists in expressing VCC metamodel through ArchiMate extension. Finally, Section V discusses the results and proposes future works and Section VI concludes the paper.

II. STATE OF THE ART AND PREVIOUS WORKS

This section presents the state of the art related to VCC modeling using concrete syntax and more especially using the ArchiMate metamodel.

A. Litterature review

Value cocreation is a very old topic that has been incorporated by Vargo and Lusch in the notion of service-dominant logic [1, 2]. According to the authors, a service is the basis of all exchanges and focuses on the process of value creation rather than on the creation of tangible outputs. Against this backdrop, Vargo and Lusch further elaborate on the idea that value is derived and determined in use rather than in exchange, meaning that value is proposed by a service provider and is determined by a service beneficiary. Hence, the firm is in charge of the value-creation process and the customer is invited to join in as a co-creator [2].

For Grönroos [47], this interaction is defined through situations in which the customer and the provider are involved in each other's practices. Consequently, the context (social, physical, temporal, and/or spatial) determines the value-in-use experience of the user in terms of his individual or social environment [48].

Recently, Chew [49] has argued that, in the digital world, service innovation is focused on customer value creation. Chew proposes an integrated Service Innovation Method (iSIM) that allows analyzing the interrelationships between the design process elements, including the service system. The latter being defined as an IT/operations-led, cross-disciplinary endeavor. In IS literature, Blaschke et al. [50] propose a business-model-based management method encouraging cocreation interactions by reconciling value propositions, customer relationships, and interaction channels.

Gordijn et al. [51] explain that business modeling is not about process but about value exchange between different actors. Gordijn et al. propose e3value to design models that sustain the communication between business and IT groups, particularly in the context of the development of e-business systems. In [52], Weigand extends the e3value language to consider cocreation. He defines so-called value encounters, which consist in spaces where groups of actors interact to derive value from the groups' resources. In a similar way, Razo-Zapata et al. propose visual constructs to describe the VCC process [53]. These constructs are built on requirements from the service-dominant logic and software engineering communities.

B. The VCC metamodel

In this section, the metamodel of value creation in the field of IT-related business services is defined according to three dimensions: the nature of the value, the method of value creation, and the object concerned by the value.

Provided that this research is anchored in Design Science Research [19-20], its development has followed an iterative cycle. Only the last version of it is presented in this section. The first version was presented in the conference FedCSIS 2017 [16], the second version in LNBiP [21], and the last version in AINA 2018 [22]. This metamodel is elaborated based on the analysis of value related frameworks [5]-[8], of scientific literature [1], [2], [47], [51], [52] and on a performance evaluation methodology for decision support in industrial project proposed in [23]. The aim of this methodology is to propose a benefit-cost-value-risk based approach to help decision makers in evaluating performance at any stage of an industrial project.

In the next sub-sections, each dimension of the value is successively analyzed and presented. Moreover, concepts of our VCC metamodel are illustrated using the first part of the case study.

[1] http://www.opengroup.org/subjectareas/enterprise/archimate

1) Dimension 1: Nature of the value

To understand and model the nature of the value, first we have reviewed a set of frameworks addressing the different value natures in the field of IT, including security, quality, compliance, privacy, responsibility, and others. Based on this review, we have extracted the most meaningful concepts necessary to express this nature. For example, we have analyzed the information systems security risks management (ISSRM [24]) framework, which addresses the IS security (*Nature of the value*). This framework characterizes security through integrity, confidentiality, availability, non-repudiation, and accountability (i.e., *Value component* concept of the VCC metamodel). And the security concerns business assets of the company (*Objects* concept of the metamodel). Finally, based on a further review of the literature, our own definitions of the constitutive concepts of the dimension have been provided and the concept has been integrated in the nature of value metamodel (Fig. 1).

Basically, most of the analyzed reference frameworks focus on depicting the semantic of value following a given perspective being function of the beneficiary of the value. In practice, due to the quantity of heterogeneous value natures [32], clearly defining the semantic of this nature is laborious. However, we observe that, in the same transaction, two main perspectives of value nature emerge depending on the context: value at the provider's side vs. value at the customer's side. At the provider's side, the basic rationale for all organizations entering into dyadic exchange relationships is the value capture [33] from a service exchange. This can be in the form of value-in-exchange (e.g., money given by the client), or in the form of value-in-context. In that regard, it is worth noting that considering the provider in the context of the digital society expands this narrow meaning to the consideration of other value elements. An example of them are the information collected on the customers (e.g., analyzing customer data to support the creation of new offerings) which, afterwards, contributes to economic increase [34]. On the customer's side, value generated by a transaction never refers to money but consists in other wealth, which contributes in sustaining and supporting the customer's own business.

According to [23], value is described as the degree of satisfaction of a set of stakeholder expectations or needs, expressed by the level of appreciation associated to a number of performance indicators. Li [35] explains that value can be described by the relative worth, utility, or importance of something. Value increases when the customer's degree of satisfaction increases. The concept of value becomes different depending on the point of view (stakeholder). Accordingly, the *expected value* is the value that the stakeholder would like to get and the *perceived value* is the real value that a stakeholder can finally get. The degree of satisfaction is identified through the comparison of these two elements. According to Zeithaml, value implies some form of *assessment of benefits against sacrifices* [36].

In our analyzed case, at the bank's side, the privacy of the customers' data is a legal requirement that has to be fulfilled by each entity processing private information. Having this data privacy generates the benefit of being compliant with regulations, but it is also expensive because the bank needs to deploy an appropriate mechanism such as performing privacy impact assessment. At the datacenter's side, offering 24/7 data availability to the bank is a benefit to distinguish the datacenter from its competitors, but this offering is also costly because it requires a very robust infrastructure.

