A Systematic Approach to Business Modeling Based on the Value Delivery Modeling Language

Joachim Metzger, Nicolai Kraemer, and Orestis Terzidis

Abstract Complex value creation networks have evolved as a substantial challenge for entrepreneurship in many industries. Value Delivery Architecture Modeling is a new approach to respond to this challenge by enabling people to understand the value creation network and by supporting the successful positioning of a company within this network. Consequently, Value Delivery Architecture Modeling allows for analyzing, evaluating and designing business models and their embeddedness in the value creation network. Value Delivery Architecture Modeling is based on the combination of the new business modeling language Value Delivery Modeling Language and semi-formal ontologies. The initial application of this new approach in the area of fast charging infrastructure in Germany shows promising results. The developed artifacts create an explicit frame of reference for the value creation network which can be useful in various situations. Value Delivery Architecture Modeling hereby addresses the understanding about the value network and enables the creation of novel value propositions.

Keywords Business model • Electric mobility • Ontology • Value creation networks • VDML

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1 Introduction

Business modeling is no doubt considered as key activity of entrepreneurship. Typical approaches discussed in literature and applied in practice include the 'Business Model Canvas' (Osterwalder & Pigneur, 2010), the 'Business Model Navigator' (Gassmann, Frankenberger, & Csik, 2013) and the 'Business Model Cube' (Lindgren & Rassmussen, 2013). In one way or another, all approaches develop a model to describe the systemic arrangement of a venture, its key components and interactions.

Al-Debei and Avison (2010) performed a comprehensive literature review on the topic. In their conclusion, they state that a business model is primarily used for three functions: (1) as a conceptual tool of alignment of stakeholders, (2) as an interceding framework between strategy and business process models, and (3) as strategic-oriented knowledge capital that answers questions related to value creation.

With respect to value creation, it is important to realize that any venture is embedded in a complex and dynamic network of industry structures. Supply networks are composed of a variety of roles and a potentially large number of firms, sometimes from multiple interrelated industries. In their meta-analysis of success factors for startups, Song, Podoynitsyna, van der Bij, and Halman (2008) named the 'embeddedness in the supply chain' to be of prominent importance for the success of a new venture.

With this background, it becomes clear that business modeling must provide tools and methods to analyze, evaluate und design the position of a firm within its value creation network. In supply chain management literature, value creation networks have been characterized as highly complex due to (i) the combinatorics that is related to the network and (ii) due to the dynamic change that takes place in these networks (see e.g. Pathak, Day, Nair, Sawaya, & Kristal, 2007). Embedding the venture in a given or emerging value creation network therefore is one of the entrepreneurial challenges that directly relate to complexity and demand the right tools and thinking in order to make a venture successful.

The trigger for the following paper was a research project in the context of electric mobility in Germany. The goal was to analyze, evaluate, and redesign the business model for fast charging stations. Experts agree that the business case for the 'isolated' fast charging station is not profitable and that there is no 'viable business model' for the infrastructure alone. The situation is a key hurdle for the broader adoption of electro mobility: If nobody is willing to invest in fast charging stations, reach and ad-hoc mobility cannot be realized adequately, slowing down the adoption of electric vehicles.

Therefore the search for an adequate business model has been one of the major challenges for the last couple of years (Nationale Plattform Elektromobilität, 2014; Reinke, 2014). Applying the mainstream methods mentioned above (Gassmann et al., 2013; Lindgren & Rassmussen, 2013; Osterwalder & Pigneur, 2010) is possible, but does not create a clear picture of the value creation network. As the business case of the 'standalone' charging point is not positive, it is necessary to

think about bundling of products and services. Fast charging makes other, profitable products and services possible and should therefore be 'cross-subsidized' by them. In order to find out which bundles could make sense, it is of direct importance to clearly describe and depict the full value creation network.

Methodologically, we started with qualitative research in the form of expert interviews and made an in-depth content analysis. We were then looking for ways to depict the expert statements, in particular with respect to the value creation network of fast charging stations. In search for a tool to visualize the interview results, we considered to extend the Unified Modeling Language (UML) (Object Management Group, 2011) used in Software Engineering. At that point, we found out that a UML derivative had been published just recently that could serve our goals: the 'Value Delivery Modeling Language' (VDML) (Object Management Group, 2014, 2015).

With the tool, we visualized and compared the interview results. We realized the approach has the potential to create a common understanding among stakeholders on how the value creation network looks like and what roles come into play.

Beyond the project context, we consider that the approach is quite generic. Coming back to our remarks on the importance of what Song et al. called the 'embeddedness in the supply chain' (Song et al., 2008), we believe that the approach substantially helps to create a sound business concept. Based on VDML, we created the 'Value Delivery Architecture Model' (VDAM). The goal of this tool is to achieve a common vision and understanding among a group of people about the business model as part of a specific value creation network.

2 Background

In this section we will present the components, which were used in the development of VDAM. We based our tool on two existing approaches, the 'Value Delivery Modeling Language' (Object Management Group, 2014, 2015) and 'Ontologies' in Business Modeling (Osterwalder, 2004). These artifacts were combined to describe and depict value creation networks (Pathak et al., 2007) and the embeddedness in the supply chain (Song et al., 2008) of an innovative venture.

2.1 Value Delivery Modeling Language

VDML has its origins in Information Systems (IS) and is a UML-specified approach for business modeling. Its first beta version was released by the Object Management Group (OMG) in April 2014 (Object Management Group, 2014). It has been developed as a business modeling tool that intermediates between strategy and business processes.

One key function of VDML is to model value creation and value exchange on a strategic level. VDML also provides a link from strategy and business models to activities, roles and capabilities necessary to implement a business model. Thus, it provides a language for analysis, evaluation and design of business models with a link to a more operational level. The key notion of VDML is the creation and exchange of value.

