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Comparing Two Business Model Ontologies for Designing e-Business Models and Value Constellations

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Abstract

Business models have been an important topic in various disciplines and particularly e-business. Yet, little research has tempted to compare and integrate the different business model approaches. This paper compares two business model ontologies, the Business Model Ontology BMO and the e3value ontology, for the design of business models and value constellations. For that purpose it introduces a framework that allows the comparison of different conceptual approaches to business models. The two ontologies are illustrated through a case study in the domain of rights music management. The outcome of the analysis is twofold. Firstly, it permits a better understanding of business model research. Secondly, it highlights the possible paths to integrate the two ontologies in order to improve the representation, design, and analysis of business models.

1. Introduction

Over the past few years, business models have been an important topic in various disciplines such as business and computer science (Pateli and Giaglis 2003). The Bled Conference cycle has paid particular attention to the topic (Klein and Loebbecke 2000; Papakiriakopoulos and Poulmenakou 2001; Osterwalder and Pigneur 2002; Pateli and Giaglis 2003; Krueger, van der Beek et al. 2004; Shubar and Lechner 2004; Yousept and Li 2004). Various aspects have been addressed such as business model *taxonomies* (Timmers 1998; Rappa 2001), *industry-specific* business models (Krueger, van der Beek et al. 2004; Rappa 2004; Shubar and Lechner 2004; Yousept and Li 2004) and *reference models* (Hamel 2000; Linder and Cantrell 2000), and *meta-models* or *ontologies* (Gordijn 2002; Osterwalder 2004). In this paper we are focusing on business model *ontologies* and their contribution to the design of e-business models. In philosophy, an ontology is seen

as a theory of what exists (Orman Quine 1961) so an e-business model ontology should explain *what an e-business model actually is*. As such, it provides the ground layer for industry specific business models and taxonomies.

Currently, a few ontologies on e-business models are available. In this paper, we employ two of these ontologies for comparison: the Business Model Ontology (BMO) (Osterwalder 2004) and the *e³value* ontology (Akkermans, Baida et al. 2004). The motivation for this comparison is twofold. On the one hand we want to understand the similarities and differences between the two ontologies and thus enhance the understanding of what e-business models actually are. On the other hand we aim to integrate the two ontologies in order to improve the representation, design, and analysis of business models.

The in-depth comparison of different business model approaches and the prospect of merging their strengths and eliminating their weaknesses is unique to the relatively young field of business model research. So far the different business model approaches have existed relatively independent from each other. An additional contribution of this paper is a generic framework for comparison of e-business model ontologies. It can be used to compare other ontologies also.

We first give an overview of the business model concept and explain the term business model ontology. Then we introduce a case study that shall allow us to illustrate the two ontologies, BMO and *e³value*, which are analyzed in this paper. We afterwards outline a framework to compare the ontologies on the basis of a set of parameters. Subsequently, we describe the outcomes of the comparison and outline similarities, overlaps, differences and complementariness. Finally, we sketch out how BMO and *e³value* could be integrated before concluding and proposing further research.

2. The Business Model Concept and Ontologies

In literature, the notion of ‘business model’ is interpreted in the following ways: (1) as a *taxonomy* (such as e-shops, malls, auctions) and (2) as a *conceptual model* of the way we do business. Taxonomies enumerate a *finite* number of business model *types* (e.g. Bambury 1998; Timmers 1998; Rappa 2001; Weill and Vitale 2001), while a conceptualization of ‘business model’ describes a *meta-model* or a *reference model* for a specific industry, allowing to describe an *infinite* number of business models (e.g. Chesbrough and Rosenbloom 2000; Hamel 2000; Linder and Cantrell 2000; Mahadevan 2000; Amit and Zott 2001; Applegate 2001; Petrovic, Kittl et al. 2001; Weill and Vitale 2001; Gordijn 2002; Stähler 2002; Afuah and Tucci 2003; Osterwalder 2004).

The evolution of business model research can be categorized in five phases (cf. Figure 1). During the first phase, when the term business model started to become prominent, a number of authors suggested business model definitions and classifications (Timmers 1998; Rappa 2001). In the second phase authors started to complete the definitions by proposing what elements belong into a business models. At first, these propositions were simple shopping lists, just mentioning the components of a business model (Chesbrough and Rosenbloom 2000; Linder and Cantrell 2000; Petrovic, Kittl et al. 2001; Magretta 2002). Only in a third phase followed detailed descriptions of these components (Hamel 2000; Weill and Vitale 2001; Afuah and Tucci 2003). In a fourth phase researchers started to model the components conceptually culminating in business model ontologies (Gordijn 2002; Osterwalder 2004). In this phase models also started to be more rigorously evaluated or tested. Finally, in the ongoing fifth phase, the reference models are being applied in management and IS applications.

