The MOF perspective on business modelling

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A Meta-Model Perspective on Business Models

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Abstract. The business model field of research is a young and emerging discipline that finds itself confronted with the need for a common language, lack of conceptual consolidation, and without adequate theoretical development. This not only slows down research, but also undermines business model's usefulness for research and practice. We offer a new perspective on business modelling to address these issues. It looks at business modelling from the perspective of the Meta-Object Facility, emphasising the role of models and meta-models. From this new perspective, a commonality analysis can identify the important classes in business modelling. This new perspective on business modelling helps to create a common language, achieve conceptual consolidation and supports theory development; it addresses issues that hinder business model research.

Keywords: Business modelling, Business models, Meta-business models, Meta-Object Facility.

1 Introduction: A Need for Business Model Theory Development

In general, a business model is a simple and, usually, graphic depiction of a company, often using boxes and arrows. It mostly describes a single company, a group of companies, or part of a company. In the broadest sense, a business model is an abstract (which means simplified) representation of the company, a "model of the business". The business model field of research is strongly growing and maturing over the last decade, mostly since 2000 [1, 2]. Since to this date no unified view exists regarding its conceptual foundation, this young and emerging discipline has been described [3] as "finding itself in a state of prescientific chaos", in the sense of Kuhn [4].

Practitioners using business models have a need for a common language, especially since they come from different disciplinary backgrounds: strategic management, industrial organization, and information systems [5]. In addition, links to other research domains are necessary to establish the business model field as a distinct area of investigation [5]. However, researchers still have to build more on each other's work, and research generally advances slowly and often remains superficial [1].

Currently, researchers use different terms to describe similar things, and the same term for different things. *Business model* often means "*a model of a single company*"

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and, specifically, of the way a company does business, creates, and captures value. However, other things are called business model as well, for example when referring to a pattern in the phrasing "*...the freemium business model...*" In addition, ontologies or frameworks such as the Business Model Ontology (BMO), e3-value, RCOV or activity system are sometimes referred to as a business model too [6–9]. In our research, we refer to such frameworks (BMO, e3-value, RCOV) as *meta-business models*. We define these analogous to meta-models in software or systems engineering [10]:

> A *meta-business model* is the set of concepts that is used to create business models. A business model developed from this set of concepts is an instance of the meta-business model.

For example, a meta-business model may define that "*a business model consists of a value proposition, organization, and finances.*" Thus, the meta-business model lays out the rules for modelling a business model. Consequently, a business model is an instance of the meta-model, following those rules. An example of a meta-business model is the BMO [6], which can serve to make a business model of any company. This business model would be an instance of the BMO. However, the BMO is itself also a model. It is a model for creating business models. As such, it is a "*business model*"-model or, in modelling terms, a meta-"*business model*".

Stimulating researchers to build more on each other's work can be achieved by developing instruments for comparing different meta-business models. This can also help the integration with horizontally related concepts such as strategy and processes [11]. "*...A conceptual framework will provide a basis for business model theory development by providing a structure from which researchers can debate, recognize points of agreement and disagreement, identify potential points of integration or linkage along with areas of future research*" (Lambert, 2008). Such a conceptual framework can help to analyse shared or distinctive features of different meta-business models [12].

Consensus on the theoretical underpinnings of the business model concept has not yet been achieved [13], which undermines its applicability in different contexts. "*...The business model remains a theoretically underdeveloped (and sometimes overloaded) concept, which may raise doubts concerning its usefulness for empirical research and theory building*" [2]. For future research, more clarity on the theoretical foundation and conceptual consolidation is necessary [2].

The articles referenced above are all review articles, specifically aimed at providing an overview of the status and developments of business model research and the emergence of the discipline. In short, the most important issues are:

- the need for a common language,
- lack of conceptual consolidation, and
- theoretical development of the concept.

These issues relate strongly to the different meta-business models existing separately. Consequently, using different meta-models may result in different business models of the very same organization. This can have severe consequences. For example, if a business model is used in a requirements engineering process, the resulting require-

ments can vary greatly depending on which meta-business model is used. Unfortunately, because of the gaps in business model research, such problems are hard to address currently.

Another area of research, software and systems engineering, has more experience dealing with a great variety of meta-models, and already addressed the need for a generic framework to manage, manipulate, and exchange these models. This generic framework is the Meta-Object Facility (MOF), created by the Object Management Group (OMG) [14]. The MOF represents a layering of meta-models for describing and representing meta-data: data *about* other data [10]. Although it originates from an object-oriented software design domain, the MOF allows the definition of (meta-) models independent of the application domain.