VDML incorporates several types of diagrams that are included in the following views:

- Business Network View
- Activity Network View
- Organization Responsibility View
- Value Contribution View

In our proposed approach we use several of these diagrams to describe different aspects of business models (see Sect. 3.1). In addition, VDML supports several existing concepts of business modeling and business analysis approaches such as the 'Business Model Canvas' or 'Value Networks' (Object Management Group, 2014, 2015).

2.2 Ontology Building

In addition to a modeling language that visualizes value creation and value delivery, it is possible to create further transparency, clarity, and a common understanding between stakeholders by the use of ontologies. Ontologies are in widespread use in the area of Information Systems as explicit specifications of conceptualizations. They create a common understanding within a domain and simplify the buildup and sharing of knowledge. This contributes to an improved communication between people, organizations and machines, and thereby leads to an improved interoperability between systems (Ehrig & Studer, 2006; Mädche, Staab, & Studer, 2001).

Consequently, they are an important component to achieve the overall goal of this paper: to provide a tool that creates a common understanding among people on what their business model is or should be and how it is embedded in the value creation network.

For the design of ontologies, the following three guidelines have been described in the literature (Uschold & Gruninger, 1996):

- Clarity, in the sense of minimized ambiguity
- Coherence, in the sense of an internal consistency
- Extensibility of the designed ontology

Uschold & Grunninger's approach of ontology building includes the steps of capturing, coding, evaluation, and documentation. In the following, we will apply ontologies and VDML in the specific domain of electric mobility and demonstrate how their combination can help to create a clear understanding of the situation.

Overall, we deem VDML and semi-formal ontologies promising artifacts for reaching our goal of developing a new tool that focusses on a common understanding of value creation and delivery. These artifacts support the management of complexity and creation of a common understanding amongst stakeholders. Thereby, VDML offers a number of visualization methods that allow to describe and manage complex value creation and delivery. Ontologies, on the other hand, enable common understanding and improved communication amongst stakeholders, supporting collaborative efforts. The specific application of these artifacts in VDAM will be introduced in the following section.

3 Value Delivery Architecture Modeling

In order to describe and visualize collaborative value creation we combined the elements mentioned in the previous section (VDML and semi-formal ontologies) and developed a tool that we refer to as 'Value Delivery Architecture Modeling' (VDAM). Here, we use the term 'architecture' in analogy to its use in information system modeling and refer to the conceptual and functional partition of the value creation processes. As mentioned before, our goal is to develop an approach to create a common understanding among people on what their business model is and how it is embedded in the value creation network.

To this end, we describe and depict value creation and delivery processes in a domain or industry. This establishes a common ground for the analysis, evaluation, and design of business models. We will introduce the VDAM framework, including the process of developing the visualizing diagrams and the corresponding semi-formal ontology.

3.1 VDML Elements

VDML offers a number of views and diagrams to model and visualize value creation and delivery. In VDAM, we use a subset of these elements. The key diagram we use in our tool is the so-called 'Value Proposition Exchange Diagram' from VDML. This kind of diagram consists of three types of elements: Roles (R), Value Propositions (VP), and Connectors (C) (see Fig. 1). Here, 'Roles' are defined as abstract elements describing patterns of behavior or capabilities. 'Value Propositions' represent tangible and intangible values of deliverables. 'Connectors' represent the association that connects a 'Role' with a 'Value Proposition' or a 'Value Proposition' with a 'Role' (Object Management Group, 2014, 2015). (For simplicity of notation, we will drop the simple quote symbols '' in the following.) For the application within VDAM, we define that a Value Proposition Exchange Diagram can be described as a 3-tuple (R, VP, C), where

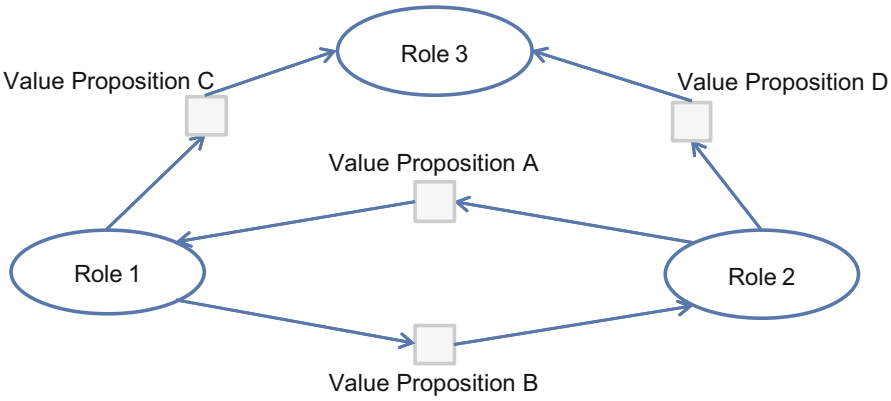

Fig. 1 Elements of a Value Proposition Exchange Diagram (Object Management Group, 2014, 2015) in VDAM

- R is a finite set of Roles
- VP is a finite set of Value Propositions
- R and VP are disjoint
- C: (R x VP) ∪ (VP x R) → ℕ is a multi-set of arcs

As a result, a specific Value Proposition can only be offered from one Role to one other Role. Additionally a specific Role can only offer one Value Proposition towards one other Role. Furthermore, since Roles and Value Propositions must not be identical, we define that Roles and Value Propositions cannot have the same names. These additional restrictions on the design of this key view aim to ensure comparability of Roles and Value Propositions due to a consistent level of abstraction. Following this approach, the resulting Value Proposition Exchange Diagram visualizes and describes the value delivery from a more strategic perspective.

