Towards a Strategy-Oriented Value Modeling Language: Identifying Strategic Elements of the VDML Meta-Model

Ben Roelens and Geert Poels

Ghent University, Faculty of Economics and Business Administration,
Tweekerkenstraat 2, B-9000 Gent, Belgium
{Ben.Roelens, Geert.Poels}@UGent.be

Abstract. The concept of value is increasingly important in organizations. This has led to the creation of value models that capture internal value creation and the external exchange of value between the company and its value network. To facilitate strategic alignment, the meta-model specification of value modeling languages should both fully reflect the strategic choices of a company and define 'what' a company must do to realize value creation. In this paper, the Value Delivery Modeling Language (VDML) meta-model elements are assessed by applying these two requirements. The resulting strategy-oriented VDML meta-model perspective is obtained by applying the Design Science methodology, which also includes the use of a case example to demonstrate its utility.

Keywords: value model, strategy orientation, business model, VDML

1 Introduction

Value modeling gets increasing attention in the field of Conceptual Modeling. These modeling techniques can be used to represent the internal creation of value and the exchange of value between the organization and its external value network. This focus on value creation and exchange is particularly relevant for the alignment of the strategic and the operational layer of the business architecture [1, 2]. Value models can bridge the conceptual gap that exists between strategy formulation, as specified by goal modeling, and the operationalization of a strategy, which is addressed by process models [1, 3, 4]. To this end, value models should represent strategy implementation choices.

As of yet, it has not been investigated whether the current value modeling languages capture strategy implementation, which results in the development of ad-hoc models with a limited strategic modeling scope (see also section 2.2). Consequently, the current value models are not able to effectively support strategic alignment.

To solve this gap, this paper proposes two requirements for value models, i.e., *(1) fully reflecting the strategic choices made by the company (i.e., the completeness requirement)* and *(2) using concepts that describe 'what' a company must do to create value for itself and its environment, without committing to the required operational details (i.e., the strategy implementation depth requirement)*. These requirements are derived from the business model literature in Management and Organization Science, which is concerned with the strategic logic of an organization, i.e., what a company must do to create value for itself and its stakeholders. As both value modeling and business

modeling are concerned with the study of value creation, the ideas drawn from the knowledge bases of these two research fields can be combined to develop the strategy-oriented value meta-model. The *completeness requirement* is based on the identification of the strategic elements that are needed to describe the implementation of a strategy according to the business model literature. The definition of the business model elements determines the abstraction level (e.g., a black box view on external business partners, individual business processes, and internal organizational structure) that should be adopted by value models to address *the strategy implementation depth requirement*.

The paper is organized as follows. Section 2 reviews related research and the modeling scope of the relevant value modeling languages. Section 3 discusses Design Science as the appropriate methodology for this research. The design and development of the meta-model can be found in section 4, together with the demonstration by means of a case example. Section 5 points at some areas for future research.

2 Background

2.1 Related Research

Previous research, which investigated the relationship between value models and process models, consists of aligning e3-value models with operational models as provided by UML activity diagrams [1, 5-7]. Other research [1, 3, 4, 8] has examined the link between e3-value and strategy models. As these techniques make use of e^3-value as value modeling formalism, their focus is on external value exchanges. Indeed, the internal view of e^3-value is limited to the value that is exchanged between activities, which offers only a partial view on the internal value creation of companies.

Other research [9] focuses on an enhanced variant of e3-value and process models. Although this research effort takes into account both external value exchange and internal value creation (which distinguishes it from [1, 3-8]), a delineated strategic context, in which value models are applied, is still not present.

2.2 Modeling Scope of Existing Value Modeling Languages

In previous research [10], we reviewed relevant research (i.e., the work of Osterwalder [11], etc.) in Management and Organization Science to identify the elements that provide an integrative view on the business model concept (table 1). This reviewed literature provides a theoretical basis to argue that these elements constitute the set of constructs that should be covered by the intended meta-model *(i.e., the completeness requirement)*.