In this paper, we introduce the MOF perspective on business modelling. Introducing a new perspective on business modelling helps identify differences and commonalities of business modelling languages and concepts. We use the MOF to create a *meta-meta-business model* that promotes further theory development. In doing so, we contribute to advancing the discipline of business modelling.

The structure of the paper is as follows. After having presented the background and motivation in this section, section 2 further explains the MOF. Section 3 provides our main contribution: it applies MOF to business modelling. In addition, it provides examples for each of the layers. This includes suggesting a meta-meta-business model and a graphical example of this new model's use. Section 4 discusses further research possibilities with the introduction of MOF in business modelling. Finally, section 5 shows how this addresses the presented issues of business model research.

2 The Meta-Object Facility (MOF)

The MOF was introduced above as a generic framework for working with a great variety of models and meta-models. This section clarifies the concept. The central idea of MOF is that every model is an instance of some meta-model in an abstract layer above it. Hence, a business model is an instance of a meta-business model. The other way round, every meta-model provides a vocabulary for creating models; these models are instances in an abstract layer below it. Thus, a meta-business model provides a vocabulary for creating business models.

The account of the MOF given here strictly follows Van Halteren [10]. Modelling data in terms of meta-data can continue indefinitely, in theory, with an infinite number of meta-layers. The MOF is defined as four layers only, M0 to M3, as shown in Fig. 1:

- Layer M0 – *instances*: an instance is the flat data, which can describe a running system's state. This data is an instance of elements in the M1 layer.
- Layer M1 – *models*: the model provides the vocabulary for the instance. For example, if the instance is a running system, the model is its source code. The model is itself an instance of the M2 layer.
- Layer M2 – *meta-model*: the meta-model consists of generic elements used for description of the model at the M1 layer. For example, having a system's source code at the M1 layer, the M2 layer is a programming or modelling language such

as java or UML. While the M1 layer is an instance of the M2 layer, this layer is again an instance of the even more generic elements of the M3 layer.

- Layer M3 – *meta-meta-model*: the meta-meta-model consists of the elements providing the most generic vocabulary for the M2 layer. For example, the M3 MOF model can be used to describe a language such as java or UML. While in theory an infinite number of meta-layers exist, for our purpose, we follow the M3 layer as standardized in the OMG MOF specification, also called the *MOF model*.

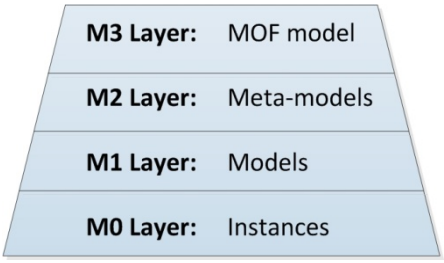

Fig. 1. The MOF layers

The MOF vocabulary comes from the context of object-oriented formalism in software engineering The MOF model itself consists of the following four concepts:

- *Classes*: classes are the primary modelling constructs. These are the central objects that interact with one another. Classes can be organized hierarchically in specializations or generalizations.
- *Associations*: associations are the relations between any two classes. Such a relationship may have a name, cardinality, and type.
- *Data types*: data types are the types used for non-class objects. For example, commonly used data types in the world of programming are integer and string.
- *Packages*: packages are groups of classes and are used to organize models and meta-models. Packages can introduce complex interactions between classes, such as nesting, inheritance, and importing.

The MOF model is a generic meta-meta-model that allows working with a diversity of meta-business models. In using the MOF, ultimately every (meta-) model is defined in terms of classes, associations, data types, and packages. In our attempt to relate business modelling to the MOF, we identify classes only.

3 The MOF and Business Modelling

This section provides our main contribution: it applies the MOF to business modelling, to create a generic framework for business modelling that provides conceptual consolidation, and helps with a common language and further theory development. The most important reason for using the MOF is the perspective it provides on the practice of modelling.

First, subsection 3.1 shows how the MOF layers encompass the business modelling concepts. Second, subsection 3.2 provides general examples for each of these layers. Third, subsection 3.3 treats the M2 layer. The layer as proposed is in fact a layer in the sense of the MOF meta-modelling hierarchy. This subsection addresses the issue of which classes should be on this layer. Finally, subsection 3.4 shows several components at the M1 layer: a commonality analysis of existing meta-business models.