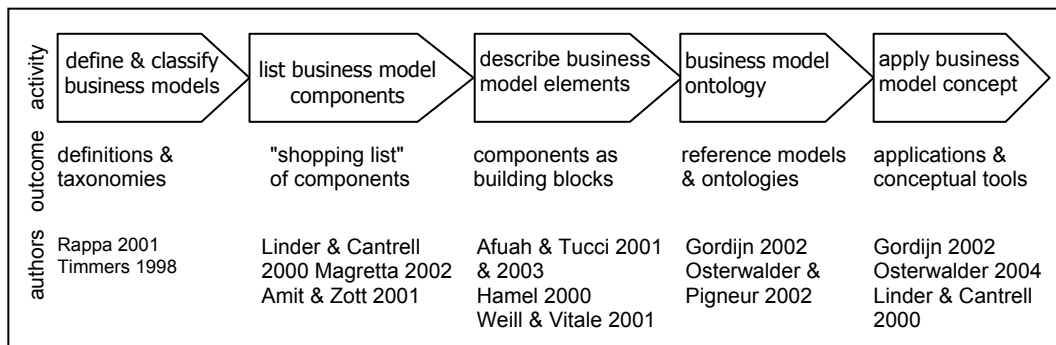


Figure 1: Evolution of the business model concept towards ontologies and applications

The paper at hand compares two e-business model ontologies. The aim of an ontology is to create a *shared, formal, and explicit conceptualization* of, in our case, an *e-business model* (Borst 1997). As we will see later on, both ontologies have a slightly different interpretation of ‘business model’, but for now it suffices to say that a business model consists of set of elements and their relationships and expresses the business logic of firms. The notion of *conceptualization* refers immediately to *business model*. A *conceptualisation* is a model of reality, here of the business logic. The notion of *shared* refers to idea that stakeholders should interpret a business model in the same way (ontological commitment); this is specifically important for e-business since many stakeholders from multiple enterprises are involved. Ontological commitment typically is reached by basing the ontology on accepted terminology in the field, which is exactly what both ontologies do. The notion of *formal* refers to a machine-processable e-business model, such that software can support and analyze a business model. To do so, an e-business model should be *explicit*; that is not only in the minds of people, but written down.

We limit the comparison in this paper to two mainstream ontologies. Future research could include, study and compare other ontologies that may qualify for the fourth phase of business model research. Different candidates would be the Resource-Event-Agent (REA) Ontology (Geerts and McCarthy 1999) or the Service Ontology (Akkermans, Baida et al. 2004), which complements the *e³value* Ontology studied in this paper.

3. Case Study

3.1 Case Study Outline

To compare the BMO and *e³value* ontology, we use a case study about the clearance of music rights, including the special case of clearing music for Internet radio stations. The case study is based on a longstanding cooperation with one of the Dutch right societies. It focuses on one particular intellectual property right (IPR) in the music business, which is the right to *make public*. This right needs to be obtained by everyone who plays music in public, which is outside a private environment. Other IPRs, such as, for example, the right to download music from the Internet are not addressed by the case study.

The case study includes three actors, which are *right users, right owners* and *right societies*. Right users acquiring this right to make public include radio & television stations, restaurants, bars, barbers, in short every one who plays music in public. Right owners possessing these rights are artists, producers, composers, and text writers. The intermediaries positioned between the right users and right owners are called right

societies and are of particular interest for this paper. These societies obtain a fee from right owners for clearing the *right to make public*. Furthermore, they collect and redistribute the fees owned to right owners by right users.

A comprehensive and rapidly understandable business model for music rights clearing is difficult to develop because a) several rights have to be addressed (in this paper we focus on the right to make public), b) numerous right users are involved, c) various right owners are implicated, d) many right societies are concerned, and e) regulations differ on a per country basis.

The reason there are so many right societies is because they often only clear and/or repartition a single right for a specific right user/owner combination in a particular country. Consequently, countless right societies exist. Another particularity adding to the complexity is that laws under which societies operate often differ from country to country. Thus, in this paper, we limit ourselves to the Dutch situation and we only consider the right to make public.

3.2 BMO

Figure 2 presents the ‘clearing rights’ case study using the BMO ontology. It takes one of the right societies, called *SENA*, as a point of departure. For reasons of space, only the top-level concepts of BMO are presented. Also, we do not introduce BMO in detail. For more information see (Osterwalder 2004).

The value proposition represents the offer of *SENA*. Its targeted customer segments embraces the groups of people and organizations it wants to address, including Internet radio providers. The customer segments are reached through distribution channels and *SENA* establishes a specific type of relationship with them. The value configuration describes the activities necessary to provide the company's value proposition, whereas the resources and core capabilities outline what the company has to dispose of to provide its offer. *SENA*'s main activities are clearing rights and repartitioning the due fees. The Partnership Agreements explains who assists the company in doing this and what they supply. Finally, the revenue stream describes where the money comes from, while the cost accounts estimate the expenses.