Current value modeling languages only cover loose elements of this framework. The *REA Value Chain Specification* [12, 13] represents *resources* and the *value chain* as an enterprise script, which is related to the overall business process architecture. The *REA Value System Level* [13] models the resources that are exchanged between a company and its external environment and corresponds with the *value network* element. The *Value System Level* can also model the *financial structure*, which reflects the monetary flows between the company and its environment. Value Network Analysis (*VNA*) [14] captures the conversion of tangible and intangible assets into value in the context of internal (e.g., within the company) and external networks (e.g., between the company and its partners).

Hence, the meta-model of VNA can capture the *value chain* and the *resources* that are the input to its processes, as well as the *value network* element. Although value models (except VDML; confer infra) do not include competences (e.g., only a pragmatic approach is presented in [15]), *Capability Maps* are well known in management practise. A Capability Map is a representation of 'what' a company does to reach its objectives [16], which can be used to model *competences*. E^3-value [17] offers a graphical representation of the *value proposition* within the context of e-business. To evaluate this value proposition, profitability sheets are used, which include a mathematical calculation of the monetary streams related to the inflow and outflow of value objects. Although this evaluation is linked to the financial structure within the business model, it does not make use of any modeling constructs. *E^3-forces* [1] (confer section 2.1) was introduced as a variant of e^3-value, which explicitly models the strategic perspective of a *value network*.

As *VDML* [2] is the only value model, of which the meta-model is able to cover *all the business model elements*, it is the suitable starting point for this research. However, its meta-model needs to be refined as it also contains constructs related to the operational details of customer value delivery and even constructs beyond the scope of the business model elements. Therefore it still needs to be investigated which constructs apply to both the *strategy implementation depth requirement* and the *completeness requirement*.

Table 1. Definition of the constituting elements of the integrative business model framework [10].

Concept	Definition
Resources	Human skills, tangible means, and intangible means under control of an organization by being bought or licensed, which are combined within the value chain of activities.
Value chain	Overall business process architecture that describes the structured set of activities that combine resources to created the necessary competences.
Competence	Ability to coordinate flows of resources through the value chain to realize the intended value proposition.
Distribution channel	The way in which the offering is made available to the customers.
Value proposition	Offered set of products and/or services that provide value to the customers and other partners, and competes in the overall value network.
Value network	Web of relations created with external stakeholders, including suppliers, customers, competitors and partners.
Financial structure	Representation of the costs resulting from acquiring resources, and the revenues in return for the offered value proposition.

3 Methodology

As our research objective is the creation of a strategy-oriented value meta-model, Design Science is the appropriate research methodology. This paper reports on a first iteration of the Design Science Research Methodology process [18]: (1) problem identification and motivation and (2) definition of solution objectives are part of the Introduction, (3) design and development and (4) demonstration by a case example are presented in the next section. A rigorous (5) evaluation is object of future research (confer Discussion).

The design and development of the intended value meta-model is based on the identification of the VDML meta-model constructs, which apply to both requirements for strategic alignment. To implement the *completeness requirement*, a combination of value modeling languages is used, which separately do not apply to the *completeness requirement*, but collectively cover the seven business model elements. *The strategy implementation depth requirement* will be operationalized by assessing whether the meta-model constructs (of the combination that collectively applies to the *completeness*

requirement) are defined at the right level of abstraction as prescribed by the business modeling literature. Afterwards a mapping between the relevant constructs of the combination of value modeling techniques and the according VDML elements will be performed, based on a comparison of the corresponding definitions.

Demonstration of the developed meta-model is based on the Healthcare Case example [19], which describes the implementation of remote monitoring of high-risk pregnancies within the healthcare industry. As this instantiation is used to demonstrate VDML and its existing notations, it can be used as a benchmark to enable a comparison between the developed meta-model and the VDML models of this case example.

4 Results

4.1 Design and Development

Identification of Relevant Value Modeling Constructs.
Resources and Value Chain. The *REA Value Chain Specification* shows the *economic resources* that are input and output of *processes*. As the REA Value Chain adopts a black box view on processes, the meta-model is specified at the right level of abstraction for modeling strategy implementation choices. Also *VNA* is oriented towards the *deliverables* that are conveyed between organizational roles through *transactions*. As internal roles relate to the internal organizational structure, they are not further included.