According to this review, the concepts that are relevant to the metamodel for the nature of the value are:

- **Value.** This concept is defined as a degree of worth of something [23, 35] and that improves the well-being of the beneficiary after it is delivered.
- **Nature of the value.** The nature of the value **defines** the value to be delivered. Table 1 shows that the nature of the value expresses a domain of interest related to which the value will be delivered (e.g., security of the IS, the cost of a transaction, or the privacy of personal data). In the case of the datacenter that archives the data of the bank customers, the nature of the value generated by the datacenter is the *availability* of the customer's data.
- **Value component**. This concept expresses the different elements that constitute the value (e.g., availability, confidentiality, portability, etc.). Hence, the value **aggregates** value components and these components may also, as a result, themselves be other **types of** value. Regarding the case study, one component of the availability is the *accessibility in real time*.
- **Object.** The object concerned by the value is the element from the information system that has significance and is necessary for a company to achieve its goal (e.g., software, process, data). From a modeling point of view, the value is associated to an object with a relation of type **concerns** or an objective to be achieved. In the case study, the object concerned by the value is the *customers' data.*
- **Measure.** The measure corresponds to a property on which calculations can be made for determining the amount of value expected from a value cocreation method. Measure can result from different factors impacting value. As stated by [23, 35], the value components are measured by means of estimation methods. Accordingly, there exist an association named **appraises** from the concept of measure to the concept of value, an association named **is function of** between the concept of measure and the type of value, and between the concept of measure and the object concerned by the value. The first expresses that the measure is characterized by the nature of the value and the second posits that the measure also depends on the object concerned by the value. According to [35], measure may integrate qualitative and quantitative elementary performance expressions.

Based on the above definitions, the nature of the value is modeled in Fig. 1.

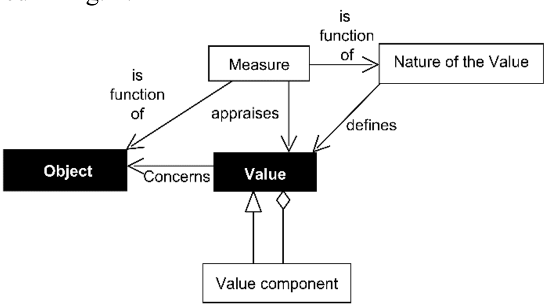


Fig. 1. Nature of the value metamodel

2) Dimension 2: Method of value creation

A method of value creation corresponds to a set of activities that contribute to the generation of value. Similar to the nature of the value, to depict the elements relevant for the creation of value, a set of IT-related frameworks on value creation methods have been reviewed. The analyzed methods include method by design [12], model driven [15], impact assessment [17], method chunk [14], risk-based [37], and process-based [38] approaches.

Traditionally, value is created through the exchange and use of goods and services [1]. Methods for value creation are the body of techniques and activities that use and generate resources [39]. These correspond, at the corporate level, to a bundle of approaches including the design of strategies, the integration of models, and the evaluation of results. By looking more closely at the analyzed methods, it has been observed that each has a dedicated goal, that they are composed of method elements, and that method elements are organized in a sequence of ordinated steps. For instance, by investigating the model-driven approach to interoperability, one can notice that it has for goal to improve interoperability of enterprises' information systems that it is composed of models, and that three steps are required for model-driven interoperability: model design, model integration, and model instantiation. Amongst the other methods reviewed, it is also interesting to highlight that one (method chunk) has for particular objective the creation of methods themselves, using, as chunk of existing methods as method elements, and as method steps the decomposition of existing methods into method chunks and the definition of new method chunks from scratch [14].

As a summary and according to this analysis, the concepts that construct the method of value creation are:

- **Method**. The method is a specific **type of** object that defines the means used by the stakeholder to **create** objects and value. A method is **composed** of a set of activities necessary to achieve a dedicated goal. In the same vein, Sein et al. [40] explain that the elementary quantitative value expressions (the value components) are aggregated by means of selected aggregation methods and quantitative weights to generate the overall value. An example of method used to create security of the IS consists for instance in performing a security risk assessment [24].
- **Activity**. The activity is an element of the method that corresponds to a unitary task (e.g., analysis, data collection, or report). The activities **compose** the method and are organized and coherently articulated with each other (e.g., if-then-else, process elements ordination, etc.). This relation is modeled using an iterative association of a type: activity **follows** activity. The articulation of activities corresponds to the aggregation from [16]. One particular type of activity consists in **generating** resources. For instance: *acquiring a backup tool, maintain the backup tool, etc.*
- **Stakeholder.** A stakeholder is a human, a machine or an organization that is involved in the creation of value at three levels. First, it **performs** the method that generates value (e.g., the risk manager performs a risk analysis); second, it **generates** resources used by the method; and third it **expresses** the value expected after the execution of the method. For example, the *datacenter* is the stakeholder that exploits the redundancy system and the *bank* expresses that it expects availability of the data.
- **Resource.** This element is **a type of** object from the IS that is generated by a stakeholder and that **is used by** an activity composing the value creation method. Resources are typically information and data (e.g., passenger location), but could also consist in computing resources, funding, manpower, etc. For instance, the *backup software* is the resource used by the exploitation of a redundancy system.

Based on the above definitions, the value creation method is modeled in Fig. 2.