In the following use case of electric mobility fast charging stations, we will focus on the Value Proposition Exchange Diagram. For reasons of completeness, we briefly mention three additional views that we consider important. Following the logic of VDML, these views can be derived from the Value Proposition Exchange Diagram by using additional information about value creation in a domain. The additional views allow for more informed decisions on if and how a new Business Model may be implemented. Without going into details, we consider the diagrams displayed in Fig. 2 as relevant and refer the reader to the VDML specification (Object Management Group, 2014, 2015) for further information:

- Network Activity Diagram
- Capability Management Diagram
- Measurement Dependency Graph

Network Activity Diagrams enable the design of key processes which are necessary to offer specific Value Propositions. The visualization can be used to identify critical steps in the value creation process and clarify responsibilities of

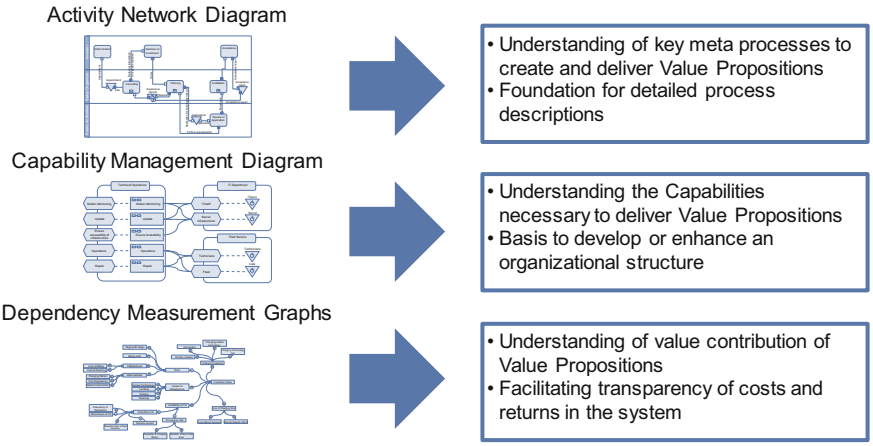

Fig. 2 Additional VDML views (Object Management Group, 2014, 2015) applicable in VDAM

partners and organizational units. Capability Management diagrams can be used to identify the necessary Capabilities and Resources for the delivery of a Value Proposition. Additionally, a gap analysis between existing and necessary Capabilities can be established and decisions towards partnerships or internal knowledge buildup can be made. By displaying organizational units and the allocated Capabilities, this type of diagram can also be used as input for the design of an organization to implement a specific Business Model. Measurement Dependency Graphs display the logic of value creation and value contribution.

The visualization of value creation and delivery between roles in a domain is a key enabler for the analysis, evaluation and design of business models, as it creates a visual language that enables stakeholders to come to a common understanding of the situation. It also helps to articulate and evaluate options and thereby leads to more informed decision on business models.

3.2 Ontology Building in VDAM

The graphical representations of VDML facilitate the understanding of relationships between Roles and their corresponding Value Propositions. The development of a domain ontology complements the approach and establishes a common language. The information captured in the ontology is directly related to the requirements of the VDML elements described above. Therefore, in addition to the elements Role and Value Proposition which are part of the Value Proposition Exchange Diagram, further elements such as Capability, Activity or Value have to be included in the ontology. These elements are necessary for the design of more detailed views. For the description of the ontology elements we used Osterwalder's

Table 1 Domain ontology element in VDAM based on Osterwalder (2004)

Name of element	VALUE PROPOSITION
Definition	VALUE PROPOSITION represents tangible or intangible VALUE offered by a ROLE towards another ROLE
Part Of	Product
Related To	ROLES CAPABILITIES VALUE
Set Of	VALUE PROPOSITION COMPONENTS
Cardinality	1 – n
Attributes	Name {abc} Description {abc} Example {abc} ValuePropositionComponents {abc} Target Role {Role} Value for Target Role {value} Offering Role {Role} Value for Offering Role {value} Activities {Activities} ~ Inherited Attributes from ValuePropositionComponents

Business Model Ontology approach. In Table 1, the approach is illustrated with the element 'Value Proposition'. Seven categories are specified: Name of the Element, Definition, Part of, Related to, Set of, Cardinality, and Attributes (Osterwalder, 2004).

Name and Definition are being used to specifically describe the elements and create a common understanding. The categories Part of, Related to, and Set of are being used to describe the semantic relationship of elements. Generally, elements can be decomposed into sub-elements to allow for different levels of granularity in analysis. For instance, an element 'Value Proposition' can be decomposed in several 'Value Proposition Components'. The cardinality defines the number of possible appearances of elements in the approach. By definition, the cardinality of the entities of Role and Value Proposition has to be one. The entities of other elements which are used in the more detailed diagrams can have other cardinalities. This enables reuse of these elements during the design process when deemed helpful. Finally the category Attributes defines what attributes have to be used to describe entities of an ontology element.

In summary, the use of Osterwalder's Business Model Ontology approach explicitly describes and defines the elements of the graphical representation in VDML diagrams. It can be applied on different levels of abstraction, e.g. for generic elements linked to VDML or for specific elements relevant in the industry or domain considered. The use of this semi-formal domain ontology in VDAM enables stakeholders to establish a common language thus reducing ambiguity through explicit definition and description.

3.3 Modeling of the Overall Value Creation and Delivery in a Domain

The VDAM approach starts with an abstraction from specific companies and their individual business models and distills a representation of the overall value creation network in an existing or emerging domain. This is accomplished by modeling abstract Roles, Value Propositions, and other elements introduced above. The resulting visualization and explicit description establishes a well-defined framework, which can become a solid foundation for analysis, evaluation, design and common opinion building. It helps to identify the role and value proposition of a venture and thereby position it strategically within the value creation network. It enables entrepreneurs to make an in-depth analysis of how to contribute to value creation and how to focus on core capabilities.

3.4 The Value Delivery Architecture Modeling Framework

As described above, the VDAM method makes use of VDML diagrams and the business model ontology to create a Value Delivery Architecture Model for a given domain. In Fig. 3, we depict the systematic approach, with typical steps and iterations. This process can be a considerable effort. We argue that this effort is time well spent, as it creates a foundation for key managerial decisions.

The process starts with gathering information about the domain or industry. This can be achieved in various ways reaching from expert interviews, industry reports and content analysis to sophisticated quantitative data analysis (Day, 1981). After processing and interpreting this information, it will be possible to draw a first version of the relevant diagrams. Modeling within VDAM implies the description of the value creation network using the Value Proposition Exchange Diagram. In addition, it is important to describe the results in the semi-formal ontology to ensure conceptual clarity and a common language.