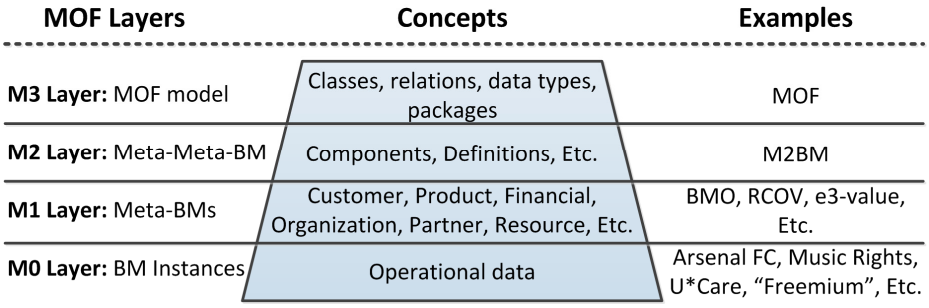

Fig. 2. The MOF layers applied to business modelling

3.1 Viewing Business Modelling from the MOF Perspective

Applying the MOF layers to business modelling leads to Fig. 2. It shows how the MOF layers encompass the concepts of business modelling. It is analogous to Fig. 1. Every (business) model is an instance of a meta-model from the above layer. Applying this notion in terms of the MOF layers, as shown in Fig. 2, leads to the following layers for business modelling:

- Layer M0 – *business model instance*: the central construct of this research area is a business model instance, which can describe an organization, situation, or pattern. This business model instance is an instance of elements in the M1 layer.
- Layer M1 – *meta-business model*: the meta-business model provides the vocabulary for the business model instance. The meta-business model is itself an instance of the M2-layer. Since the instance data is a model already, the terms change compared to the MOF model. In this case, the model from MOF is a meta-business model.
- Layer M2 – *meta-meta-business model*: the meta-meta-business model consists of generic elements used for description of the meta-business model at the M1 layer. While the M1 layer is an instance of the M2 layer, this layer is again an instance of the even more generic elements of the M3 layer.
- Layer M3 – *MOF model*: the MOF model consists of the elements providing the most generic vocabulary for the M2 layer. This is the same model as the top layer of MOF (Fig. 1). The MOF model defines every instance in terms of classes, associations, data types, and packages.

The above description shows that the concepts of business modelling and meta-business models fit effortlessly in the MOF layers. This indicates that the MOF is indeed a generic framework, which works for any form of models and meta-models.

3.2 Simple Examples for Each Layer

Starting from the bottom up, many possible examples exist at the M0 layer for business modelling. Business model instances belong in this layer, therefore, any business model that describes an organization, situation, or pattern would fit here. An example of a real life case is U*Care, a service platform for elderly care [3]. Other examples of a business case as business model instances are two models of the clearing of music rights for internet radio stations [11], and modelling of the development of Arsenal FC over a period of eleven years [8]. A pattern, such as "freemium", also belongs on the M0 layer [15].

At a higher level of abstraction, the M1 layer contains the meta-business models. They provide the vocabulary for the business model instances. Previously often called frameworks or even ontologies, examples of meta-business models are plentiful. For example, the music rights case is modelled in two different meta-business models, e3-value and the BMO [11]. The Arsenal FC case is modelled using the meta-business model RCOV [8]. Fig. 3 in subsection 3.4 provides more examples, while focussing on their components.

Since this is the first time the M2 layer is recognized in business modelling, nobody has presented examples as such at this layer yet. Following the MOF perspective, the M2 layer contains a meta-meta-business model that provides a vocabulary for meta-business models at the M1 layer. This means that such a meta-meta-business model must consist of generic elements that capture meta-business models, such as the BMO, e3-value, and RCOV. Literature that presents a review of business modelling research, such as Zott, Amit and Massa [2], suggest those generic elements. In subsection 3.3, we propose classes for a meta-meta-business model (M2BM) that belongs on the M2 layer.

At the top of the pyramid, the M3 layer has only one example in our case. It is the MOF model itself, which we have explained in Section 2 already. It includes classes, associations, data types, and packages.

3.3 Specifying Classes at the M2 Layer

While an interpretation of business modelling in MOF terminology provides conceptual consolidation, a meta-meta-business model at the M2 layer would provide a common language for business modelling. The meta-meta-business model would be overarching the meta-business models. This subsection researches what is necessary to create such an overarching meta-meta-business model.

First, we present what type of elements should be in the meta-meta-business model. Second, we explain how and where to obtain these elements. Third and final, we suggest several of these elements in the form of classes (Table 7).

What Should Be in the Meta-Meta-Business Model?

Business modelling is the act of creating a business model instance; this is an instance of a meta-business model. The instance is a M0 layer model, the meta-business model is a M1 layer concept. Many of these meta-business models exist already, some with a strong link to information systems, others closely related to strategic management or industrial organisation. For example, Vermolen [16] identified nine such meta-business models published in the top 25 MIS journals. The Business Model Ontology from Osterwalder [6] was also mentioned previously.

All meta-business models, as M1 models, must follow some sort of guidelines defined at the M2 layer. The generic rules for meta-business model should be defined at the M2 layer as a *meta-meta-business model*: M2BM (M2 both for MOF M2 layer and for meta-meta-). Such a meta-meta-business model does not exist yet; however, as the introduction shows, creating it is exactly what different researchers in the business model discipline are asking for.

