Towards Comparable Business Model Concepts: Resource Description Framework (RDF) Schemas for Semantic Business Model Representations

Research in Progress

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Abstract. Scholars have demonstrated that business model (BM) choices have a significant impact on the success of products, innovations and organizations. However, knowledge about key elements of BMs is disseminated across a large body of literature and builds on different conceptualizations. We take a step back and provide a new approach to formalize BM concepts and related BM knowledge, based on concepts from the semantic web. We introduce and evaluate the Resource Description Framework (RDF) as a data model for comparable and extensible BM descriptions. Moreover, we use this new perspective to analyze commonalities and differences between BM concepts, to reflect critically on the process of translating concepts to RDF and evaluate its relevance for BM design practice.

Keywords: Business Model · Business Model Representation · RDF · Semantics

1 Introduction

The business model (BM) is a highly interesting object for product owners, innovation managers and strategists alike [1]–[3]. It can represent the logic and capabilities of a business in a "remarkably concise way" [4] and serve as a holistic approach to renew and innovate organizations in times of digitization and change [5], [6]. Research seeks to develop "conceptual toolkit[s] that enables entrepreneurial managers to design their future business model, as well as to help managers analyze and improve their current designs to make them fit for the future." [7].

A main challenge in the BM domain, however, is that multiple definitions, representations and formats of BMs exist [8], [9]. These conceptualizations are either very formal in terms of ontologies or taxonomies or less formal and result in many different perspectives of what the "key" constructs of the BM concept are [10]. At the same time, arguments have been made to make research "more cumulative in nature, and to effect a more efficient transfer of research results into practice" [11].

We assume that each (re-)conceptualization of a BM adds novel, partially overlapping yet equally relevant facets that, together, are a valuable source of knowledge for BM innovation and decision making. However, to translate these insights from rigor to relevance we address the challenges of how to find, integrate and use different BM conceptualizations. Consequently, the research question is the following: *How can varying BM conceptualizations be integrated to make key aspects of the concepts as well as attached BM knowledge comparable?*

We take a step back and provide a new approach to formalizing BM concepts and related BM knowledge, based on ideas from the semantic web. We introduce and evaluate the Resource Description Framework (RDF) as a data model for comparable and extensible description of BMs. This approach allows not only the representation of very formal BM ontologies but also of less-structured concepts that are primarily text-based – in a common format (schema). We do not focus on a specific kind of BM concept but on the underlying mechanisms of describing, comparing and transferring BM knowledge. Moreover, we use this new perspective to analyze commonalities and differences between BM concepts, to reflect critically on the process of translating concepts to RDF and evaluate its relevance for BM design practice.

2 Conceptual foundations

This section introduces the two key concepts – BMs and the resource description framework – before proposing why and how both can benefit from each other.

2.1 Business models

BMs have become a critical element for business success and the concept is identified "as the missing link between business strategy, processes, and Information Technology" [11]. Scholars from various disciplines use the concept to understand how organizations create, capture and deliver value in different markets [12]. [13] classify BM research in three streams: *overarching concept* ("meta-models that conceptualize them"), *taxonomies* (generic BM types with common characteristics), and the *instance*s (that "consists of either concreate real world business models or […] descriptions of real world business models"). Many scholars have tried to define BMs formally by developing ontologies, taxonomies or frameworks [13]–[15]. No definition seems to satisfy all purposes [9], [16]. Thus, our research provides a data model to describe different BM concepts (meta-models) and demonstrate the application of this data model based on BM types and instances.

2.2 Resource description framework

The resource description framework (RDF) is a standard model and abstract syntax to represent information [17] and is primarily used in the context of the semantic web [18]. In RDF, information is represented in a set of triples. Each triple consists of a subject, predicate and object. By forming triples, we build *statements* about the relationship (predicate) between two *resources* (subject and object) [17]. For example, one could state that the city "Berlin" (subject) "has-major" (predicate) "Michael Müller" (object). Or that the customer segment "professionals" (subject) "have-a-need-for" (predicate) "seamless online shopping" (object).

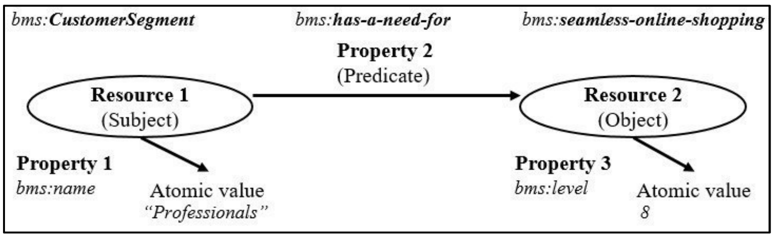

Fig. 1. An RDF graph with two nodes (subject and object), a triple connecting them (predicate) [17], additional properties and *examples* ("bms:" prefix serves as identifier for a namespace)

2.3 RDF schemas as flexible, comparable and reusable ontologies

Without constraints and additional semantics, the triple-logic could be used to describe any kind of (un-)meaningful data. For example, the following statements are meaningless in a BM context:

```
:large-enterprises :type :software
:customer-segment :customer-segment :customer-segment.
```

Therefore, predefined RDF vocabularies are available in the RDF namespaces that can be used to create simplified, domain-specific ontologies, called *schemas*, which provide a set of definitions and constraints for the underlying RDF data. For example, a schema could define "Customer Segment" as a meaningful "type" of RDF Resource, which can have a Property "has-a-need-for"[1]. Schemas provide the meta-data for the actual information.