The design of the diagrams and the development of the ontology is an iterative process. Developing additional diagram types makes use of the ontology that has emerged at that stage of the process. These diagrams in turn may create new questions and will trigger a process of additional empirical information gathering. The additional knowledge will be made explicit by including it in the ontology, which thereby is enriched and enhanced. In this way, the iterative ontology building and refinement process makes explicit use of the extensibility guideline for ontologies (Uschold & Gruninger, 1996).

The VDAM artifacts (VDML diagrams and the domain ontology) create an explicit frame of reference for the value creation network of a given domain. This is useful in various situations:

1) They help an entrepreneur or team to clearly position and align.

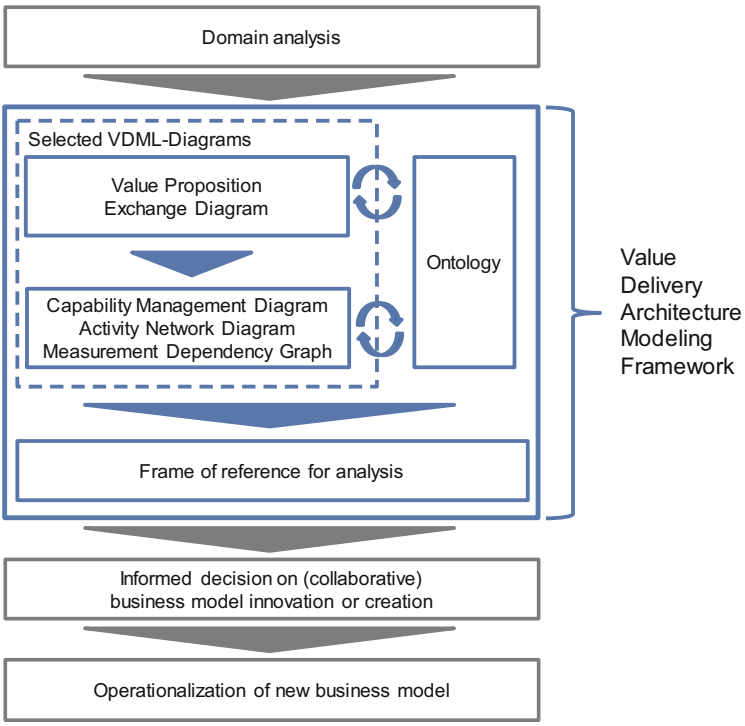

Fig. 3 VDAM approach based on VDML (Object Management Group, 2014, 2015) and semi-formal ontologies (Osterwalder, 2004)

2) They help to create a common understanding among stakeholders about value creation and delivery, thereby facilitating cross-company and cross-industry collaboration.
3) They help to analyze existing business models and create the basis for evaluating and (re-) designing these them.

Key questions of entrepreneurship and strategy definition are related to these topics. They include the own positioning in the value creation network, the identification of key capacities and resources, 'make or buy' decisions, competitor analysis, clarity about coopetition situations, the identification of key partnerships and more. VDAM can make a contribution to an informed decision making in these key questions of entrepreneurial management.

In the following section we will show this potential of VDAM on the case of fast charging infrastructure in Germany.

4 The Case of Fast Charging Infrastructure in Germany

As mentioned in the introduction, the trigger for our approach was a research project on business models of fast charging infrastructure for electric vehicles. In this context, we applied VDAM in the related domain, focusing on the Value Proposition Exchange Diagram. Thereby we visualized and explicitly described the value creation network of this specific domain from a more strategic perspective. In fact, the context of fast charging has some interesting aspects:

- Involvement of companies from diverse industry sectors, namely automotive, electro-technology, utilities and other services.
- Lack of a well-established value network and an ambiguous understanding of how value is created due to the novelty of this area.
- Deployment of heterogeneous technological standards and proprietary solutions, like CHAdeMO, Combined Charging System, and the Tesla system.
- Lack of a sound business case for the operation of fast charging infrastructure based only on electricity sales, due to high upfront investments and a limited willingness to pay (Nationale Plattform Elektromobilität, 2014; Reinke, 2014).

Altogether, this creates a very complex and uncertain environment not favorable to direct investments and entrepreneurial engagement.

Our research project was motivated by the question how to analyze the situation, how to create a conceptual framework and common understanding for the context and finally how to systematically create options for viable business models for fast charging stations. Methodologically, we performed the following steps:

1) Interviews with 17 domain experts and systematic content analysis,
2) Modeling of the experts' individual perspectives in VDML,
3) Creation of a consolidated frame of reference for the value creation network,
4) Positioning of companies in the frame of reference,
5) Analysis of value creation and existing business models.

Form a design science point of view, we have gone through the first steps to construct the VDAM artifact (Hevner, March, Park, & Ram, 2004). The validation of the artifact is still work in progress, but we want to report on the results we have obtained so far, as they are of general interest for advanced business modeling. In the following, we will describe the steps mentioned in some detail.

4.1 Interviews and Qualitative Data Analysis

Using qualitative research methods we interviewed 17 senior executives and top experts from companies representing the different industry sectors involved. We asked about their perspectives on this new domain of fast charging infrastructure and their companies' business models. All experts except one have direct

experience in electro mobility for 2 or more years. All of them show cross-company experience by participating in government funded research and demonstration projects and being part of the German National Electric Mobility Platform (Nationale Plattform Elektromobilität). The interviews were held face-to-face or via telephone during August and September 2014. The 17 interviews produced a record of approximately 16 hours, corresponding to a transcript of about 115,000 words. This empiric data was coded following Mayring and Brunner's iterative qualitative analysis approach (Mayring & Brunner, 2009), building the empiric basis for the modeling of the individual perspectives and the subsequent application of VDAM.