The different meta-business models at the M1 layer give the first hint of what this meta-meta-business model looks like. Every model at the M1 layer must be an instance of more generic elements at the M2 layer. The meta-meta-business model must consist of such concepts that it allows the creation of any model that can be regarded as an M1 meta-business model.

The required coverage of M2 classes can be discovered with a commonality analysis amongst different meta-business models. For example, all M1 meta-business models propose some set of *components*, so one of the classes of the M2 meta-meta-business model should be *components*.

Several researchers have in fact performed such commonality analyses. We argue that the abstract meta-meta-business model that belongs on this layer should come from review literature on meta-business models. As a review synthesizes the concepts used in business modelling literature, the resulting concepts can be considered instances of classes from the M3 layer.

Review Literature on Business Modelling

An extensive literature survey identified five articles that can aid us in finding out what classes make up the M2 meta-meta-business model. The method we followed consisted of three steps. The first step was a search on Scopus and Web of Science for relevant articles published between 2000 and august 2011, using two queries:

- in title: "business model*"
- in title-keywords-abstract: "business model*" AND ontology OR ((framework OR e-commerce) AND (design OR analysis))

Table 1. Overview of business model review literature

Authors	Title	Year
Pateli and Giaglis [5]	*A research framework for analysing eBusiness models*	2004
Gordijn, Osterwalder and Pigneur [11]	*Comparing two Business Model Ontologies for Designing e-Business Models and Value Constellations*	2005
Lambert [12]	*A Conceptual Framework for Business Model Research*	2008
Al-Debei and Avison [13]	*Developing a unified framework of the business model concept*	2010
Zott, Amit and Massa [2]	*The Business Model: Recent Developments and Future Research*	2011

All results were checked for relevance by analysing the abstract. The second step was an analysis of the articles' content for relevance, searching for presentation of meta-business models, or review of business model research or literature. The third step was selecting those articles usable for creating the M2 meta-meta-business model. Table 1 presents the resulting five articles.

These five articles present a number of concepts that the authors consider important in business modelling. Pateli and Giaglis [5] identify eight streams of research in business modelling. Gordijn, Osterwalder and Pigneur [11] compare the Business Model Ontology and e3-value on a number of criteria. Lambert [12] creates a business modelling framework based on a conceptual framework from the domain of accounting. Al-Debei and Avison [13] identify four facets of business modelling. Zott, Amit and Massa [2] provide the most up to date overview of the state of art of business modelling research.

Paper 1: Pateli and Giaglis, 2004

While eBusiness is in the title of their paper, Pateli and Giaglis provide a framework for business models more generally. They provide a bottom-up review approach for defining an analytic research framework for business models. This literature review forms the basis for selecting research, which they analysed to extract eight elements. They state that these are not necessarily exhaustive, as they base them on pattern identification of the analysed previous research. The eight elements are definitions, components, taxonomies, conceptual models, design methods and tools, adoption factors, evaluation models, and change methodologies.

Many definitions exist, yet none is accepted as standard. In their analysis, Pateli and Giaglis mention several possible dimensions of definitions, ranging from the logic of doing business, to components of a meta-business model, to linking strategy and IS. For the components of a meta-business model, they identified three ways of defining BM components, namely top-down analysis and hierarchical decomposition, matrix analysis, and value analysis. Independently of the way of defining the components, most research identifies similar core elements. The taxonomies element found two factors on which to differentiate: classification criteria and object classified. No exhaustive taxonomy for meta-business models yet exists. Pateli and Giaglis identify two streams of research for conceptual models. The first analyses BMs at one layer (ontology), while the second identifies multiple levels and tries to integrate them. Design methods and tools, as an element, covers methods, languages, standards, and software to use in the development (and subsequent leverage) of business models. The sixth element, adoption factors, handles the beforehand analysis of ("to-be") business models to guide them to success. Evaluation models are similar to the adoption factors, except that they assess success with hindsight. Four reasons for evaluation exist: benchmarking, assessment of alternative business models, risk identification, and economic evaluation (of both feasibility and profitability). The final element that Pateli and Giaglis mention is change methodologies. These provide an approach to implementing a new or changed BM (instance) in the organization.

Table 2. Elements for a meta-meta-business model by Pateli and Giaglis (2004)

Definitions	Design methods and tools
Components	Adoption factors
Taxonomies	Evaluation models
Conceptual models	Change methodologies

Paper 2: Gordijn, Osterwalder, and Pigneur, 2005
After Osterwalder published his PhD thesis about the Business Model Ontology (BMO), he worked with his promoter and Gordijn to compare the BMO and e3-value. They created a comparison framework with parameters based on the work of both Jasper & Uschold [17] and Pateli & Giaglis [5]. This framework was split in two parts, characteristics and applications.