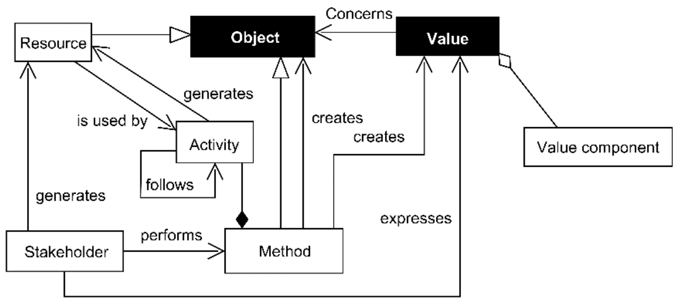


Fig. 2. Value creation method metamodel

3) Dimension 3: Object concerned by the value

The object concerned by the value corresponds to elements (e.g., information, process, tool, or actor) being part of an enterprise. These elements exist in a specific environment represented by the context. This context has an influence on the type and the amount of value associated with this object, for instance, a *customer's browsing history* is an object of a data type that has a particular pecuniary value for an airline travel agency that can estimate the value ascribed to a flight ticket for a customer. This value is calculated based on the number of times this flight ticket is viewed on the company's website by the customer. At the opposite, this *customer's browsing history* is not an object of value on a drugstore website with fixed prices. Complementarily, it is also worth noting that the context has no impact on the nature of the value. For example, privacy in healthcare is defined in the same way with the same characteristics as in industry.

To collect and deal with the concepts that are necessary to model the object of value, it has been assumed that each sector such as manufacturing, finances, or healthcare, is associated with a specific information system. Each enterprise specific architecture models the objects composing this enterprise as well as the relationships between these objects, using a dedicated language.

Sector-specific information systems and enterprise architecture (EA) models and languages are good approaches here because they semantically define generic objects and sometimes concrete languages to express these objects. Numerous frameworks have been designed to model IS and EA of various sectors, e.g., Cimosa [41], ArchiMate® [42], DoDAF [43], and many others.Regarding the financial case study, the data of the bank's customers is the object concerned by the required privacy (generated by the bank) and concerned by the required availability (generated by the datacenter).

As a summary and according to this analysis, the concepts defining the context and the object concerned by the value are:

- **Information system**. The information system encompasses, and **is composed by,** the objects concerned by the value and the stakeholders that benefit from the value created.
- **Context**. The context represents the surrounding of the IS. It includes (1) the constraints on the system in which the value is created and (2) the definition of the borders of this system (e.g., the sector and the sector purpose of the business entity that is concerned by the IS, the rules and regulations related to the sector or the IS, the institutional arrangements, etc.). Accordingly, the context is associated to the information system with an association named characterizes. As stated in [23], the context also allows selecting the performance components […] necessary to define the scope of the performance evaluation problem. Hence, this selection defines a particular context, or viewpoint, for the evaluation of the value. To model this, the concept of context is associated to the measure with a relation named influence. Regarding the case study in the financial sector, the context is the financial regulation.

Based on the above definitions, the object concerned by the value is modeled in Fig. 3.

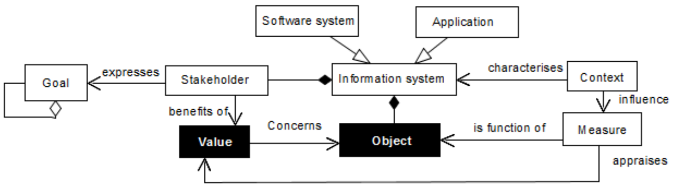


Fig. 3. Object concerned by the value metamodel

III. ARCHIMATE EXTENSION

In this section, we extend ArchiMate language to the VCC domain. Therefore, first we introduce ArchiMate's metamodel, language and extension mechanisms, and finally present the extended ArchiMate to VCC.

A. Introduction to ArchiMate

ArchiMate is a modeling language built on a thorough metamodel for enterprise architecture. It is used by IT architects to design static business and IT views and their links in enterprise architecture endeavors [42]. ArchiMate allows reducing the complexity and proposes means to model and thus better understand the enterprise, and the interconnections and interdependency between the processes, the people, the information, and the systems. Consequently, one objective of ArchiMate is to provide pictures of each enterprise architecture aspects such as the organisational structure, the business processes, the information processing system or the infrastructure. It permits to ensure uniform semantics of the instantiated models but it is not really appropriate to enable quantitative analysis.

One of the underlying assumptions of ArchiMate is to support enterprise architecture for the creation of business value. Relying on ArchiMate's metamodel, each business value is generated by business processes that are supported by applications and infrastructures.

ArchiMate's core is structured in three horizontal layers: the business layer, the application layer and the technology layer. All three layers are built with the same type of concepts and associations. They are structured according to three aspects (vertical layers). The first aspect concerns the active structure elements, which are defined as *entities that are capable of performing behaviour,* e.g., a role or an actor. The second aspect concerns the behavioural elements, which are defined as *units of activity performed by one or more active structure elements*, e.g., a process or a function. The last aspect addresses passive structure elements, which are defined as *objects on which behaviour is performed*, e.g., a contract or an object. ArchiMate metamodel is presented in Figure 4.

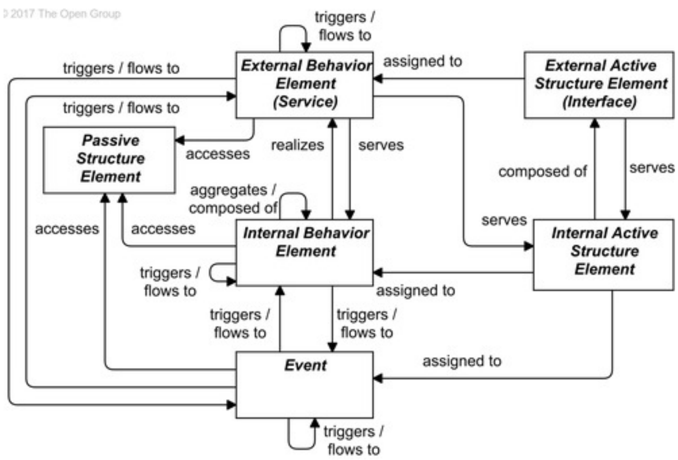
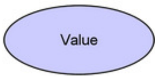
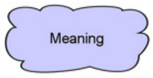
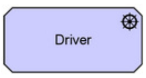


Fig. 4. ArchiMate metamodel (extracted from [10])

B. *ArchiMate language*

ArchiMate uses a syntax based on symbols and colors, related to the vertical and horizontal layers. Table I provides a sample of ArchiMate elements, definitions and symbols that we later use in the mapping and integration of both metamodels (i.e., ArchiMate's and our previously outlined metamodels).