4.2 *Modeling of Experts' Individual Perspective*

Even though the experts all work in this emerging domain and were asked the same questions, the data reveals a highly heterogeneous understanding of how and by whom value is created. In particular, the experts were asked to name the key Roles and their corresponding Value Propositions in the area of fast charging infrastructures. In a first step, we visualized the experts' statements in the interviews, not yet applying the guidelines which we specify in the Value Proposition Exchange Diagram in VDAM. (Specific Roles and Value Propositions in the domain of fast charging infrastructure will be written in *italic*).

Figure 4 shows the view on the value creation network described by 4 of the 17 interviewed experts. Examples of the differences displayed in Fig. 4 are:

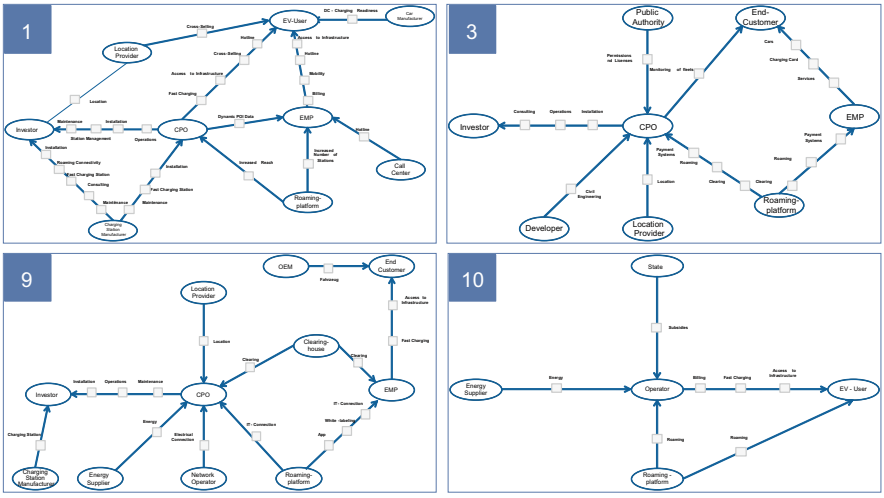

Fig. 4 Exemplary perspectives on the value creation network in the new domain of fast charging infrastructure in Germany

- The number of Roles in the value creation network ranges from 5 to 11 Roles.
- The number and nature of the Value Propositions exchanged by the Roles is highly heterogeneous.
- Experts assign different types of Value Propositions to the same Role and have different perceptions about which Role receives these Value Propositions.
- Even when experts described the same topics, the wording and terms of use were highly heterogeneous.

To some degree, these diverse perspectives may be intrinsic to the research design based on semi-structured interviews (Barriball & While, 1994; Burnard, 1991; Diefenbach, 2009). Another reason may be the different industry and personal backgrounds of the experts. In any case, four reoccurring phenomena can be observed which complicate the cross-company collaboration:

- Experts use different levels of abstraction when talking about Business Model, Roles and Value Propositions.
- Experts use patterns associated with their own company or other companies they have experienced.
- An unambiguous, common cross-company vocabulary is missing.
- Different experts do have a significantly different understanding of how value is created in the specific domain.

These results from the primary analysis show the need for a common conceptual framework which is fundamental for managing cross-company collaboration. The application of Value Delivery Architecture Modeling can substantially contribute to this.

4.3 Frame of Reference for the Value Creation Network

Applying the VDAM approach, we identified 21 different Roles and the corresponding Value Propositions that Actors (companies) can take on in the area of fast charging infrastructure. To derive these Roles and Value Propositions, we used the methods of abstraction (integration of Roles and Value Propositions) and structuring (creation of new Roles and Value Propositions) to fulfill the VDAM specific requirements for Value Delivery Exchange Diagrams. To minimize the potential of misunderstanding, we described all elements and their relationships in a semi-formal domain ontology, as described in Sect. 3. Thereby we developed an explicit frame of reference for the value creation network under consideration.

To illustrate the VDAM development process of a Value Delivery Exchange Diagram in more detail, we exemplify this process with one of these Roles, the so-called *Charge Point Operator* (*CPO*) Role. All experts mentioned the Role *CPO* but there were many different associations to what exactly this Role is supposed to do (Activities) and what Value Propositions this Role is offering or receiving. To

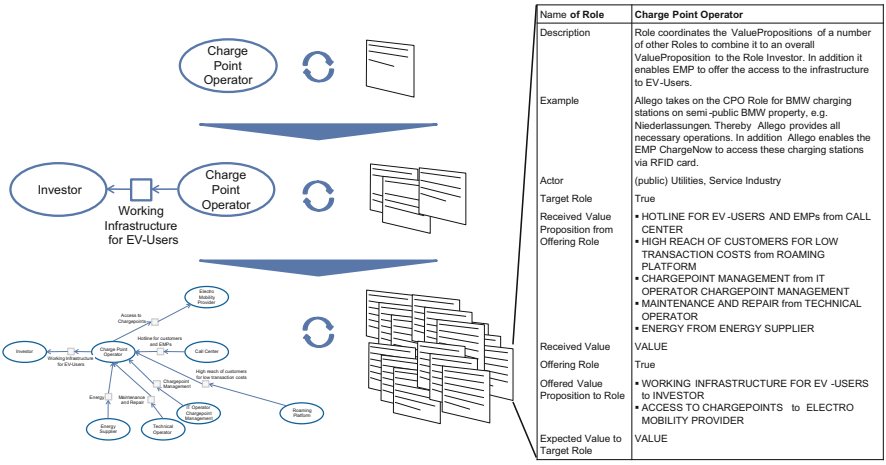

Fig. 5 Example of the iterative process of visualization and ontology building in VDAM

explicitly describe the Role, a first version of the ontology entity *CPO* was developed. In the iterative approach of analyzing expert opinions and defining and visualizing Roles and Value Propositions, the Value Proposition Exchange Diagram was constantly growing and changing. Simultaneously, the corresponding ontology element of the Role *CPO* became more detailed and other related ontology entities were described. Thus we created the desired unambiguous understanding of elements as well as the corresponding value creation and delivery (see Fig. 5). In the case of fast charging infrastructure it became evident that the Role *CPO* is mainly organizing the actual operations of charging infrastructure by coordinating several Roles as well as their Value Propositions and offering the result to the Role *Investor*. In addition, a second Value Proposition *Access to Charging Points* is offered to the *Electro Mobility Provider* Role.