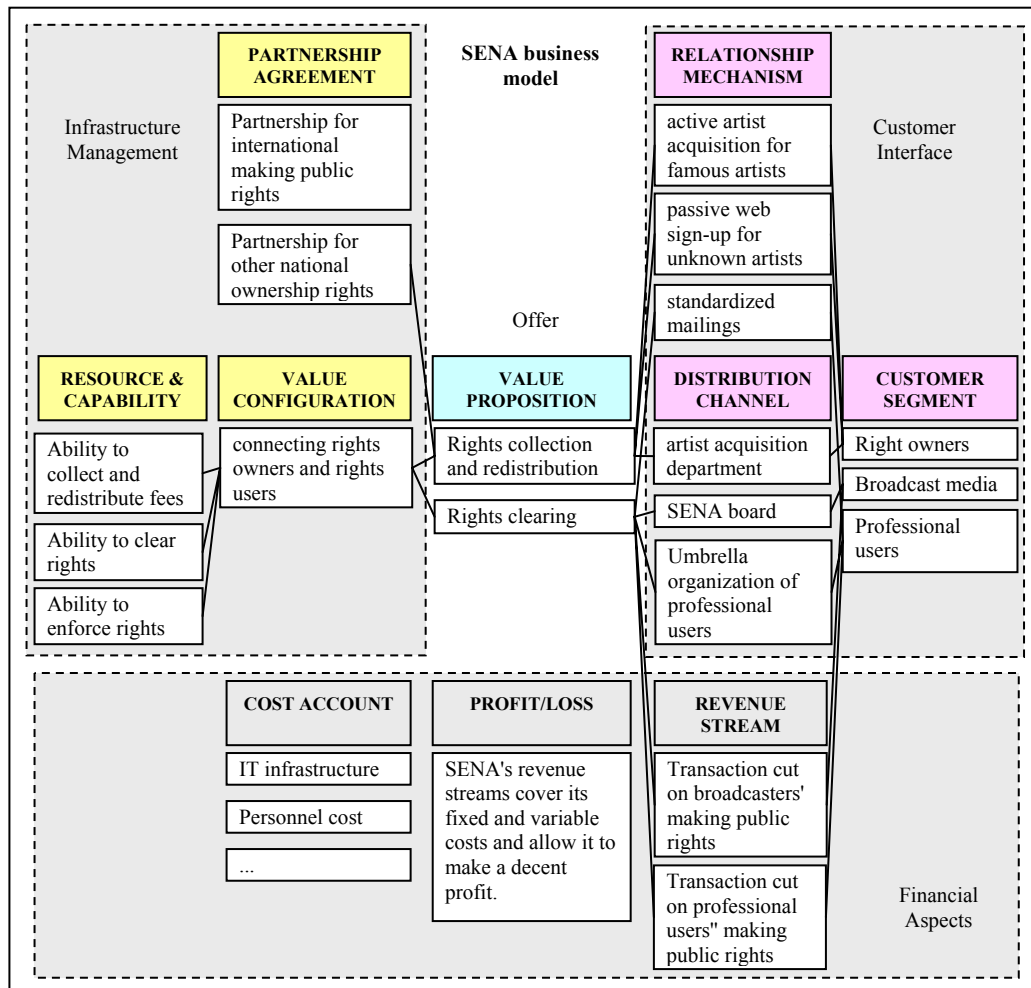


Figure 2: 'Clearing rights' case study using the BMO ontology

3.3 e³value

One specific case of rights clearing is related to Internet radio. If Internet radio stations broadcast a music track, they have to obtain the rights for doing so.) Figure 3 (a) shows a value model based on the *e³value* ontology (for more information on the *e³value* ontology, please consult (Gordijn and Akkermans 2003)). Figure 3 (b) presents the profitability sheets that can be generated out of the model. The value model shows the actors involved (both enterprises and final customers). The listener is the final customer. This listener has a need 'enjoy music'. This need is satisfied by obtaining a radio stream from an Internet radio station. In return, the listener offers 'audience', which is used by the Internet radio station to attract advertisers. The rights user, here the Internet radio station, performs a value activity (broadcast music) to create its profit. To do so, the station needs to obtain the right to make a music track public from two right societies. The first society clears the rights on behalf of the artists and producers, while the second society does the same for the composers and text writers. Societies can perform two value activities 'clearing' and 'repartitioning'. Clearing is about collecting money from right users; here Internet radio stations. Repartitioning represents the activity of paying money

to right societies. By following the path, it is easy to observe which values need to be exchanged if a need occurs.

The model can be attributed with so-called *valuation* functions. These represent the price of objects delivered. For instance, the valuation function of the right to make public is 0.00083 Euro, according the RIAA/DCMA rules in the US. Additionally, other constructs can be attributed with properties such the need/start stimulus construct. With the need, the number of occurrences per timeframe is associated. Based on the value model and the quantitative attributes such as the valuation functions and the number of occurrences, a software tool can generate a profitability sheet (Figure 3 (b)) showing the ingoing and outgoing cash flows. Because the underlying numbers of this sheet can be easily changed in the value model, it is possible to assess various model assumptions (such as the estimates in the number of occurrences of customer needs).