2.4 Towards comparable and extensible business model concepts based on RDF schemas

This research is motivated by the fact that the body of BM research has similar characteristics to the World-Wide-Web where data "covers diverse structures, formats, as well as content […] and lacks a uniform organization scheme that would allow easy access to data and information" [18]. We assume that the business model is a complex, multi-faceted concept with different, equally relevant aspects that differ across context or purpose and that the concept will evolve even further in the future. Here, RDF and RDF

1 Please refer to the official specifications [17] for additional information on the RDF concept and the set of predefined vocabularies.

schemas can help to create comparable, extensible and processible descriptions of BM (meta-)information. In specific, we see the following advantages of RDF:

- **Properties**: Unlike traditional object- and class-oriented data models, RDF provides a rich data model where *relationships* are also first class objects, “which means that relationships between objects may be arbitrarily created and be stored separately from the two objects. This nature of RDF is very suitable for dynamically changing, distributed, shared nature of the Web” [18]. In other words, relationships between objects can be added without changing the definition of the class. An existing BM construct such as “Customer Segment” can be enriched with idiosyncratic properties (e.g. linking customer segments with atomic values or other resources).
- **Namespaces**: A unique feature of RDF is that is uses the XML namespace mechanism: “A namespace can be thought of as a context or a setting that gives a specific meaning to what might otherwise be a general term. […] using namespaces, RDF provides ability to define and *exchange semantics among communities*.” [18]. The advantage of this is that each BM concept can be associated with its own namespace and BM information building on different concepts be exchanged.
- **Mixing definitions:** One of the most interesting features of RDF is its extensibility and shareability. It “allows metadata authors to use multiple inheritance to mix definitions and provide *multiple views* to their data. In addition, RDF allows creation of instance data based on multiple schemas from multiple sources” [18]. Scholars, who document information about BM instances, often combine different BM conceptualizations.
- **Query language:** With SPARQL (an acronym for SPARQL Protocol and RDF Query Language) a powerful tool to query RDF data is available (see the following example that gets all BMs with a customer in the software industry).

```
@prefix bm: http://bm.example.com/exampleBmOntology#
SELECT ?businessModel ?customer
WHERE {
  ?businessModel bm:hasCustomer ?customer .
    ?customer bm:isInIndustry  bm:Software;
}
```

3 Methodology

This research follows a design science paradigm [19] and Peffers et al’s. [20] specific guidelines. Peffers et al. suggest the following phases: problem identification & motivation, objectives of a solution, design & development, demonstration, evaluation, communication. Problem, motivation and objective were already outlined in the previous sections. Communication takes place in academic conference proceedings. The following sub-sections explain the remaining phases.

3.1 Design and development: eliciting conceptual meta-constructs and creating an exemplary BM schema vocabulary

We leverage an exemplary set of six BM conceptualizations (see table 2) and translate the underlying implicit or explicit constructs into RDF schemas. Conceptual literature is defined as peer-reviewed, scientific articles that explicitly discuss the nature of the BM concept (in contrast to case studies that use the BM lens, to understand how a company works, for example [21]) and have a significant number of citations (>150). In contrast to previous BM ontology mapping approaches [22], [23], we do explicitly include also more qualitative concept definitions. For example, [7] consider BMs as activity systems which are "a set of interdependent organizational activities centered on a focal firm" with two relevant design parameters "design elements and design themes". The concept is not as formal as a taxonomy and rather implicit but holds valuable information about key BM constructs. Specifically, we translate text and concepts into a set of triple statements which will then be consolidate in an RDF schema in the namespace of the authors. To remain with the example of [7], the sentence "an activity in a focal firm's business model can be viewed as the engagement of human, physical and/or capital resources of any party to the business model" is translated into the following schema (extract):

```
@prefix za: http://schema.bm.org/2010/Zott_and_Amit
za:BusinessModel   za:consistsOf    za:Activity
za:Activity        za:linkedTo      za:ActivityLink
za:Activity        za:uses          za:Resource
za:ActivityLink    za:hasNovelty    rdfs:Bag ["Novel", "Not-
Novel"]
za:Physical        a                za:Resource
```

In a parallel step, we review these concepts for commonalities to create a common BM schema within its own namespace (BMS) that represents a custom schema mapping – yet again extensible and comparable in RDF.