In several iterations, we were able to map a consolidated view of the complex overall value creation network (see Fig. 6). This view includes 21 Roles and 29 Value Propositions. In the case of fast charging infrastructure it becomes apparent that even though the VDAM approach reduces heterogeneity resulting from disparate views, it also maps the actual complexity of the situation: the graph shows a considerable number of Roles and Value Propositions.

4.4 Positioning of Companies in the Frame of Reference

Using the Value Proposition Exchange Diagram as a frame of reference allows for an exact positioning of business models of companies. Fig. 7 demonstrates the general process of linking Roles to Actors (that is concrete firms) based on the expert statements. In the displayed case, the expert originally mentioned nine

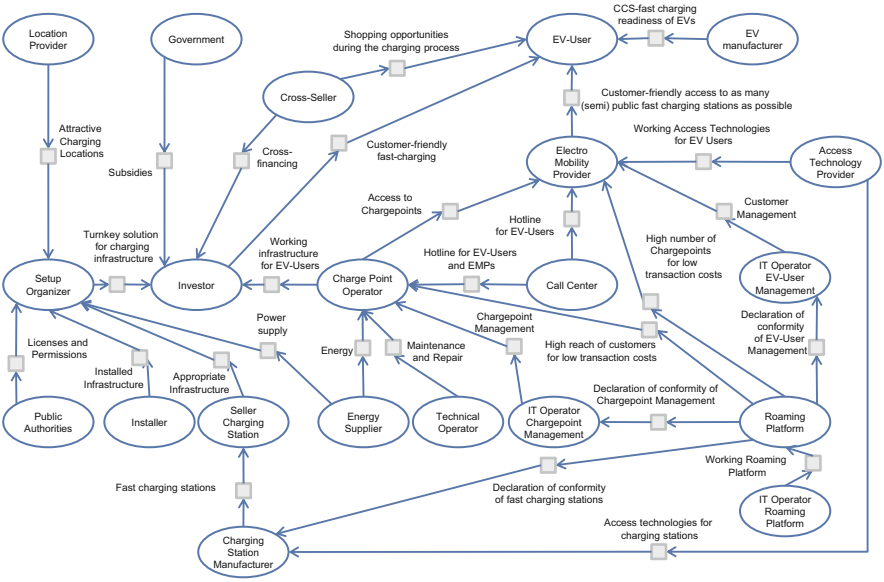

Fig. 6 Value Proposition Exchange Diagram of the fast charging infrastructure domain in Germany

Roles. In her perspective, her company occupies the roles EV Manufacturer, Charging Location Provider, Electro Mobility Provider, and Investor. After deriving the consolidated view, it is possible to allocate her perspective in that broader picture. Instead of filling four Roles as stated in her own description, the consolidated VDAM view shows that the company is in fact assuming six Roles.

Instead of three Roles which are filled by partners, there are four Roles. Additionally, in this specific case it becomes obvious that the expert described an oversimplified view on the value creation network. Therefore, a larger number of Roles offer Value Propositions to Roles which her company is assuming.

By following this approach of placing business model views of individual experts into the VDAM-referencing framework, a comparison of business models becomes possible. This can be used as foundation for various types of analysis. Additionally, understanding what Roles competitors, partners and other companies in the value network assume, allows for a more informed decision on partnerships. All these aspects are key to prepare informed decisions on if and how a new business model should be implemented or if the existing business model needs to be innovated.

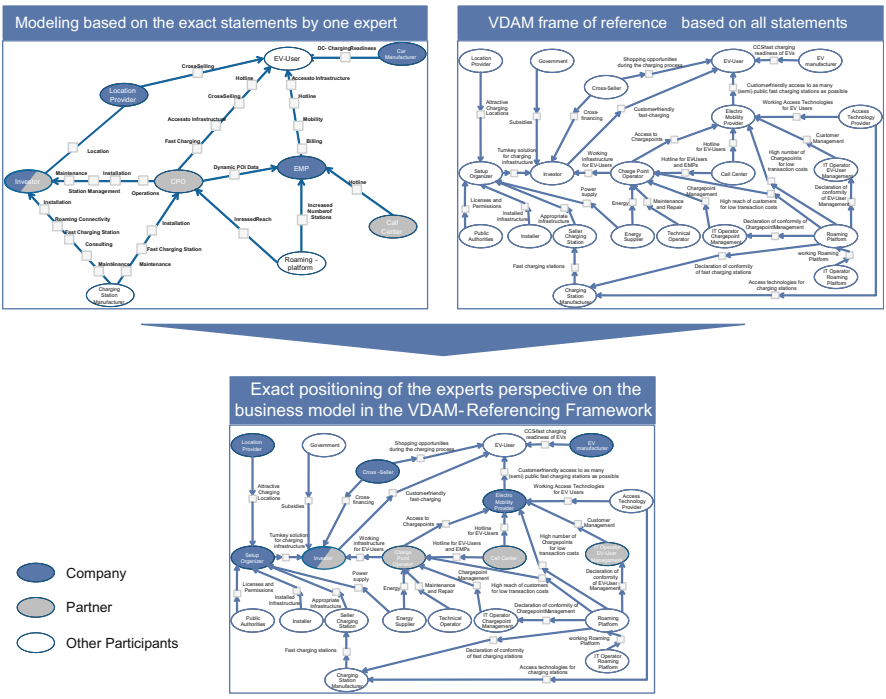

Fig. 7 Example of the positioning process of individual business models in the Value Proposition Exchange Diagram

4.5 Analysis of Value Creation and Existing Business Models

We used the Value Proposition Exchange Diagram to conduct four types of analysis based on the empiric data from the expert interviews. Two of these analyses are on the level of the overall value creation network and two are on the level of individual business models of companies:

- Analysis of Roles in the value creation network,
- Analysis of the competitiveness or complementarity of Roles,
- Analysis and comparison of companies with the same industry background,
- Analysis and comparison of all companies.