For characteristics, Gordijn et al. use all the concepts proposed by Jasper and Uschold, a few concepts from Pateli and Giaglis, and add some themselves. From Pateli and Giaglis, they use definition, components, and representation. Gordijn et al. add two concepts: focus of the ontology, and origins. The focus of the ontology has several dimensions. Those that Gordijn et al. name are strategy-operational, technology versus business innovation. The concept origins indicates from which area of research the meta-business model emerged, ranging from business strategy to computer science.

For applications, the following concepts of Pateli and Giaglis are used: evaluation, change methodology, and classification (taxonomy). Gordijn et al. add three concepts: Tool support, visualization, and other applications. Tool support describes which tools were developed to support using the meta-business model. Visualization indicates whether the researchers specified a notation to represent (instances of) the meta-business model, whether textual or graphical. The element other applications is a "catch-all" for the element of applications.

From Pateli and Giaglis, the subdomain conceptual models is not used, as both Gordijn and Osterwalder have been classified on the same layer in this subdomain. One more subdomain of Pateli and Giaglis is not used: adoption factors.

Table 3. Elements for a meta-meta-business model by Gordijn, Osterwalder, and Pigneur (2005)

Purpose of the ontology	Representation
Business model definition	Tool support
Ontology content & components	Visualization
Origins	Evaluation method for business model instances
Ontological role	Change methodology
Actors using the ontology	Classification
Supporting technologies	Other applications
Ontology maturity & evaluation	Representation

Paper 3: Lambert, 2008
Among other work on business models, Lambert [12] presents a conceptual framework for business model research (BMCF). She bases it on the financial reporting conceptual framework from the financial accounting field. The BMCF consists of five levels. From the financial reporting conceptual framework, she drops the levels related to regulations and standards, as they do not apply to business modelling. The levels emphasise a hierarchy, the lower levels require the ones above to be completed.

The top-level concept Lambert identifies is the definition of business modelling. She argues that the domain of business modelling must be agreed upon, before discussion on other parts. As part of the domain, she identifies three user groups. The objective of business modelling should include which potential user group to serve. She uses two dimensions for this: level of abstraction, and aspect of the view. In the third level,

fundamentals, she includes two parts: Qualitative characteristics of business model information, and elements of business models. The first part, the characteristics, for accounting includes such things as relevance, reliability, understandability, and comparability. Which characteristics are important for business modelling, still has to be researched. The second part, elements, is the list of components and their relations. Lambert suggests that the elements are derived from the previous levels. The element that has primacy of concept should serve as starting point. She argues value proposition has this primacy for business modelling. She discusses the last two levels only briefly. The fourth level, operationals, includes two parts. The first part is about when and how to recognize the elements. The second part focuses on how to measure them. The last level, business model representations, should standardize how to display business model (instances). In addition, Lambert creates a meta-business model, based on the notion of primacy of concept. It is a list of basic business model elements, with a further detailed element, the value adding process. She represents these as the basic and comprehensive business models.

Table 4. Elements for a meta-meta-business model by Lambert (2008)

Definition of Business Modelling
Objectives of Business Modelling
Fundamentals (Qualitative characteristics of business model representations, Elements of business models)
Operational (Basis of recognition, Basis of measurement, Measurement techniques)
Business Model Representations

Paper 4: Al-Debei and Avison, 2010

Recently, Al-Debei and Avison [13] published an overarching guide to business modelling. In their work, they create a unified framework for business models (BMs) based on twenty-two scholarly descriptions of the business model concept. Their unified framework consists of four upper classes: V4BM dimensions, BM functions, BM reach, and modelling principles.

The first class, V4BM Dimensions, consists of four core components of a meta-business model. The Dimensions identified by Al-Debei and Avison are Value Proposition, Value Architecture, Value Finance, and Value Network. The second class, BM functions, identifies three non-exclusive functions of a meta-business model. 1) A meta-business model may function as an alignment instrument to fill the gap between strategy and business processes (including supporting IS). 2) It may serve as an interceding framework (mediating construct) between technological artefacts and strategic goals. 3) A meta-business model may function as (strategic-oriented) knowledge capital, so it provides (the necessary level of) information if it is made explicit. The third upper class, BM reach, explains the positioning of the BM concept within organizations, as an intermediate layer between strategy and business processes including their supporting IS. The fourth and final upper category covers five modelling principles, which act as guidelines and features for creating BMs. The identified principles are: coherent (represent the business logic comprehensively), conceptual (abstract, covering only key business components), granular (components can be broken down into dimensions to be subdivided into elements), multi-level (a. individual organizations; b. parts of an organization; c. business networks), dynamic (able to cope with continuous change).