3.2 Demonstration: Representing business models and BM knowledge

To demonstrate the value of compatible BM RDF schemas for BM design purposes we select exemplary BMs from the BM literature (e.g. [21]) and represent them by manually selecting constructs from the concept schemas. Moreover, we want to demonstrate that BM knowledge that builds currently on different BM concepts (e.g. [24]) can be described and identified. We select in total 10 exemplary articles from the body of BM research that build on one (or a combination of) the above BM concepts. These articles represent BM design knowledge either by BM type or instance. We use an instance of Apache Jena, an open source framework for semantic web and linked data applications[2], to store and query the RDF data.

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2 http://jena.apache.org/index.html

3.3 Evaluation

We adopt the following evaluation criteria:

Table 1. Evaluation criteria

Criterion	Definition and measurement
RDF translatability	In general, any text or concept can be translated into more formal ontologies, regardless of the data format. Thus, we reflect on our experiences with RDF and provide qualitative insights, whether we perceived this process as easy or difficult and whether enhanced text-to-ontology methods could support this process. Moreover, we provide suggestions for researchers who want to code other BM information bases.
Construct-schema coverage	An interesting aspect is, to what extend different BM conceptualizations build on similar meta-constructs and whether a common schema is meaningful. We build the BMS iteratively, based on the body of knowledge identified as describe in section 3.1 and try to identify the lowest common denominator of constructs. We provide a simple measurement of construct coverage in our schema. This will support our understanding of differences and commonalities between BM concepts.
Knowledge extraction and comparability	The main research objective is to assess whether RDF supports the representation and extraction of meaningful BM knowledge for BM design purposes. We evaluate this aspect based on ten BM instances and interviews with at least three different BM experts (who have more than two years of experience working on BM innovation or BM development). In particular, we will assess whether the underlying semantics help to identify a) problems such as inconsistency between BM elements and b) additional, previously unknown BM knowledge to improve the BM design.

4 Preliminary results

4.1 Representing and comparing BM concepts in RDF (ongoing)

Table 2. Business model concept meta-constructs (legend: ● key construct, explicitly defined and ex-plained ◕ defined and explained ◑ mentioned but not explicitly defined ◔ mentioned briefly ○ not mentioned)

			Named Elements											
Concept constructs (BMS vocabulary) *Author(s): concept name (if available) and source*	**Element**	**Link**	**Resource**	**Activity**	**Offering**	**Other**	**Group**	**Attribute**	**Actor**	**Value**	**Transaction**	**Level**	**…**	*Completed?*

Akkermans & Gordijin: e^3-value ontology [14]	●	●	○	●	●	◔	○	●	●	●	●	●		○
Osterwalder & Pigneur: business model ontology [13]	●	◑	●	●	●	●	●	●	◑	◑	◔	◔		◔
Zott & Amit: Activity system [7]	●	◑	◑	●	◑	●	◔	◑	●	◑	●	◕		◑
Johnson et al. [25]	●	◑	●	●	●	●	◕	◑	◑	●	◔	◔		○
Casadesus-Masanell & Ricart : Choices and consequences [26]	◑	●	◑	●	◔	●	◔	◔	◔	◑	◑	●		◑
Demil & Lecocq : RCOV [27]	●	●	●	●	●	◑	○	◔	◔	●	◑	◑		◑

Our current results are mainly based on a detailed analysis of a subset of BM concepts and a simple analysis of all concepts for similar constructs (Table 2). For a subset of concepts [7], [27], [28], we have extracted all sentences and images that include relevant facts about the BM concept, for example "Choices, [..] are not the sole constituent of business models. As all authors highlight, choices must be connected to value creation and value capture, or to alternative goals the company may want to pursue" [28] and translated them into RDF statements. These statements were then consolidated to create an initial BM concept schema within the namespace of the corresponding authors (e.g. Casadesus-Masanell_and_Ricart). In general, our impression is that the process of translating text to RDF works very well and the resulting schema is consistent even when created independently by two authors of this paper. Moreover, we discover some constructs that appear frequently, such as the idea to decompose a BM into elements and links between these elements and novel constructs that are usually not explicitly modeled (for example the properties "novelty" of an activity link or "switching costs" of a customer [7]). This is also a main difference to previous ontologies and ontology mappings because we discover additional properties that may have important implications for the understanding of a BM. Moreover, our current impression is that, yes, concepts differ significantly but have certain constructs in common. These common constructs can then be used the make links between the concepts explicit. For example, [13] consider revenue models, costs and activities (besides others such as channels, customers etc.). In contrast, [7] focus mainly on activities and consider the revenue model as "conceptually distinct" and [28] introduce price as a "choice" and cost as a "consequence". We look forward to evaluate whether a standard BM schema improves concept integration. Our preliminary results strengthen the assumption that each BM concept is unique and that attempts to conciliate them into one 'ideal' ontology are likely to remain impracticable because ontology mappings and simple taxonomies neglect relevant properties. Given that these concepts are then used to capture BM knowledge, for example about the development of cloud BMs in the software industry, a flexible and comparable schema language, such as RDF can then help to them in a simple, yet effective way and to model the underlying BM information.

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