4.5.1 Analysis of Roles in the Value Creation Network

Analyzing the Roles in the value creation network displayed in the Value Proposition Exchange Diagram is conducted without taking the positioning of specific companies into consideration. By analyzing the Roles in the value creation network, the understanding about value creation in a domain can be deepened and

potentials for business model opportunities can be carved out. Looking at the Roles in the area of fast charging infrastructure in Germany several interesting facts about this emerging industry can be revealed:

Four Roles, namely *EV Manufacturer*, *Electro Mobility Provider*, *Investor*, and *Cross-Seller* have a direct Value Proposition for the Role *EV-User*, thereby occupying the B2C interface. Additionally, there are two Roles which can be placed into the public or governmental sector, namely *Public Authorities* which offers *Licenses and Permissions* to the Role *Setup Organizer* and *Government* which offers *Subsidies* to *Investor*.

In addition, a number of Roles with a high level of interrelatedness appear. These Roles are characterized by coordinating and thereby combining a high number of Value Propositions from other Roles to subsequently integrate them to one new Value Proposition. Therefore these Roles are acting as hubs, adding value to the complex network by system design.

Examples in the area of fast charging infrastructure are the *Setup Organizer*, *Charge Point Operator*, *Electro Mobility Provider*, and *Investor*. Two of these Roles have a major impact to facilitate the level of engagement by the *Investors* by coordinating a high number of Value Propositions of other Roles and offering a combined Value Proposition to the *Investor*. Other Roles like *EV Manufacturer*, *Charging Station Manufacturer* or *Energy Supplier* add value to the system by offering Value Propositions which are based on specific expertise and Capabilities from the respective industry types, namely automotive, electro-technology, and energy sector.

It is interesting to note that the level of granularity of the value creation network is not something absolute, but depends on the context. As an example, a car manufacturer is part of a very complex supply network that does not appear in our model. In contrast, the electric vehicle is considered as a whole. Depending on the business model in question, various levels of aggregation may make sense. In the context of fast charging stations, the interview statements of the experts determined the degree of granularity of the representation. In any case, VDAM has the flexibility to capture further details and extend the framework if needed.

4.5.2 Analysis of the Competitiveness or Complementarity of Roles

The positioning of the experts' companies in the frame of reference (Fig. 7) is necessary for this kind of analysis. One starting point is to look at the number of Roles assumed by a company as displayed in Fig. 8.

The Role assumed by most companies is *Seller of Charging Stations*. This is remarkable because only three of the interviewed experts stated that their company is actually providing charging infrastructure technology (Role *Charging Station Manufacturer*). This fact shows that the Role *Seller of Charging Stations* delivering to the Role *Setup Organizer* is appealing to companies from industries other than technology providers. It therefore shows a high degree of competition.

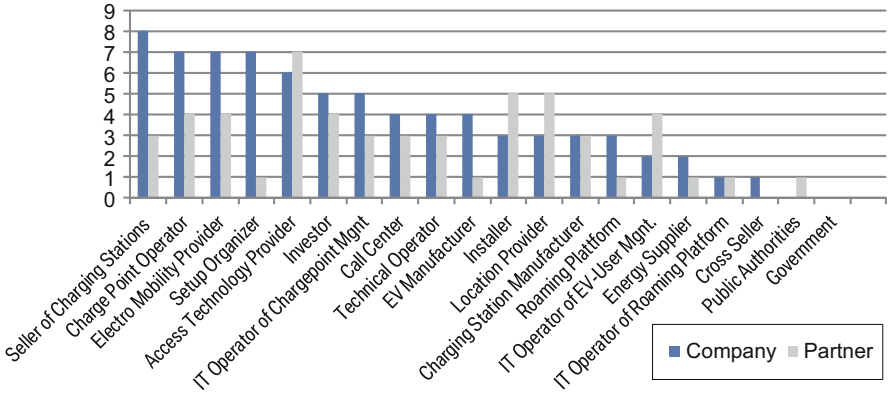

Fig. 8 Roles assumed by companies or Roles assumed by their respecting partners

The Roles *Charge Point Operator*, *Setup Organizer*, and *Electro Mobility Provider* rank second. This might be explained by the fact that these Roles are characterized with a high number of receiving Value Propositions. These Value Propositions are coordinated and combined to be offered as a single Value Proposition, or in the case of *CPO*, as two Value Propositions. Therefore we can conclude that coordinating Roles are appealing to Actors from different industries, too, and therefore reach a relatively high level of competitiveness.

Looking at the Roles which only few experts mentioned, it becomes apparent that only one expert stated that her company is filling in the Role *Cross Seller*. This is noteworthy because this is one of only four Roles that have a direct Value Proposition to *EV-User* and therefore is active in the B2C business. Analyzing the number of statements towards Roles that are assumed by partners of the companies, it becomes evident that the Role *Access Technology Provider* is of great importance to many Actors. This Role profits from the fact that its products and the corresponding Value Propositions build the technological interface which enables *EV-User* to authenticate at charging stations.

On the other hand, almost all experts did not name Roles from the public or governmental sector as partners. The fact that *EV-Manufacturer* did also just get mentioned by one expert is astonishing because the Value Proposition *CCS-readiness of EVs* is essential to the system as a whole.

Additionally, there are still some interoperability challenges between EVs and the infrastructure. Therefore the mentions of *EV-Manufacturers* were expected to be higher. Besides that, most Roles got mentioned as partners 3–5 times which supports the interrelatedness of roles and the complex value creation network in this domain.