Table 5. Elements for a meta-meta-business model by Al-Debei and Avison (2010)

V4BM	BM reach
BM functions	Modelling Principles

Paper 5: Zott, Amit, and Massa, 2011

The broad and multifaceted literature review on business models, which forms the core of the paper, is the most up to date review of the relevant literature currently available. The authors use it to examine the business model concept through multiple subject matter lenses. As opposed to the other reviews that we examined, no single figure or table lists the core concepts used. However, they structured their analysis of the literature in such a way, that the subheadings indicate their ten core concepts.

First, they treat the emergence of the business model concept, to analyse where the concept comes from and how it has developed. Second, they handle definitions and point to the lack of definitional clarity. Their review revealed three main objectives for business modelling: e-business, strategy, and innovation. The third concept Zott, Amit & Massa describe is typologies. Many researchers have focussed on describing generic business models and classifying them. Fourth, they consider components that make up business models. Fifth, they deal with representations. These range from informal textual, to formalized ontologies. Sixth, they tell about strategic marketing, for which business models are often used. The seventh concept, value creation in networked markets, indicates another goal of business modelling. Firm performance, the eighth concept, received plenty attention, as it corresponds to profitability. Especially, it evaluates profitability in a competitive environment. This also relates to the ninth concept, strategy. According to Zott, Amit & Massa, it focuses more on competitive advantage, and less on the role of the customer. The final concept Zott, Amit & Massa cover is innovation. This goal of business modelling can be achieved in two ways. Either through connecting new technology to customers' needs, or through innovating the business model itself.

Table 6. Elements for a meta-meta-business model by Zott, Amit, and Massa (2011)

Emergence	Emergence of the business model concept and Definitions
	Emergence of the business model concept
Definition	Business model definitions
	E-Business and the use of IT in organizations (Business Models for e-Business)
Typology	Description of generic e-business models and typologies
Components	Components of e-business models
Representations	Business model representations
Strategic marketing	Strategic marketing
	Strategic issues (Business Models and Strategy: Value Creation and Value Capturing Through Activities)
Value creation in networked markets	Value creation in networked markets
Firm performance	Business model and firm performance
Strategy	Strategy and the business model
Innovation	Innovation and technology management (Business Models, Innovation, and Technology Management)
	Business model innovation

Classes of the M2BM: A Meta-Meta-Business Model

Table 7 identifies the important concepts in business modelling according to the review literature. It is a first indication of possible classes for the M2BM. A comforting result is that there is quite some overlap in the identified classes. For example, four of the five articles name *definition*, and all have *components*. This allows for mapping of the concepts on to each other to get to a compact list of classes. Already, Table 7 provides an attempt at this. While in some cases this mapping is obvious (as for definition and components), it remains interpretative. As section 4.2 discusses, two concepts were left out of Table 7 deliberately, *ontological role* and *ontology maturity & evaluation*. Both are from Gordijn, Osterwalder and Pigneur [11]. The table suggests which classes are important to business modelling at the M2 layer.

Table 7. Classes for the M2 layer meta-meta-business model

Pateli and Giaglis, 2004 [5]	Gordijn, Osterwalder and Pigneur, 2005 [11]	Lambert, 2008 [12]	Al-Debei and Avison, 2010 [13]	Zott, Amit and Massa, 2011 [2]
Definition	Definition	Definition		Definition
	Purpose of the ontology Focus of the ontology Actors using the ontology Other applications	Objective	BM reach BM Functions	Strategic marketing Value creation in networked markets Strategy Innovation
Components	Ontology content and components	Fundamentals (elements)	V4 BM dimensions	Components
Conceptual models	Representation Visualization	Fundamentals (characteristics of representations) Representations (display)		Representations
Change methodology	Change methodology			
Evaluation models	Evaluation methods for business model instances	Operational (measurement)		Firm performance
	Origins			Emergence
Design methods and tools Adoption factors	Supporting technologies Tool support		Modelling principles	
Taxonomies	Classification	Operational (recognition)		Typologies

3.4 Example Use of M2BM: Components of Meta-Business Models

This section presents an example of the M2BM's use in business modelling. The core construct of business modelling is probably the very visible *components* of meta-business models. This example provides a comparison of ten different meta-business models based on their components. It shows how several meta-business models all have their own *instantiation* of the M2BM class *components*. Fig. 3 is the result of the comparison [18].

The first nine meta-business models are those identified by Vermolen [16], published in the top 25 MIS journals. The tenth has also been mentioned already, Osterwalder's Business Model Ontology (BMO) [6].