Competence. *Capability Maps* represent organizational competences as hierarchies of capabilities that enable value delivery to the customer. This high-level analysis of *competences* provides the right level of abstraction for specifying the value layer within the organization. The detailed decomposition of competences into tasks addresses operational details and is no part of the subsequent mappings.

Value Proposition, Distribution Channel, and Value Network. *Value System Level REA Modeling* is concerned with the *economic resources* that are exchanged between the *enterprise* and its *external business partners*. These elements apply to the *strategy implementation depth requirement* and are further included in the analysis. The meta-model of *VNA* augments the vision of the REA ontology as it includes the *transactions* through which the *deliverables* are conveyed. Now, the *role* concept within VNA is relevant as it may refer to the company and its external business partners. The meta-model of *e^3-forces* uses the concepts of *constellation* and *business force* (i.e., *market*) to capture the strategic perspective of a value network. The other elements (i.e., *actor, value interface, value offering, value port, value exchange, and value object*) originate from e^3-value and model the value exchange between a company and its value network.

Financial Structure. The financial structure can be considered as a specific model view in the *Value System Level REA Modeling* as the relevant revenues and costs can be captured by *monetary resources* that are exchanged by the *enterprise*.

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Mapping to VDML Meta-Model Constructs. The mappings between the extracted elements and the VDML meta-model constructs (tables 2-4) extend the mappings provided in [2]. Corresponding elements of the definitions are characterized by the same layout inside the tables. Mappings that are less straightforward are discussed in the text.

A CapabilityMethod (table 2) is defined as a process at the value layer of the business architecture, which focuses on delivering capabilities (and the resulting value contribution) [2]. However, the concept also includes who is responsible for individual activities, which is outside the scope of a strategy-oriented value modeling language. The definition of a BusinessItem (table 2), which includes anything that is conveyed between two roles, is too narrow to capture resources that are exchanged between black box processes (i.e., which abstract from internal roles). Within the meta-model (figure 1), these problems can be overcome as internal roles are omitted and BusinessItems are only specified as deliverables for CapabilityMethods. Moreover the internal activities, which constitute these CapabilityMethods, are not explicitly included.

Table 2. Mapping between the relevant meta-model constructs that address resources, value chain, and competence and the corresponding VDML elements.

Value modeling technique	Meta-model element	Definition
REA Value Chain Specification	Economic Resource	*Objects* that are scarce and have utility and are **under the control** of an enterprise [12].
VNA	Deliverable	The actual (physical or non-physical) *things* that move from one role to another [14].
VDML	BusinessItem	*Anything* that can be **acquired or created**, that conveys information, obligation or other forms of value and that can be conveyed from a provider to a recipient [2].
VNA	Transaction	Occurrence in which a *deliverable*, originated by one role, is **conveyed to** and received by another role [14].
VDML	DeliverableFlow	The **transfer** of a *deliverable* from a provider to a recipient [2].
REA Value Chain Specification	Process	The exchange or conversion of an *input resource* (or set of resources) to an *output resource* of **more value** [12].
VDML	CapabilityMethod	A Collaboration specification that defines the Activities, DeliverableFlows, *BusinessItems*, CapabilityRequirements and Roles that deliver a Capability and **associated value contributions** [2].
Capability Maps	Competence	Network of valuable capabilities (i.e., the *ability* to make use of resources *to perform some task or activity*) in terms of enabling the firm to **deliver a fundamental customer benefit** [15].
VDML	CapabilityOffer	The *ability to perform a particular kind of work* and **deliver desired value**, by applying resources that are managed together, possibly based on formalized methods [2].