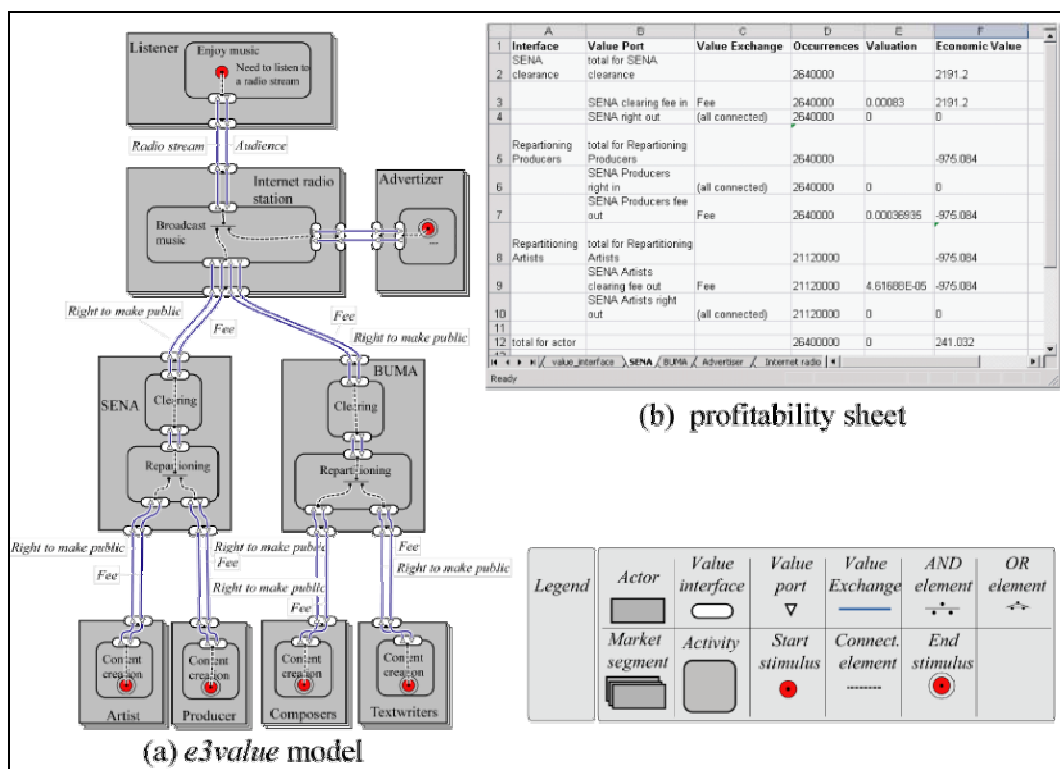


Figure 3: 'Clearing rights' case study using the *e³value* ontology

As can be seen, the focus of a value model expressed using the *e³value* ontology is on the value constellation: a number of actors creating, exchanging and consuming things of economic value.

4. Comparison Framework

In this paper, we compare *e³value* and the BMO to ultimately arrive at a more comprehensive ontology for the design and analysis of business models for networked value constellations. We aim at identifying the similarities and difference of both approaches in order to find out if they can be merged and if it makes sense to integrate them. This could lead to further research to connect both ontologies, such that we can employ both *e³value* and BMO for the representation, design, and analysis of business

models. To do so, it is first necessary to have a thorough understanding of both ontologies, to know their differences and overlap. Only then it is possible to produce a consistent and well related overall ontology. Furthermore, the framework will also allow to analyze other approaches, such as those mentioned in the literature review, to constantly improve the methods and concepts employed to design and analyze business models.

Table 1: Comparison of ontology characteristics

Parameter of comparison	Ushold and Jaspers (REF)	Patell and Giuglis (REF)	Description of the parameter of comparison
Purpose of the ontology	X		Explains the motivation to use ontologies in the business model domain. This parameter serves as a first significant indicator to understand the differences and overlaps between different approaches. Purposes can be, but are not limited to, improved communication, interoperability, system engineering aspects such as re-usability, searching, reliability, specification, knowledge representation and acquisition.
Business model definition		X	Definitions are used to capture the scope and interpretation of a business model approach. Business model definitions vary considerably according to the different authors.
Focus of the ontology			The locus of attention differs from approach to approach. Some have an enterprise centric view, others focus on value constellations. Some concentrate on strategy, others on operational aspects. Some pay particular attention to technology, others to business innovation and some to both.
Ontology content & components		X	Content refers the actual concepts, relationships, and rules/axioms the ontology uses to represent a business model.
Origins			Ontologies are based on already known knowledge. The various business model concepts and ontologies emerged from different backgrounds, such as business strategy, e-business, innovation theory or computer science and thus convey different inheritances and assumptions.
Ontological role	X		Ontologies generally have three different roles. They can contain operational data (L_0), concepts, relations and axioms for containing operational data (L_1), or they can be a language to express ontologies at level L_0 and L_1 (L_2).
Actors using the ontology	X		This parameter describes the different ontology actors, which are the parties that interact with the ontology.
Supporting technologies	X		Supporting technologies for ontology development and use are indispensable. This parameter describes the use of generic ontological technologies for representing ontologies (e.g. Ontolingua, RDF/S, OWL), for ontology design (e.g. Protoge), for ontology interchange, ontology merging, ontology versioning, ontology migration and other purposes. b) Domain specific ontological technologies: Both <i>e³value</i> and BMO have specific tool support to enable business developers to develop business models.
Ontology maturity & evaluation	X		The degree of maturity of an ontology refers to its evaluation and use. Evaluation can cover different indicators and forms of measurements. One important type of evaluation is how much an ontology has been applied and to what kind of problems (e.g. academic examples or real-world companies).
Representation	X	X	Comprises the amount of data represented and the degree of formality. With respect to the amount of data, there are <i>light-weight</i> ontologies that consist of a limited number of concepts, relations and axioms (order of magnitude tenths), and there are <i>heavy-weight</i> ontologies (order ten-thousands concepts, relationships and axioms). With respect to the degree of formality of the ontology, we can distinguish <i>highly informal</i> (natural language), <i>structured-informal</i> (a restricted form of natural language), <i>semi-formal</i> (using an ontology language like OntoLingua, RDF/S or OWL), or <i>rigorously formal</i> (formal semantics, theorems, and mathematical proofs of soundness and completeness).