1. *Activity system* by Zott and Amit [9].
2. *e3-value* by Gordijn [7].
3. *RCOV* by Demil and Lecocq [8].
4. *The BM concept* by Hedman and Kalling [19].
5. *Entrepreneur's BM* by Morris, Schindehutte and Allen [20].
6. *The social BM* by Yunus, Moingeon and Lehmann-Ortega [21].
7. *The BM guide* by Kim and Mauborgne [22].
8. *4C* by Wirtz, Schilke and Ullrich [23].
9. *Internet BM* by Lumpkin and Dess [24].
10. *BMO* by Osterwalder [6].

Fig. 3 identifies the components used in the above articles. It is an indication of possible components for meta-business models. Quite some overlap exists in the identified components, which allows for mapping of the concepts on to each other. Already, Fig. 3 provides an attempt at this. While in some cases this mapping is obvious, it remains interpretative. However, the figure still suggests which components are important to business modelling.

The notion of M2BM may allow a more systematic commonality analysis of existing meta-business models at this M1 layer in the future. The common components found in such a manner are abstractions of the concepts in the meta-business models. This collection of components resembles an "*abstract platform*" in the sense used by Almeida et al. [25]. This would allow the formulation of a business model in terms of the common language that the abstract platform supports. At a later stage of development, one could choose a platform-specific realization in terms of an existing language. Such an abstract platform may also include common patterns to be reused or configured.

4 Discussion

The purpose of this study is to promote theory development by viewing the concepts of business modelling in light of the Meta-Object Facility. Besides an open review of what the MOF allows, this section also comments on the classes left out of the B2BM.