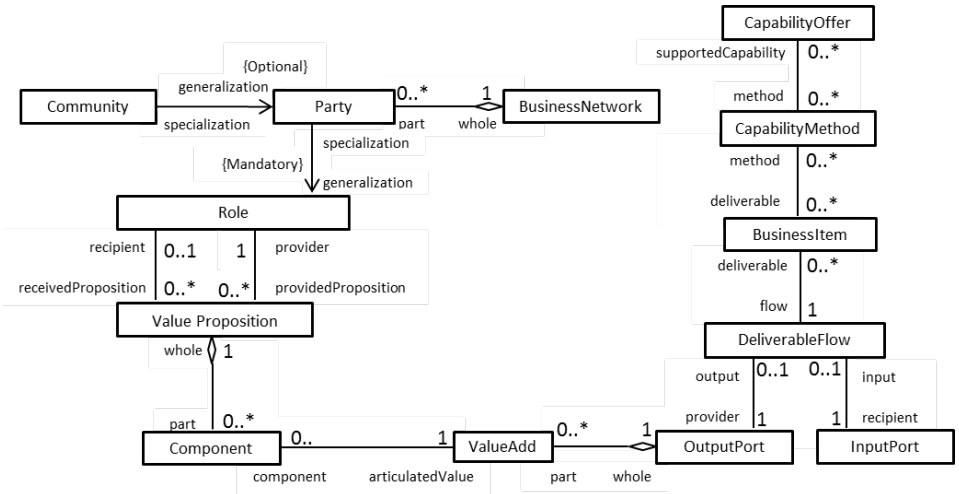

Fig. 1. Strategy-oriented VDML meta-model.

The financial structure (table 4) results from the whole of monetary streams to and from a company. Within VDML, an Economic Resource is modeled as a BusinessItem, while the flow of these resources is represented by a DeliverableFlow. However, the combination of these elements is too general to capture the financial structure, so the difference between revenues and costs should be stored as a profit attribute of a Party.

Table 3. Mapping between the relevant meta-model constructs that address value proposition, distribution channel, and value network and the corresponding VDML elements.

Value modeling language	Meta-model element	Definition
Value System Level REA Modeling	Enterprise, External Business Partner	**Actors** in the value system such as the **company**, its **suppliers**, its **customers**, its **creditors/investors**, and its **employees** [13].
VNA	Role	**Real people or participants** (both **individuals and organizations**) in the network who provide contributions and carry out functions [14].
e^3-forces	Constellation	Coherent **set** of two or more **actors** who cooperate to create value to their environment [1].
VDML	Party	**Roles** specific to and contained in the BusinessNetwork [2].
e^3-forces	Market	Set of **organizations** operating in the environment of a constellation [1].
VDML	Community	A loose collaboration of **participants** with similar characteristics or interests [2].
e^3-forces	Value Interface	**Group** of one ingoing and one outgoing value offering, which shows the *mechanism of economic reciprocity* [17].
VDML	No specific concept	**The aggregate** of value propositions *provided and received by* one party in a business network [2].
e^3-forces	Value Offering	Models **what an actor offers** to or requests from its environment, which is a set of equally directed *value ports* [17].
VDML	Value Proposition Component ValueAdd	Expression of the **values offered** to a recipient evaluated in terms of the recipient's level of satisfaction [2]. The **components** that constitute the ValueProposition [2]. Objects that represent the **values that are delivered** by a *OutputPort* [2].
e^3-forces	Value Port	A means of an actor to show to its environment that it wants to **provide or request** value objects [17].
VDML	Input Port Output Port	**Receives** the deliverable that is transferred via the DeliverableFlow [2]. **Provides** the deliverable that is transferred via the DeliverableFlow [2].
e^3-forces	Value Exchange	Connection between two value ports, which represents that **two actors** are willing to exchange *value objects* with each other [17].
VNA	Transaction	Occurrence in which a *deliverable*, originated by **one role**, is conveyed to and received by **another role** [14].
VDML	DeliverableFlow Channel	The transfer of a *deliverable* from a **provider** to a **recipient** [2]. Mechanism to execute a *deliverable* flow [2].
Value System Level REA Modeling	Economic Resource	*Objects* of economic value (with or without physical substance) that are **provided or consumed by an enterprise** [13].
VNA	Deliverable	The actual (physical or non-physical) *things* that **move from one role to another** [14].
e^3-forces	Value Object	*Product and services* that are of value for one or more **actors** [1].
VDML	BusinessItem	*Anything* that can be acquired or created, that conveys information, obligation or other forms of value and that can be **conveyed from a provider to a recipient** [2].