4.5.3 Analysis and Comparison of the Positioning of Companies with the Same Industry Background

After describing ways to analyze the overall value creation network, we now focus on the positioning of individual companies. This analysis help in decision making processes about the entrepreneurial engagement of companies with specific industry backgrounds:

Six experts from five automotive companies took part in the study. Companies from this industry show very diverse levels of engagement in the new field of fast charging infrastructure. Interestingly, even the two experts from the same automotive company had different perceptions on which Roles are filled by their employer. Nonetheless, they agreed that their company assumes all Roles with direct contact to *EV-User*, thereby offering a holistic Value Proposition to this Role.

Other firms from the automotive industry show much less engagement in the area of fast charging infrastructure. Two experts stated that their company does not fill any Role in the value creation network at the moment, not even *EV Manufacturer* with the Value Proposition *CCS-fast charging readiness of EVs*. Based on the statements of the experts, two of the remaining three companies from the automotive industry act on a limited scale as *Investors*. One of the companies is active as *Access Technology Provider* due to the fact that the company implemented Power Line Communication as an authentication technology into their cars.

Looking at the companies from the energy sector it becomes apparent that all of them assume the Roles *Charge Point Operators* and *Setup Organizer*, thereby offering the two existing Value Propositions to *Investor*. But only two of the five companies do also act as *Investors* themselves. Besides that, four out of five companies are active as *Electro Mobility Provider*. Therefore, companies from the energy sector are highly active in three of the coordinating Roles mentioned above. Additionally, four out of five companies fill the Role *Seller of Charging Stations*.

Companies from the electro-technology area are active as *Charging Station Manufacturers*, *Technical Operators*, and *IT Operators for Charging Station Management*. Thereby they offer a holistic Value Proposition for fast charging stations. All of them fill the Role *Seller of Charging Stations*, but also have partners to support their own engagement in this Role. For all companies *Access Technology Provider* is another important partner. In general, electro-technology companies tend to focus on Roles close to their original industry and area of expertise and show only little engagement in other parts of the complex network.

The picture of the companies from the service industry is more diverse. Two of the three companies from the service industry are active in the Role *Roaming Platform* and closely related Roles, focusing on the B2B business. One of the two companies is acting as *Electro Mobility Provider* too, thereby expanding its reach towards the B2C business. The third company from this industry focuses on the Roles with access to *Investor*. This company is able to offer these highly complex Value Propositions *Turnkey Solutions of Charging Infrastructure* and *Working*

Infrastructure for EV-Users by having a widespread net of partners in all necessary Roles. Thereby this company needs the Capabilities 'Integration' and 'Coordination', as well as 'Project Management' to fulfill its Value Propositions.

4.5.4 Analysis and Comparison of the Positioning of All Companies

Shifting the analysis and comparison towards the specific positioning of all companies in the study, a number of additional observations can be made:

In general, primarily companies from the automotive and the energy sector compete for access to the *EV-User*. Especially the Role *Electro Mobility Provider* is of particular interest to companies from both industries. Other Roles with a relatively high degree of competition are the Roles with direct Value Propositions to the *Investor*. Mainly companies from the energy sector fill these Roles but there is competition from companies from other industries, e.g. Services, too. A Role with little competition is *Cross-Seller*. Even though this Role has a direct Value Proposition to *EV-User*, only one expert stated that her company fills this Role and no other expert mentioned this Role as a partner.

Even less attention is given to the public or governmental Roles as partner. This is a surprise due to the complexity of regulations for installing fast charging infrastructure and the general calling for subsidies as initial aid for the implementation of fast charging infrastructure in Germany. The willingness to act as *Investor* is relatively low. Only five of the experts stated that their company fills this Role, mostly with a relatively low level of engagement. All other companies simply want to participate in the market without bearing the risk of high investments.

In conclusion, the different types of analysis described enable to deepen the understanding on a number of aspects. Besides a clearer picture of the value creation network in the domain of fast charging infrastructure, it is possible to carve out indications about the competitiveness of different Roles. By looking at the specific positioning of companies active in the domain, conclusions towards current and future potential engagement of companies from certain industries could be drawn. All of these analyses support the decision making process of innovative enterprises or firms already active in the field.

5 Conclusion

The post-industrial economy can be characterized as a highly networked economy. Focusing on core competencies and creating adequate partnerships with other firms are key strategic activities in such contexts. We think that the well-known business modeling approaches do not fully account for the increasing importance of understanding the value creation network and the successful positioning of a firm within this network.

In order to fill this gap, we described the 'Value Delivery Architecture Model' approach to analyze, evaluate and design business models and their embeddedness in the value creation network. We have applied the method to the specific case of fast charging infrastructure for electric mobility in Germany and gave a first impression of the breadth and depth of analysis that the method makes possible.

We are well aware about some limitations of what we present. In developing VDAM, we are following a design science approach. In the paper, we have focused on the description of the artifact, and have provided some evidence for its usefulness.

The validation of the approach is still work in progress. In the case of fast charging stations, we still want to validate the consolidated VDAM view by presenting it to the experts and gathering their explicit feedback on the artifact. A successful application of VDAM in this case can also be considered a validation of the method. Further applications in entrepreneurial practice must be performed to gather further data, detect possibilities and limitations and develop the method further.

Nevertheless, we think the first results are very promising and are confident that Value Delivery Architecture Modeling is valuable to researchers and practitioners. VDAM is based on the new expressive business modeling language VDML and semi-formal ontologies. These artifacts create an explicit frame of reference for the value creation network of a given domain which can be useful in various situations. VDAM addresses one of the truly complex entrepreneurial tasks, namely understanding the value creation network and creating a novel value proposition that is relevant in that overall setting.

In our use case, we were able to visually document how heterogeneous the views of the different experts were. In an emerging market, this may be natural, but creating a common understanding or even defining the 'rules of the game' of value creation and delivery is one of the key success factors for entrepreneurial action. In creating a consolidated view of various expert statements, the VDAM approach is a key tool for business development in newly emerging value creation networks.

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