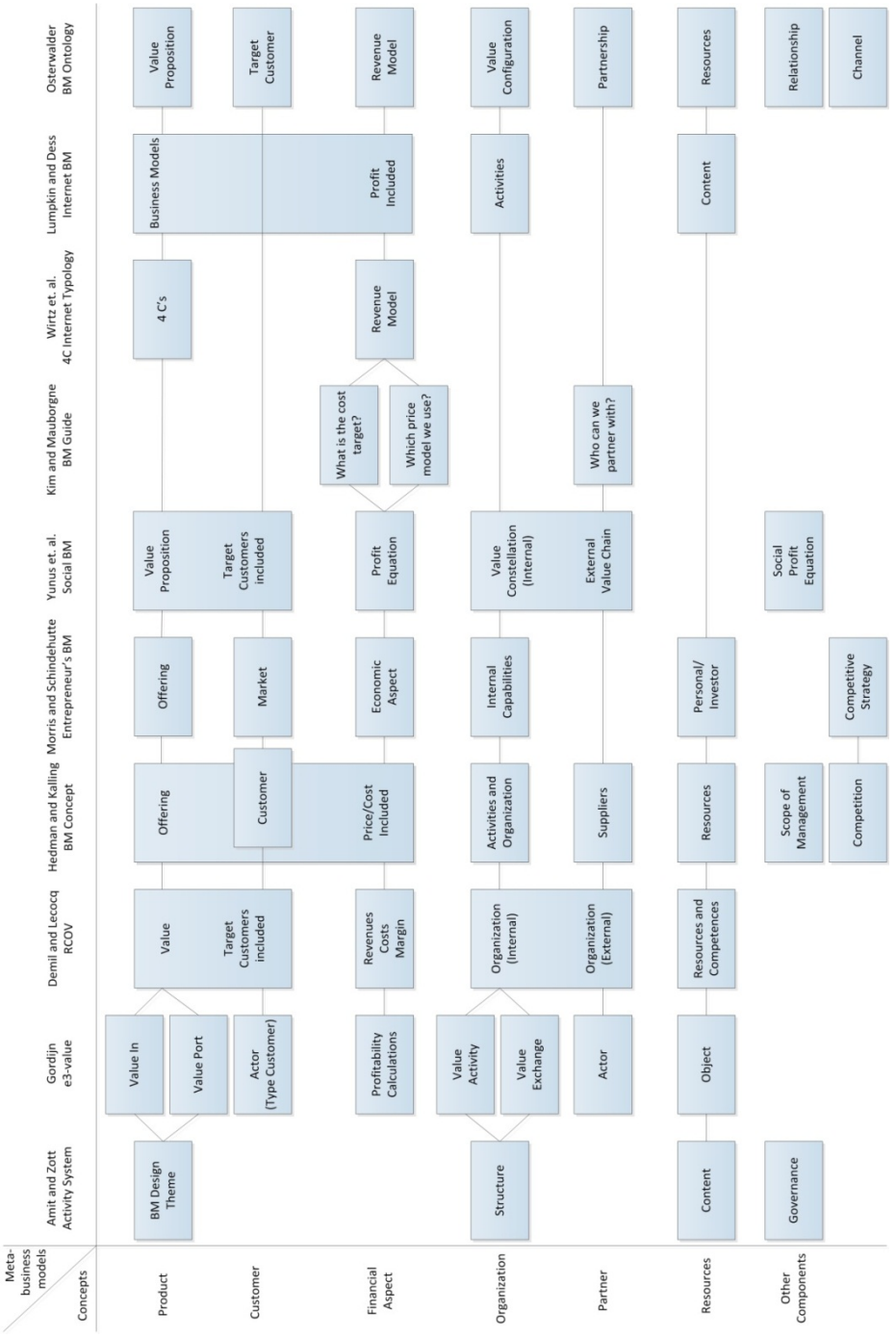

Fig. 3. Comparison of M1 layer meta-business model components (adapted from Alberts [18])

4.1 Uses for the MOF Perspective on Business Modelling

Our main reason for using the MOF is the perspective it offers on the practice of modelling. As such, we have only identified classes in the M2 Layer meta-meta-business model. Still, it has become very clear that the discipline of business modelling allows for use of the MOF, and that the concept of meta-models can be of great assistance. We believe this introduction of MOF in business modelling has only scratched the surface of what is possible. Take for example an association between two classes: the scope of what is being modelled will strongly influence which components are important.

Defining the M2BM in terms of the MOF model concepts allows formalization of business modelling that promotes its use in requirements engineering and software development. In the same line of reasoning, the MOF perspective may provide a new chance to match business modelling and UML. So far, literature that uses both the terms "UML" and "business modelling" focuses on process modelling, not on business modelling. Another application of UML in this domain is creating a reference ontology [26]. This reference ontology allows model transformations between Resource-Event-Agent (REA), e3-value, and BMO. Such reference ontology may provide useful methods for the M2BM.

The MOF opens a rich new view on business modelling. So far, we have only looked at one aspect: the possible classes of the M2BM. There are still many more possibilities in using the MOF to approach business modelling.

4.2 Classes Left Out of the M2BM

Two potential classes were left out of Table 2. They are ontological role, and ontology maturity & evaluation. Both concepts come from Gordijn, Osterwalder and Pigneur [11]. We argue that these two concepts are not suitable as classes for a meta-meta-business model.

The ontological role does not fit, as it is very similar to the entire concept of the MOF. As such, it has no place within one of the layers. For ontological role, Gordijn, Osterwalder and Pigneur [11] define three levels: operational data at Level L0, ontology at Level L1, and ontology representation language at Level L2. Operational data is similar to what we call a business model instance at layer M0. Ontology is similar to what we call a meta-business model at layer M1. Finally, an ontology representation language is similar to the M2BM at layer M2.

Ontology maturity & evaluation does not fit, as it is itself not meta-data describing a meta-business model. Rather, checking maturity could be a use of the M2BM. For example, the maturity of a meta-business model could be scored based on how many of the M2BM classes it instantiates. For example, whether it has a clear definition and scope, and whether it has identified components and a way to evaluate a business model made with it.

5 Conclusion

This article uses MOF to provide a new perspective on business modelling. This contributes to business modelling on three important issues:

- the need for a common language,
- lack of conceptual consolidation, and
- theoretical development of the concept.

Introducing the MOF perspective provides conceptual consolidation in business modelling. The MOF is used to take a different perspective on the meta-business models, which makes it possible to find commonalities. Identification of the M2BM classes illustrates this. In addition, existing definitions of "business model" can be positioned on the layers. This provides better options to compare definitions.

The M2BM on the M2 layer provides a common language for business modelling. In business modelling literature, many authors have their own vocabulary. In creating the M2BM, we show that different terms often refer to a single concept. Approaching the different meta-business models from a higher MOF layer addresses this issue. Doing so allows building on the strengths of the meta-business model original domains: strategic management, industrial organization, and information systems. Using the MOF, and especially the M2BM as a common language, helps overcome the differences of these domains and focus on commonalities.

Finally, theoretical development of the business model concept is promoted, as the MOF opens up a wide range of research possibilities for business modelling. Placing the concept of business model in the frame of the MOF allows for further theory development, both within the discipline and in relation to other domains. It serves as a navigational landmark for business model research when relating it to existing material. Additionally, it helps to create bridges to other research areas, especially when relating to other modelling domains.

Future research must specify a M2BM with classes, and possibly relations, datatypes, and packages. This common language will define business modelling. The M2BM presented Table 7 is a first draft, as such, it requires more work. The table contains classes that were identified for the M2 layer, and which are a first step towards its definition. The identified classes should be incorporated in a complete M2BM proposal, and this proposal should be validated in future work. However, even in this rough form, it shows that the MOF is a rich addition to the business modelling discipline.

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