Table 4. Mapping between the relevant meta-model constructs that address financial structure and the corresponding VDML elements.

Value modeling language	Meta-model element	Definition
Value System Level REA Modeling	Money	*Monetary Objects* of economic value (with or without physical substance) that are **provided or consumed by** an **enterprise** [13].
	Enterprise	**Actor** in the ***value system*** [13].
VDML	Party_profit DeliverableFlow	The *difference between revenue and cost* that a providing **Party** in a ***BusinessNetwork*** might realize [2]. The **transfer of** *a deliverable* from a provider to a recipient [2]. *Anything* that can be acquired or created, that conveys information,

	BusinessItem	obligation or other forms of value and that can be **conveyed** from a provider to a recipient [2].

4.2 Demonstration

This section makes an analysis of the meta-model elements of the nine VDML modeling viewpoints used in the Healthcare Case Example [19]. These elements will be compared with the developed meta-model to demonstrate the utility of our proposal. This way of working is needed as we do not dispose yet of a graphical notation to visualize instantiations of the strategy-oriented meta-model within VDML.

(1) *Value Proposition Exchange Diagrams* visualize *Value Propositions* that are offered between *Party Roles* in the BusinessNetwork. (2) *Role Collaboration Diagrams* focus on the *DeliverableFlows* of *BusinessItems* between *Parties*, as well as *sequence numbers* to identify the exchange order of these BusinessItems. (3) A *Business Network Activity Diagram* identifies the *high-level Activities* that need to be executed by *Parties* and the *BusinessItems* (held in *Stores*) that *flow* between these activities. These DeliverableFlows can be split by an *alternative deliverable output*. (4) A *Capability Method Delegations Diagram* identifies the internal *CapabilityMethods* that realize the *high-level Activities* of the different *Party Roles*. (5) *Capability Method Diagrams* define the *Activities* needed to realize a CapabilityMethod, the associated *flows* of *BusinessItems*, and the responsible internal *Roles*. (6) A *Measurement Dependency Graph* augments this view by making explicit the *value contribution* of individual *Activities*. (7) A *Capability Management Diagram* shows the *CapabilityOffers,* as well as the required *CapabilityMethods* and *Resources*, performed by an *Organization Unit*. (8) A *Capability Map* identifies *Capabilities* that can be improved. (9) An *Organization Structure Diagram* models the internal structure as a hierarchy of *Organization Units*.

The analysis of the VDML modeling viewpoints provides an insight of the strengths of the developed meta-model. Although the VDML meta-model applies to the *completeness requirement*, the internal view (perspectives 1-3) and the external view (perspectives 4-9) on strategy implementation are addressed by separate models. This is solved by our proposal which fully addresses the strategic scope within a single model view. Moreover, existing VDML views adopt operational details in their instantiations (e.g., (5) internal activities, (5, 7) internal responsibilities, (9) internal structure, etc.). The developed meta-model, which is based on the *implementation depth requirement*, makes abstraction from any of these operational details. Hence, instantiations of the developed meta-model have the potential to effectively support strategy orientation.

5 Discussion

Although the utility of the strategy-oriented meta-model is demonstrated in the previous section, future research is required. A next step is developing a graphical notation to visualize the strategy-oriented VDML meta-model. This will enable the creation of model instantiations, which can be rigorously evaluated. Moreover the developed meta-model needs to be further formalized to ensure the development of instantiations, which comply with the meta-model restrictions. This will result in the creation of a proper value modeling language that captures the value layer in an organization.

Afterwards, the alignment between the strategy, value, and operational layer of the business architecture needs to be ensured. This will require a comparison of the existing alignment techniques (confer section 2.1) to discover which of these research efforts is suitable to realize strategic alignment and which eventual adaptations are needed.