TABLE I. SAMPLE OF ARCHIMATE SYMBOLS

ArchiMate 3.0 metamodel	Definition	ArchiMate 3.0 metamodel element symbol
Value	Value represents the relative worth, utility, or importance of a core element or an outcome.	
Meaning	The knowledge or expertise present in, or the interpretation given to, a core element in a particular context	
Assessment	An assessment represents the result of an analysis of the state of affairs of the enterprise with respect to some driver.	
Business function	A business function is a collection of business behavior based on a chosen set of criteria (typically required business resources and/or competencies), closely aligned to an organization, but not necessarily explicitly governed by the organization	
Business process	A business process represents a sequence of business behaviors that achieves a specific outcome such as a defined set of products or business services	
Business actor	A business actor is a business entity that is capable of performing behavior	
Resource	A resource represents an asset owned or controlled by an individual or organization	
Capability	A capability represents an ability that an active structure element, such as an organization, person, or system, possesses	
Driver	An external or internal condition that motivates an organization to define its goals and implement the changes necessary to achieve them	

C. *ArchiMate extension mechanismes*

ArchiMate extension is achieved by integrating its metamodel with the metamodel of the domain that extends it. According to [44], the integration of two metamodels requires resolving three types of heterogeneities: syntactic, semantic and structural. For our integration, only the semantic and the structural heterogeneities have been addressed. In effect, the syntactic heterogeneity aims at analyzing the difference between the serializations of the metamodel. As explained by [45], it addresses technical heterogeneity such as hardware platforms and operating systems, or access methods, or it addresses the interface heterogeneity such as the one which exists if different components are accessible through different access languages. The structural heterogeneity exists when the same metamodel concepts are modelled differently by each metamodel primitives. This structural heterogeneity has been addressed together with the analysis of the conceptual mapping and the definition of the integration rules. Finally, the semantic heterogeneity represents differences in the meaning of the considered metamodel' elements and must be addressed through elements mapping and integration rules. Regarding the mappings, three situations are possible: no mapping, a mapping of a type 1:1, and a mapping of a type n:m (n concepts from one metamodel are mapped with m concepts from the other).

After defining the mapping, the concepts can be integrated in a single metamodel using both ArchiMate' extensions mechanisms: the addition of attribute as well as the specialization [46]. Concretely, if no mappings are detected, the concept from extension domain is added in the ArchiMate using the first extension mechanism, which consists of adding an attribute to an existing concept. If a 1:1 mapping exists without conflict between two concepts, both concepts are merged in a unique one. The resultant concept is added into the integrated metamodel, and this concept keeps the name of the ArchiMate concept. If a mapping of type 1:1 with conflict exists between two concepts, this means that one concept from one metamodel is richer or poorer than a concept from the other metamodel and in this case, both concepts are added in the integrated metamodel using the second extension mechanism of ArchiMate i.e., the stereotype (specialization) (e.g.: [56]).

D. *ArchiMate extension to VCC*

In this section, the ArchiMate extension mechanisms have been applied to the field of VCC. Table II explains the mapping between elements from the VCC and from the ArchiMate metamodels. Nine VCC elements (as outlined in section B) are mapped with ArchiMate elements (as outlined in section C) and only one VCC element (i.e., the **value component**) has no corresponding ArchiMate element. In effect, although the **value component** from the VCC metamodel could have been mapped to the **value** from the ArchiMate metamodel, we have preferred to keep the semantic difference amongst the **elements of value** and the **value component** from the VCC metamodel in the ArchiMate metamodel. Accordingly, the integration rule that we have exploited to integrate the **value components** with the ArchiMate metamodel is the addition of attribute, and as a result, we have considered that the **value component** is an attribute of the **value**.

Another integration rule that we have used is the merge, i.e., the concept of **value** from the VCC metamodel has been merge with the concept of **value** from the ArchiMate metamodel. This is due the fact that both concepts are defined somewhat equivalently, respectively: *as the degree of worth that concerns something* [which] *improves the well-being of the beneficiary after it is delivered* (VCC metamodel) and as *the relative worth, utility, or importance of a core element or an outcome* (ArchiMate metamodel).

TABLE II. VCC-ARCHIMATE EXTENSION MAPPING

VCC elements	ArchiMate elements	Map-ping	Integration rule	Integrated element
Value	Value	1-1	Merge	Value
Nature of the value	Meaning	1-1	Specialization	<<Nature of the value>>
Value component	-	-	Addition of attribute	<<Value>>, Value component: description
Object	Business, Application and Technology layers	1-n	Generalization	Business, Application and Technology layers
Measure	Assessment	1-1	Specialization	<<Measure>>
Activity	Business function	1-1	Specialization	<<Activity>>
Method	Business Process	1-1	Specialization	<<Method>>
Stakeholder	Business actor	1-1	Specialization	<<Stakeholder>>
Resource	Resource and Capability	1-2	Generalization	Resource
Information system	Business, Application and Technology layers	1-n	Generalization	Information system
Context	Driver	1-n	Generalization	Context

We considered four concepts of the VCC metamodel as specialization of concepts from ArchiMate: **nature of the value**, **measure**, **method**, and **stakeholder** in VCC are respectively specialization of **meaning**, **assessment**, **business function** and **business actor** in ArchiMate. For instance, the method is defined as *a property on which calculations can be made for determining the amount of value expected from a value creation method* in VCC metamodel and by *the result of an analysis of the state of affairs of the enterprise with respect to some driver* in ArchiMate metamodel. The second definition is hence more general than the first.