The business model ontology comparison framework we present in this section is mainly based on the work on Uschold and Jaspers (1999) and Pateli and Giaglis (2003). Former have proposed a framework to understand and classify applications of ontologies. Latter have proposed a framework to study, classify and indicate research directions in the domain of business models. The parameters of comparison for our analysis are derived from these two frameworks and are outlined in Table 1 and Table 2. we make a difference between various ontology characteristics on the one hand (cf. Table 1), and the applications of the ontologies on the other hand (cf. Table 2).

Table 2: Comparison of ontology applications

Parameter of comparison	Uschold and Jaspers (REF)	Pateli and Giaglis (REF)	Description of the parameter of comparison
Tool support			This parameter describes tools developed on the basis of the analyzed ontology to design, analyze, evaluate or otherwise manipulate business models.
Visualization			Visualization concerns methods to represents the business model of a company graphically, textually, or both.
Evaluation method for business model instances		X	This parameter describes if there is a method to evaluate a company's business model, which was modelled with the ontology. Such a method may embrace the feasibility, coherence and economic viability of a business model or benchmark it against best practices or other business models.
Change methodology		X	Describes a methodology containing guidelines, steps and actions to transform a current business model into a desired business model.
Classification		X	Some business model approaches outline a set of criteria to classify business model instances.
Other applications			Describes other possible applications of a business model ontology.

5. Comparison

5.1 Ontology Characteristics

In this section we outline the actual comparison of the characteristics of the two ontologies with the parameters described in Table 1.

Purpose of the ontology. We identified 8 different purposes that are partially common and partially unique to the analyzed business model ontologies. The purposes comprise *improving communication*, *inter-company interoperability*, *intra-company interoperability*, *achieving reliability*, *enhance business model maintenance* (i.e. management of business models), *knowledge acquisition*, *provide a basis for scientific research on business models* and, *provide the fundament for enabling support tools* (e.g. for business model design and analysis).

Both ontologies aim at improving various forms of communication. They both achieve this through the representation and shared understanding of a business model by explicit conceptualizations of the business model. However, the approaches differ in their visualization approach (cf. section 7.2). As regards inter-company interoperability the BMO as well as *e³value* want to improve the way companies work together as a networked enterprise to offer a product or service jointly. They aspire to improve the reasoning of value constellation formations between companies. BMO reflects this in the

form of the partnership concept in its ontology, while in e^3value the main purpose of the ontology are inter-company business models. As to intra-company operability the goal of both ontologies is to align business strategy and Information Systems by blueprinting the logic of how a company makes money and to bridge the gap between business strategy and business processes. In this regard e^3value additionally comprises constructs known from process modelling (UML, Petri Nets) and IS requirements engineering & design as complementary ontologies. Relative to the purpose of achieving reliability e^3value -based business models can be checked for various business rules (e.g. the fair-exchange rule: an enterprise offers only something of value to its environment if it gets something of equal or higher value in return).

Furthermore, the model can be checked for sustainability by assessing chances for profitability for each actor involved. BMO does not yet provide any rule-checking, though it is one of its ultimate purposes (e.g. in terms of consistency and economic viability). Relative to knowledge acquisition both ontologies, BMO and e^3value , aim at providing a pre-defined terminology (as an ontology is), the concepts and relationships that can help to elicit a business model. Likewise both ontologies also have a scientific intention. They both seek to provide the fundamentals to be able to compare various business models for scientific purposes. Therefore they aim at proposing a language that can be used to express a business model for subsequent scientific use. Finally, BMO and e^3value alike reason that business models tend to become complex very rapidly and can only be handled efficiently using automated tool support. Consequently they both aspire to make available the adequate computerized tool support to manipulate business models (e.g. design and visualization). The different tools and their maturity are described in section 7.2.

Business model definition. In BMO a business model is understood as a conceptual tool that contains a set of elements and their relationships and allows expressing the business logic of a *specific firm*. It is a description of the *what*, the *who*, the *how* and the *how much* in a company ((Kaplan and Norton 1992; Markides 1999; Hagel III and Singer 2000). In other words it describes the value a company offers (what?) to one or several segments of customers (who?) and the architecture of the firm and its network of partners for creating, marketing and delivering this value and relationship capital (how?), in order to generate profitable and sustainable revenue streams (how much?).