References

1. Pijpers, V., de Leenheer, P., Gordijn, J., Akkermans, H.: Using Conceptual Models to Explore Business-Ict Alignment in Networked Value Constellations. Requirements Engineering 17(3), 203-226 (2012)
2. OMG: Value Delivery Modeling Language (Vdml), bmi/2012-11-06 (2012)
3. Gordijn, J., Petit, M., Wieringa, R.: Understanding Business Strategies of Networked Value Constellations Using Goal- and Value Modeling. In: 14th IEEE International Requirements Engineering Conference, RE'06, pp. 129-138, Minneapolis/st Paul, Minnesota (2006)
4. Andersson, B., Johannesson, P., Zdravkovic, J.: Aligning Goals and Services through Goal and Business Modelling. Information Systems and e-Business Management 7(2), 143-169 (2009)
5. Zlatev, Z., Wobacher, A.: Consistency between E3value Models and Activity Diagrams in a Multi-Perspective Development Method. In: Meersman, R., Tari, Z. (eds.) On the Move to Meaningful Internet Systems 2005: CoopIS, DOA, and ODBASE. LNCS, vol. 3760, pp. 520-538. Springer, Heidelberg (2005)
6. Edirisurija, A., Johannesson, P.: On the Alignment of Business Models and Process Models. In: Ardagna, D., Mecella, M., Yang, J. (eds.) BPM 2008 Workshops. LNBIP, vol. 17, pp. 68-79. Springer, Heidelberg (2009)
7. Andersson, B., Bergholtz, M., Grégoire, B., Johannesson, P., Schmitt, M., Zdravkovic, J.: From Business to Process Models – a Chaining Methodology. In: Pigneur, Y., Woo, C. (eds.) Proceedings of the CAISE*06 Workshop on Business/IT Alignment and Interoperability (BUSITAL '06). CEUR-WS, vol.237, pp. 1-8 (2006)
8. Gordijn, J., Yu, E., van der Raadt, B.: E-Service Design Using I* and E3value Modeling. IEEE Software 23(3), 26-33 (2006)
9. Weigand, H., Johannesson, P., Andersson, B., Bergholtz, M., Edirisuriya, A., Ilayperuma, T.: On the Notion of Value Object. In: Dubois, E., Pohl, K. (eds.) CAiSE 2006. LNCS, vol. 4001, pp. 321-335. Springer, Heidelberg (2006)
10. Roelens, B., Poels, G.: Towards an Integrative Component Framework for Business Models: Identifying the Common Elements between the Current Business Model Views In: Deneckère, R., Proper, H. (eds.) CAiSE'13 Forum at the 25th International Conference on Advanced Information Systems Engineering. CEUR-WS, vol. 998, pp. 114-121 (2013)
11. Osterwalder, A., Pigneur, Y., Tucci, C.: Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley and Sons Inc., Hoboken, NJ (2010)
12. Geerts, G., McCarthy, W.: An Ontological Analysis of the Economic Primitives of the Extended-Rea Enterprise Information Architecture. International Journal of Accounting Information Systems 3, 1-16 (2002)
13. Dunn, C., Cherrington, J., Hollander, A.: Enterprise Information Systems: A Pattern-Based Approach. McGraw-Hill Irwin, Boston (2005)
14. Allee, V.: Value Network Analysis and Value Conversion of Tangible and Intangible Assets. Journal of Intellectual Capital 9(1), 5-24 (2008)
15. Hafeez, K., Zhang, Y., Malak, N.: Determining Key Capabilities of a Firm Using Analytic Hierarchy Process. International Journal of Production Economics 76(1), 39-51 (2002)
16. Cook, D., http://msdn.microsoft.com/en-us/library/bb402954.aspx

17. Gordijn, J., Akkermans, H.: Value Based Requirements Engineering: Exploring Innovative E-Commerce Ideas. Requirements Engineering Journal 8(2), 114-134 (2003)
18. Peffers, K., Tuunanen, T., Rothenberger, M.,Chatterjee, S.: A Design Science Research Methodology for Information Systems Research. Journal of Management Information Systems 24(3), 45-77 (2007)
19. OMG: Vdml Healthcare Use Case, bmi/2012-11-11 (2012)