Finally, we considered four concepts of the VCC metamodel as generalization of concepts from ArchiMate: **Object**, **Resource**, **Information system** and **context** in VCC are respectively generalization of elements from the **Business, Application and Technology layers**, **Resource and Capability**, **Business, Application and Technology layers**, and **Motivation** in ArchiMate.

According to the ArchiMate semantic, the VCC concepts may be expressed using the corresponding symbols, as illustrated in Table II

IV. CASE STUDY

The case study presented in the introduction section is illustrated using UML at Figure 5. This figure demonstrates that without an appropriate visual language, the UML model are hardly exploitable by business people having to design new business activity and to co-create new value.

At Figure 6, which model the same case, we illustrate that using the ArchiMate extension provides a much more understandable presentation of our case in terms of clarity and readability.

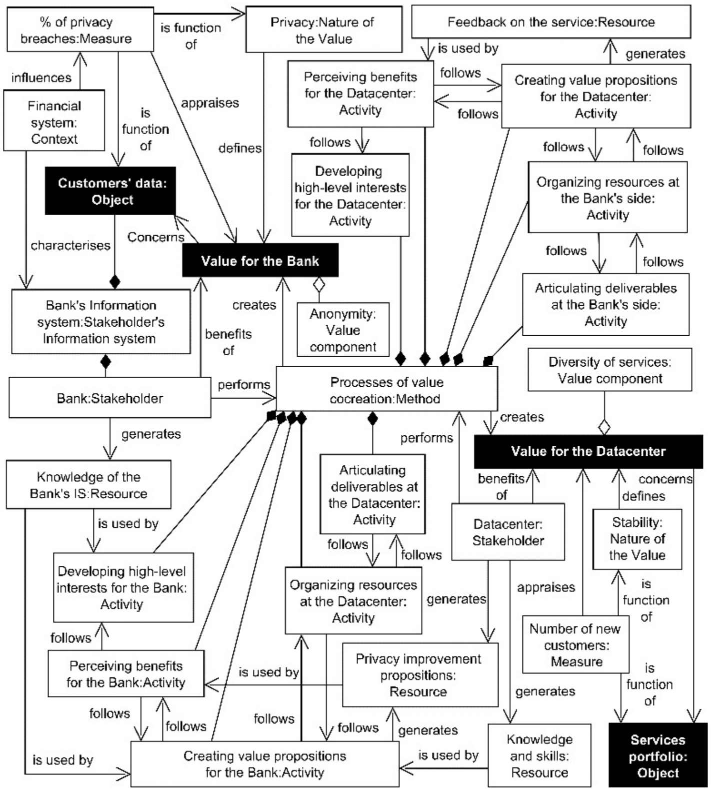


Fig. 5. Value creation perspectives

The advantages are the following:

1. The elements expressed in the model are classified using a code of colors, i.e., **business concepts** are in yellow, **resources** are in orange, **value** related concepts are in purple. These are mainly specialization from the **motivation extension** of ArchiMate, which means that the cocreation of value is something that may be perceived in addition to the **information system** and that motivates the design of elements of this IS.
2. Elements on the figure may also more easily be geometrically organized, e.g. **activity of value cocreation** is on the right-side and **value related elements** are on the left side.
3. Concept reading is facilitate using the shape of the symbols. For instance, **value elements** are rapidly detectable on the model because they are in oval. The **nature of this value** is also easily differentiated because it is presented as clouds.
4. The last advantage is that using ArchiMate also allows us to take advantage of the relationships between concepts semantic. For instance, a task that accesses a resource is illustrated using a dotted line, the association between the activity or the actor that generates the resource is illustrated in dash line, and the generic association is illustrated using a plain line. To improve the semantic of the association, we have specialized it, e.g., the association between the context and the information system has been specialized so that the context <<**characterize**>> the information system.

V. Discussions and Future Works

A. ArchiMate extension

Although ArchiMate extension has already been achieved in many areas such as security [55] and risk management [55], our study conducts such extension in the new field of value cocreation. Concretely, such extension effort resulted in the improved readability of the cocreation instances of the value cocreation metamodel and that all ambiguities have been removed regarding the conceptual semantic.

On the other hand, the most challenging issue is that ArchiMate must be adopted as a common language beforehand, and that all organizations involved in the cocreation have to understand the meaning of the symbol and the language structure, but also that they agree to invest in the usage of the framework.