In e^3value a business model is seen as a *constellation of enterprises and final customers* that jointly create, distribute and consume things of economic value. As the BMO, it is a conceptualisation allowing to reason about well-formed constellations and to reason about expected profitability for each enterprise involved.

Focus of the ontology. The focus of the BMO is the company as it aims at conceptually representing the way a specific company does business and its logic as to earning revenues. Nevertheless, the BMO includes the company's network of partners and thus the immediate network value constellation surrounding the company. In contrast to the BMO, the e^3value ontology focuses on *networks of enterprises*, rather than on a single enterprises. It leans on the ideas of Tapscott (2000), that new partnerships and constellations of enterprises emerge to create value for customers, enabled by the Internet as a platform for interoperability.

This difference in focus can be seen in the case study (see section 3): BMO takes SENA as the key enterprise, whereas in e^3value SENA is a player in a constellation of enterprises creating, distributing and enjoying music.

Origins. The BMO's roots are found in management science and information systems research. Its four basic areas of preoccupation of a business model, the value proposition, the customer interface, the infrastructure management and the financial aspects stem from management literature (Kaplan and Norton 1992; Markides 1999; Hagel III and Singer

2000). The proposed business model elements and their subsequent modelling are a synthesis of the whole spectrum of business model literature but also include contributions from management, IS, e-business and marketing literature in general. Its scientific roots originate in so-called design science (Owen 1997) and its recent upsurge in Information Systems research (March and Smith 1995; Au 2001; Ball 2001; Hevner, March et al. 2004).

The *e³value* ontology's roots are found on the one hand in computer science and on the other hand in management science. Computer science, and more specifically the sub-disciplines *requirements engineering* and *conceptual modelling* (Loucopoulos and Karakostas 1995) deliver a way of working: A business model is expressed using a rigor conceptualization such that *automated reasoning* (e.g. about flaws in the model and expected profitability) becomes possible. From management science it borrows terminology: on business webs (Tapscott, Ticoll et al. 2000), value chains (Porter 1985), marketing (market segmentation), accounting (investment analysis) and axiology (Holbrook 1999).

Ontology content & components. The elements that the two ontologies conceptualize are in some cases similar and in some cases they diverge. This section mainly enumerates the concepts and sketches a mapping between the elements of the respective ontologies that roughly correspond (cf. Figure 4). The discussion of overlaps and distinction as well as possibilities to merge the two approaches are raised in section 8 and particularly Table 3.

The elements and relationships conceptualized in BMO encompass four areas which are the offer, the customer interface, the infrastructure management and the financial aspects. The concepts modeled in the ontology are the value proposition, customer segment, distribution channel, relationship mechanism, resources & core capabilities, value configuration, partnership agreement, cost account and revenue stream. In addition the ontology provides the relationships between the mentioned elements.

The elements and relationships conceptualized in the *e³value* ontology encompass the actor, value object, value port, value interface, value activity and value exchange of a business model. In addition the ontology models the dependency, connection, stimulus and AND and OR connections between the element outlined before.

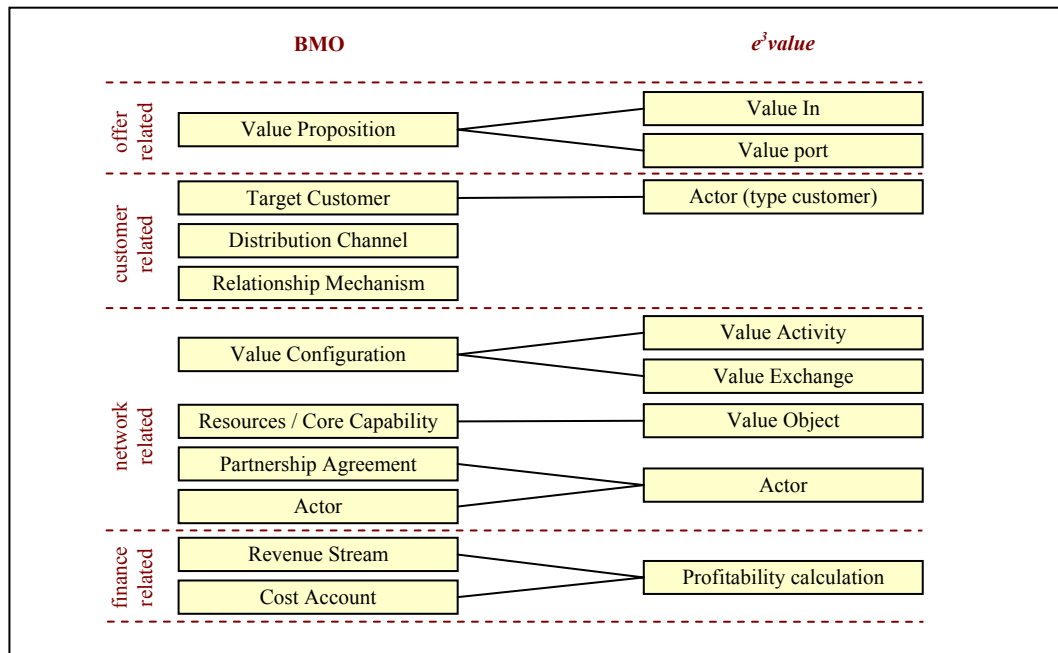


Figure 4: Mapping of similar (but not identical) elements in the respective ontology concepts

Ontological role. BMO and e^3value alike are ontologies at level L_1 containing the concepts, relations and axioms to express a business model. BMO is an ontology described in the Web Ontology Language OWL (Dean and G. 2004), whereas e^3value is described in the Unified Modeling Language UML (Rumbaugh, I. et al. 1999), Resource Description Framework Schema RDF/S (Manola and E. 2004) and Prolog. e^3value 's tool support is implemented in Java.

Actors using the ontology. The BMO ontology differentiates between the following actors:

- The business developer that is involved in designing a business model for a company. This can be a business or IS manager/analyst of a company but in many cases will be an external consultant.
- Business and IS managers or consultants involved in aligning business and IS strategy.
- Stakeholders involved in the execution/implementation of a business model. This can range from business managers and process designer all the way to IT people and software designers, etc.
- Scientist concerned with understanding business models and scientist aiming at developing new theory based on business models.

The e^3value ontology distinguishes the following persons:

- The CxO's: Since innovative e-business models often change a network of enterprises substantially, top-level management of participating companies is involved. Although the e^3value business models are not constructed by CxO-type persons (modelling is rather specialized job), the experience is that e^3value models can be understood by CxO's, because the models are visually expressed.

- Stakeholders responsible for (inter-organizational) business processes: Most business models require a change in the way enterprises work internally as well as the way enterprises interoperate with each others.
- Stakeholders responsible for information technology: The e^3value ontology has been developed specifically for *e*-business models that rely substantially on information technology. In order to develop supporting IT for a business model, the model should be expressed sufficiently precise so that a requirements elicitation track can started for the supporting IT. In other words: A business model expressed in, often ambiguous, natural language is an insufficient starting point for IT development.
- Scientists: The e^3value ontology contributes in saying precisely *what a business model is*. This refers to the use of ontologies as an instrument to state a theory about what exists (Orman Quine 1961).

Supporting technologies. Both approaches analyzed in this paper make extensive use of supporting technologies. Protégé was one of the tools used in BMO and e^3value . Former use it in combination with the Web Ontology Language OWL (Dean and G. 2004) to describe the ontology in a formal way and in order to be able to share it. Latter used it in its capability as a Resource Description Framework Schema RDF(S) (Manola and E. 2004) editor. BMO made use of the Extensible Markup Language XML (Abiteboul, Buneman et al. 1999) to design a language to capture, describe and store business models. e^3value used UML case tools to describe the ontology. Furthermore, e^3value made use of Prolog as a tool to reason about business models expressed using the ontology. Reasoning includes various business rules that should be satisfied. An example is the *fair-exchange* rule: An enterprise offers something of economic value to its environment if s/he gets something of value in return as compensation.

Ontology maturity & evaluation. In terms of maturity and evaluation the two ontologies slightly differ. e^3value has been extensively applied to real world cases, whereas BMO has been applied to 30 different case settings. While both ontologies have been evaluated as to their expressiveness and consistence they both lack a systematic evaluation of their effective performance in relationship to their stated purposes.

BMO has been applied to different case settings and has been used during several semesters of a Masters course on IT management by students. So far the ontology was used in one consulting project of a Swiss SME. Its power of representation can thus be described as reasonably mature. The authors of the BMO outline how the ontology could further be evaluated in terms of usefulness and performance, which is different from its expressive power. They describe how more could be learnt about the ontology's business value through testing with concrete tools (i.e. artifacts) built on the basis of the ontology. This would allow the assessment of a tools' suitability to an intended purpose and would indirectly validate the ontology.

The e^3value ontology has been uses in a series of business development practices in various industries including telecommunication, Internet service provisioning, electricity supply, news provisioning, music and entertainment, and event organization (cf. e.g Gordijn 2002 and (Gordijn and Akkermans 2003) and (Akkermans, Baida et al. 2004)). The ontology is educated during master-level courses at various universities.

Ontological representation. Both studied approaches are light weight ontologies meaning that they contain a limited number of concepts and relationships and axioms. The industrial projects carried out with e^3value and the case studies done with BMO show that modelled business model instances themselves also remain light weight. In terms of formality (Jasper, Uschold et al. 1999) BMO has evolved from a structured informal ontology to a semi-formal one that is described in OWL. e^3value is semi-formal, with

sufficient formality to reason about business rules and expected profitability for the various enterprises participating in the model.

5.2 Ontology Usages

In this section we compare the applications of the two ontologies on the basis of the parameters described in Table 1.

The business model ontology comparison framework we present in this section is mainly based on the work on Uschold and Jaspers (1999) and Pateli and Giaglis (2003). Former have proposed a framework to understand and classify applications of ontologies. Latter have proposed a framework to study, classify and indicate research directions in the domain of business models. The parameters of comparison for our analysis are derived from these two frameworks and are outlined in Table 1 and Table 2. we make a difference between various ontology characteristics on the one hand (cf. Table 1), and the applications of the ontologies on the other hand (cf. Table 2).