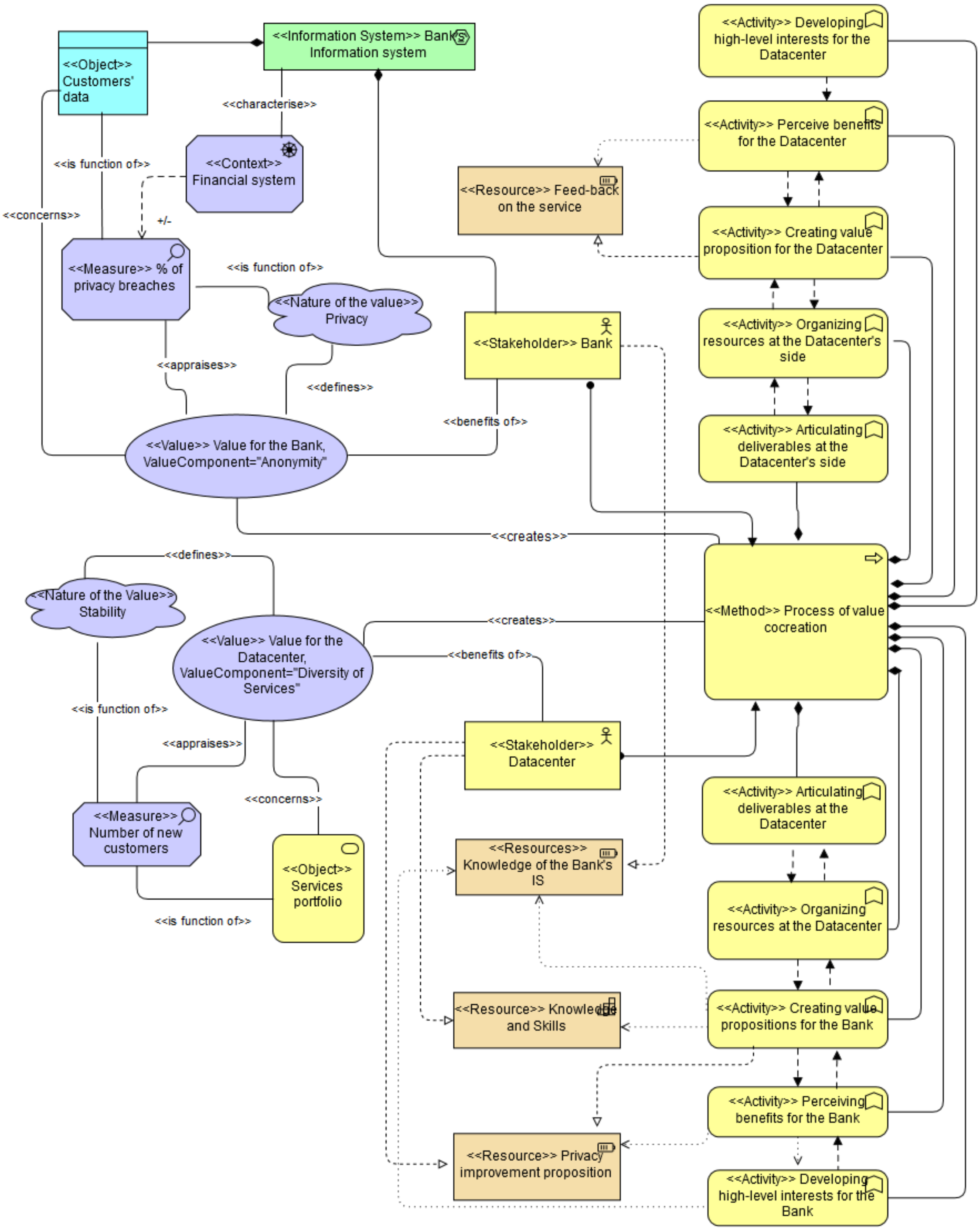


Fig. 6. Value cocreation expressed with ArchiMate

B. Value perspectives

ArchiMate has been extended for the field of value cocreation. However, more perspective may be addressed in that VCC domain, such as those illustrated in figure 7:

- The creation of value. This is the most basic but important one. It addresses the method used to valuate an object of the IS, e.g., a privacy impact assessment method that improves the privacy of a database, or a process based method that contributes to the repeatability of the incident management activity of a company. Accordingly, in this first perspective the creation of value is generally expressed based on the three following dimensions: the nature of the value, the object concerned by this value, and the method that creates the value. Preliminary work related to the modeling of the value with ArchiMate were achieved in [54].
- **The method of value creation**. The second perspective considers that the creation of value is a value per se for the company. Hence, the method of value creation may be view as a type of value creation. Example of contribution in this perspective is the method chunk [14] which consists in a type of method of value creation, which in turn, contributes to making an object of the company better off.
- **The value cocreation.** As explained in this paper, the creation of value results sometime to a collaboration between a provider and a client. For instance, a consultant that improves the security of its client's information system collaborates with the client to access the IS architecture, to analyze the value of the business assets to be protected, and to understand the threats. Hence, when a customer collaborates with a provider to generate value, we are in the perspective of value cocreation.
- **The method of value cocreation.** Similar to value creation, the value cocreation may also be perceived as a type of value being cocreated by more than one actor. For instance, a provider and a customer who collaborate for a long time and who analyze, together, how they could cogenerate new value for each other's businesses (like in the case of PowerDrive [3]). Example of processes to support this cocreation mechanism are proposed in [18].

In frames 1 and 3, the (co)created value concerns the creation of value of a concrete nature (e.g. security, privacy, quality,…) and therefore corresponds to a type of value that already has a benefit for company. The value created in both frames 1 and 3 also concerns a concrete object of the IS or of the company. We thus advocate that the value created in both frames corresponds to value-in-use [28].

In frames 2 and 4, we postulate that the created value is the method of value(co)creation itself. This method of value (co)creation is necessary before (co)creating concrete value. In frames 1 and 3 this method is transformed in value-in-use when it is used to (co)create value of a concrete nature. In the frame 4, the value proposition (defined by one actor) is proposed to another actor, which accepts it or not. If accepted, this proposition of value cocreation is transformed in value-in-use when the concrete value is realized through a collaboration among the actors involved.

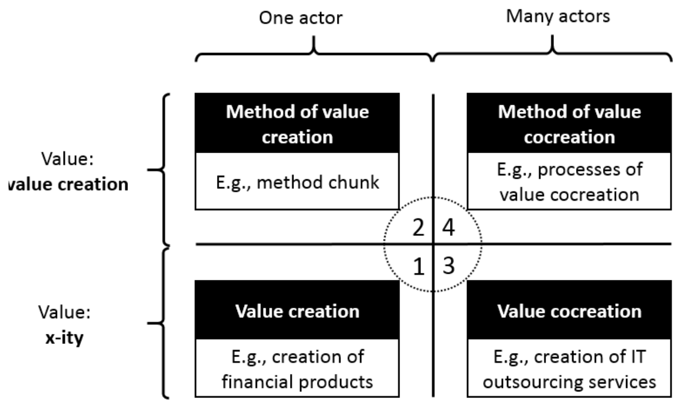


Fig. 7. Value creation perspectives

Provided the similarities among the four perspectives, we claim that perspectives 2, 3 and 4 are specializations of perspective 1. Accordingly, we claim that designing one language for many value creation perspectives is redundant and that our language designed to express the cocreation of value could be specialized to express all perspectives. Therefore, we plan for specializing the ArchiMate extension for the VCC to the four perspectives and validate the expressiveness of these specialization in our future works.

VI. Conclusion

This paper has defined a concrete value cocreation language based on the VCC metamodel previously presented in [16, 21, 22]. To define this language, we have extended ArchiMate using its extension mechanism, to know: the specialization and the addition of attributes as explained in [46]. Finally, we have demonstrated the usability of the language with a case in the financial domain.

References

[1] S. L. Vargo, R. F. Lusch, "Service-dominant logic: continuing the evolution," Journal of the Academy of marketing Science, vol. 36, no. 1, pp. 1-10, Mar. 2008.

[2] S .L. Vargo, R. F. Lusch, "Evolving to a new dominant logic for marketing," Journal of marketing, vol. 68, no. 1, pp. 1-17, Jan. 2004.

[3] Westergren, U. H.: Opening up innovation: the impact of contextual factors on the co-creation of IT-enabled value adding services within the manufacturing industry. Information Systems and e-business Management, 9(2), 223–245 (2011)

[4] B. Leavy, "Collaborative innovation as the new imperative–design thinking, value co-creation and the power of "pull"." *Strategy & Leadership* 40, no. 2 (2012): 25-34.

[5] C. Calero, J. Ruiz, and M. Piattini, "Classifying web metrics using the web quality model," Online Inf. Review, vol. 29 (3), pp. 227-248, 2005.

[6] C. Feltus, E. Grandry, T. Kupper, and J. N. Colin, Model-Driven Approach for Privacy Management in Business Ecosystem, in 5th International Conference on Model-Driven Engineering and Software Development, 2017.

[7] R. M. Foorthuis, F. Hofman, S. Brinkkemper, and R. Bos, "Assessing business and IT projects on compliance with enterprise architecture," in Procs. of GRCIS, 2009.

[8] A. Dix, "Human-computer interaction: A stable discipline, a nascent science, and the growth of the long tail," Interacting with Computer, vol. 22, no. 1, Jan. 2010. 13-27.

[9] A. Josey, M. Lankhorst, I. Band, H. Jonkers, and D. Quartel, "An Introduction to the ArchiMate® 3.0 Specification," White Paper from The Open Group, Jun. 2016.

[10] G. Berio and F. Vernadat, "Enterprise modelling with CIMOSA: functional and organizational aspects," Production planning & control, vol. 12, no. 2, pp. 128-136, Jan 2001.

[11] A. W. Scheer, and M. Nüttgens, “ARIS architecture and reference models for business process management,” Business Process Management, 2000, pp. 376-389.

[12] M. Langheinrich, “Privacy by design—principles of privacy-aware ubiquitous systems,” in International Conference on Ubiquitous Computing, 2001, pp. 273-291.

[13] A. Cavoukian, "Privacy by design: The 7 foundational principles. implementation and mapping of fair information practices." *Information and Privacy Commissioner of Ontario, Canada*, 2009.

[14] J. Ralyté, “Towards situational methods for information systems development: engineering reusable method chunks, ” in Procs. of 13th International Conference on Information System Development. Advances in Theory, Practice and Education. 2004.

[15] F. Bénaben, J. Touzi, V. Rajsiri, S. Truptil, J. P. Lorré, and H. Pingaud, “Mediation information system design in a collaborative SOA context through a MDD approach,” in Procs. of MDISIS, 2008, pp. 89-103.

[16] C. Feltus, and E. H. A Proper, Conceptualization of an Abstract Language to Support Value Co-Creation, 12th Conference on Information Systems Management (ISM'17), Federated Conferences on Computer Science and Information Systems, Prague, Czech Republic

[17] H. Becker, “Social impact assessment: method and experience in Europe, North America and the developing world,” Routledge, 2014

[18] L. Lessard, C.P. Okakwu, Enablers and Mechanisms of Value Cocreation in Knowledge-Intensive Business Service Engagements: A Research Synthesis. In: 2016 49th Hawaii International Conference on System Sciences, USA. IEEE Computer Society, pp. 1624–1633 (2016)

[19] R. Hevner, S. T. March, and J. Park, “Design science in information systems research,” MIS quarterly, vol. 28, no. 1, 2004. DOI: 10.1007/978-1-4419-5653-8_2

[20] K. Peffers, T. Tuunanen, M. A. Rothenberger, and S. Chatterjee, “A design science research methodology for information systems research,” Journal of management information systems, vol. 24, no. 3, pp. 45-77, Dec. 2008. DOI: 10.2753/MIS0742-1222240302

[21] C. Feltus, L. Lessard, F. Vernadat, D. Amyot, Erik H.A. Proper, Conceptualization of a Value Cocreation Language for Knowledge-Intensive Business Services, In: E. Ziemba (ed.), LNBiP 311, 2018

[22] C. Feltus, E. HA Proper, A. Metzger, J. F. García López, R. C. González, Value CoCreation (VCC) Language Design in the Frame of a Smart Airport Network Case Study, 32nd IEEE Int. Conf. on Advanced Information Networking and Applications (AINA-2018), Poland.

[23] F. Li, A. Etienne, A. Siadat, F. Vernadat, A Performance Evaluation Methodology for Decision Support in Industrial Projects. In: Proc. 7th IESM conference, htw saar, Germany (2017)

[24] R. Matulevicius, N. Mayer, P. Heymans, Alignment of misuse cases with security risk management. In: 3rd Int. Conf. ARES. IEEE, pp. 1397–1404. (2008)

[25] C. Feltus, M. Petit, E. Dubois, Strengthening employee's responsibility to enhance governance of IT: COBIT RACI chart case study. In: 1stACM Workshop on Information Security Governance. ACM, pp. 23–32 (2009)

[26] C. Calero, J. Ruiz, M. Piattini, Classifying web metrics using the web quality model. Online Inf. Review, 29(3), 227–248 (2005)

[27] R. M. Foorthuis, F. Hofman, S. Brinkkemper, R. Bos, Assessing business and IT projects on compliance with enterprise architecture. In: GRCIS’09. CEUR-WS Vol-459, paper 6 (2009)

[28] S. L. Vargo, P. P. Maglio, and M. A. Akaka, 2008. On value and value co-creation: A service systems and service logic perspective. *European management journal*, *26*(3), pp.145-152.