Tool support. The two studied approaches differ in the maturity of the tools they supply. The authors of *e³value* provide a set of tools including a visual business modeller, a business model checker and a tool that generates financial spreadsheets out of a constructed business model. They have done this because they have experienced that generic ontology tools are only usable for ontology experts, and not for the intended users of a business model ontology (cf. section 7.1.). The authors of BMO provide a set of IT artifact research prototypes, such as an XML-based description language to capture, describe and store business models, including a channel strategy visualizer. Furthermore, they propose a Business Model Navigator, which allows to navigate in an assessed business model of a specific company and look at it from different perspectives (e.g. customer relationship view, resource-based view, etc.).

Business Model Design. Both ontologies are intended to support the design of business models. They both provide business planners and developers with concepts to outline business models. However, the focal points of the two ontologies are slightly different. As mentioned in section 7.1. BMO centers around the design of a firm's business model, whereas *e³value* concentrates on the design of a value constellation's business model. Similarly, the two approaches differ in some of the elements modelled.

Visualization. *e³value* and BMO highly estimate the value of visualizing business models. Such visualisations are used to explain a model to stakeholders. The BMO approach builds on the use of entity-relationship-type models (cf. Figure 2). Additionally, it proposes specific diagrams, for instance for distribution channel strategies or activity configurations. The *e³value* ontology builds on specific business model constructs for visualizing a business model (cf. Figure 3). Additionally, *e³value* uses an operational scenario mechanism that can be used to “tell” the business model as a story to stakeholders.

Evaluation method for business model instances. The *e³value* ontology allows to automatically calculate the profitability of the business model of a value constellation given a set of assumptions. BMO does not yet allow such calculations.

Change methodology. Both ontologies claim being useful to improve change from one business model to another. Yet, unlike BMO, the *e³value* ontology outlines a veritable change methodology that accompanies the user from the deconstruction of an existing business model to the design and reconfiguration of a new business model.

Classification. None of the two approaches outlines an explicit business model classification scheme. BMO however, outlines how business models may be categorized according to a set of indicators corresponding to the outlined business model elements.

Other applications. BMO proposes the navigation of business models. In other words its observation from different business perspectives (e.g. customer perspective, infrastructure perspective).

6. Discussion

Table 3: Complementary aspects and mutual contributions

area	BMO		e ³ value
Network constellation related concepts	The notion of resources and core capabilities present in BMO and important to business management theory could contribute to e ³ value. Similarly, the reasoning behind partnership agreements in BMO could be integrated into e ³ value.	↔	The e ³ value ontology embraces all the actors of the value constellation of a business case and additionally assesses their interest to participate in a particular configuration. This complementary aspect could be merged with BMO's more company-centric view.
Offer-related concepts	The descriptive nature of BMO and the subsequent structured description of a company's value proposition could be integrate into e ³ value.	⇒	
Customer-related area	The explicitly modelled distribution channels and relationship mechanisms in BMO are complementary to e ³ value and could be integrated.	⇒	
Value exchange related area		⇐	The modelling of value exchanges in e ³ value is very detailed and complementary to BMO. Additionally they can serve as a basis to introduce profitability calculation to BMO, which is absent.
Tool support & usages	Business model navigation and its decomposition in different levels of detail are aspects where BMO is complementary to e ³ value.	↔	The e ³ value design tools are already quite advanced and could serve as a basis for a BMO design tool. Similarly, the e ³ value change methodology is complementary to BMO.

Both ontologies have largely parallel purposes. Similarly they aim at improving the design, understanding, management and analysis of business models. They equally use ontology techniques for knowledge acquisition and representation in the domain of business models. Furthermore, they play the same ontological role. Yet, their different focal points in the design of a business model (firm-centered vs. value constellation centered) and their different strengths open up interesting opportunities for integration. The complementary aspects and the mutual contributions of the two ontologies are outlined in Table 3.

7. Conclusion

In this paper we focused on business models that, as a topic, has received intensive attention over the last several years. Our contribution to this thread of publications is that we tackled a longstanding omission in business model research: the comparison and discussion of eventual integration of different business model concepts. To achieve this objective we selected two business model approaches, the BMO and e^3value ontology that we illustrated through applying these ontologies to the same case study. Then we proposed a framework to compare the different conceptual approaches of business models. Subsequently, we applied the framework to BMO and e^3value to evaluate their similarities and differences in order to understand if it would make sense to integrate the two ontologies. Finally, we proposed in what respect they are complementary and we outlined where the mutual contributions lie. In the area of network constellation-related concepts both ontologies complement each other. In the area of offer- and customer-related concepts BMO has much to contribute, whereas in the value-exchange-related area and profitability calculation e^3value provides important inputs. In the area of tool support and usage both ontologies are complementary, while e^3value disposes of more mature tools.

Further research would include two areas. First, it seems interesting to consider the extension and refinement of the comparison grid, for example to enable the comparison and integration of horizontally related concepts, such as business strategy models or business process models. Second, deriving from this paper it should be possible to consider the actual integration of the two and ontologies, as well as other related ontologies.

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