[29] M. Langheinrich, Privacy by design—principles of privacy-aware ubiquitous systems. In: Ubicomp 2001: Ubiquitous Computing, LNCS, vol. 2201. Springer, pp. 273–291 (2001)

[30] OMG: Value Delivery Metamodel, Version 1.0. OMG Document formal/2015-10-05 (2015)

[31] A. Dix, Human-computer interaction: A stable discipline, a nascent science, and the growth of the long tail. Interacting with Computer, 22(1), 13–27 (2001)

[32] H. Alves, C. Fernandes, M. Raposo, Value co-creation: Concept and contexts of application and study. J. of Business Research, 69(5), 1626–1633 (2016)

[33] A. Cox, Business relationship alignment: on the commensurability of value capture and mutuality in buyer and supplier exchange. Supply Chain Management, 9(5), 410–420 (2004)

[34] J. Nyman, What is the value of security? Contextualising the negative/positive debate. Review of Int. Studies, 42(5), 821–839 (2016)

[35] F. Li, Performance Evaluation and Decision Support for Industrial System Management: A Benefit-Cost-Value-Risk based Methodology. PhD thesis, Arts & Mét. Paritech, France (2017)

[36] V. A. Zeithaml, “Consumer perceptions of price, quality, and value: a means-end model and synthesis of evidence,” The journal of marketing, pp. 2-22, Jul. 1988. DOI:10.2307/1251446

[37] I. Manuj, J. T. Mentzer, Global supply chain risk management. J. of Business Logistics, 29(1), pp. 133–155 (2008)

[38] M. Daneva, “Applying real options thinking to information security in networked organizations,” No. TR-CTI. Centre for Telematics and Information Technology, University of Twente, 2006.

[39] E. Ziemba, M. Eisenbardt, R. Mullins, Use of Information and Communication Technologies for Knowledge Sharing by Polish and UK-Based Prosumers. In: E. Ziemba (ed.) Information technology for management: New ideas and real solutions, Lecture Notes in Business Information Processing LNBIP, vol. 277, pp. 49–73 (2017)

[40] M. K. Sein, O. Henfridsson, S. Purao, M. Rossi, and R. Lindgren (2011) Action design research. MIS Q., 35(1), pp. 37-56, ISSN 0276-7783.

[41] G. Berio, F. Vernadat, Enterprise modelling with CIMOSA: functional and organizational aspects. Production planning & control, 12(2), 2001.

[42] M. M. Lankhorst, H. A. Proper, H. Jonkers, The Architecture of the ArchiMate Language. In: Business-Process and Information Systems Modeling, LNBIP, vol 29, Springer (2009)

[43] U.S. DoD: DoDAF framework, version 2.02 (2010).

[44] C. Parent, and S. Spaccapietra, Database integration: The key to data interoperability. Advances in Object-Oriented Data Modeling, 2000.

[45] S. Zivkovic, H. Kühn, and D. Karagiannis, Facilitate modelling using method integration: An approach using mappings and integration rules. ECIS 2007, pages 2038-2049. University of St. Gallen.

[46] The Open Group. ArchiMate® 2.1 Specification. Van Haren Publishing, The Netherlands. 2012-2013

[47] C. Grönroos, Service logic revisited: who creates value? And who co-creates? European business review, 20(4), 298–314 (2008).

[48] J. D. Chandler and S. L. Vargo, Contextualization and value-in-context: How context frames exchange. Marketing Theory, 11(1), 35–49, (2011)

[49] E. K. Chew, iSIM: An integrated design method for commercializing service innovation. Information Systems Frontiers, 18(3), 457–478 (2016)

[50] M. Blaschke, M. K. Haki, U. Riss, S. Aier, Design Principles for Business-Model-based Management Methods – A Service-dominant Logic Perspective. In: Designing the Digital Transformation (DESRIST 2017), LNCS, vol. 10243. Springer, pp. 179–198 (2017)

[51] J. Gordijn, H. Akkermans, H. Van Vliet, Business modelling is not process modelling. In: ER 2000, LNCS, vol. 1921. Springer, pp. 40–51.

[52] H. Weigand, Value encounters–modeling and analyzing co-creation of value. In: I3E 2009. IFIP Advances in ICT, vol. 305, Springer, Berlin, Heidelberg, pp. 51–64 (2009)

[53] I. S. Razo-Zapata, E. K. Chew, E. Proper, Visual Modeling for Value (Co-)Creation. In: 10th Int. W. on Value Modeling and Business Ontologies, Trento, Italy, paper 6 (2016)

[54] S. de Kinderen, K. Gaaloul, and E. Proper, 2012, February. Integrating value modelling into archimate. In International Conference on Exploring Services Science (pp. 125-139). Springer, Berlin, Heidelberg.

[55] E. Grandry, C. Feltus, E. Dubois, 2013, Conceptual integration of enterprise architecture management and security risk management. In Enterprise Distributed Object Computing Conference Workshop*s (EDOCW), 2013 17th IEEE International* (pp. 114-123). IEEE.

[56] C. Feltus, E. Dubois, E. Proper, I. Band, M. Petit, Enhancing the ArchiMate® Standard with a Responsibility Modeling Language for Access Rights Management, 5th ACM International Conference on Security of Information and Networks (ACM SIN 2012), Jaipur, Rajastan, India. ISBN: 978-1-4503-1668-2