

A Comparative Analysis of Enterprise Modeling Approaches for Modeling Business Strategy

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Abstract. A gap in the alignment of business and IT lies between strategy and IS, despite the advancements of enterprise modeling. The objective of our study is to compare various enterprise modeling approaches with respect to their ability to capture and represent strategy notions. This includes identifying strategy notions from established business strategy formulations within Strategic Management, which are expressed in the Unified Business Strategy Meta-model. The interdisciplinary nature of the study constitutes a research challenge due to the significant difference on the levels of abstraction between Strategic Management and IS. To the best of our knowledge, no similar effort has been undertaken, therefore, the outcome of this study will provide the enterprise modeling community with a basis to address strategy and IS alignment linking strategic objectives and intentions to information systems.

Keywords. Business Strategy, UBSMM, Enterprise Modeling, EKD, iStar, e³value, BMO.

1 Introduction

Organizations typically strive to attain some long-term goal (vision) with a defined purpose (mission) following a general plan. Strategic planning is the process of defining/formulating such a general plan for an organization encapsulating its intentions and actions, encompassing a certain period of time, to achieve its vision. The devised plan is commonly expressed through a business strategy, which has been broadly defined as the determination of long-term goals and courses of action using resources to achieve them, thus enabling organizations to enact the strategy [1].

Within the area of information systems (IS), Enterprise Modeling (EM) is the process for creating an integrated and negotiated model of an organization. The ensuing enterprise model helps in developing the business creating a unified and shared knowledge culture and gaining commitment from different stakeholders [2].

Business strategy coming from Strategic Management provides a business perspective of the organization, while EM offers an alternative perspective that is more Information Systems-oriented. While these two perspectives should be aligned

with each other within the same organization, quite often they are not. Despite the advancements of enterprise modeling, such alignment gap between strategy and IS is still an important issue in the scope of business-IT alignment [3].

Therefore, the research question of this study is: *how do enterprise modeling approaches capture business strategy notions (explicitly or not)?* The objective of the study is to analyze a number of enterprise modeling approaches and compare their ability to capture and represent strategy notions. Such an analysis will help practitioners in selecting enterprise modeling approaches relevant to the business strategy formulations used in their organizations.

The strategy notions used for the analysis and comparisons should be derived from Strategic Management. Therefore, we are using the unified business strategy meta-model (UBSMM) as a reference model for the analysis, because it provides an integrated view of established business strategy formulations within Strategic Management (e.g. Strategy Maps and Balanced Scorecards [4], the Value Chain [5], etc.) [6], and serves as an interface of business strategy to IT, relevant to the intended analysis. This paper initiates our research and is focused on the analysis on notions of the UBSMM instantiation for Strategy Maps and Balanced Scorecards (SMBSC) [4].

Section two presents the enterprise modeling approaches analyzed. Section three presents an overview of the updated UBSMM. Section four presents the analysis. Section five discusses our findings and concludes with future directions of the work.

2 Enterprise Modeling

There exist various EM approaches that are relevant to this analysis, which can provide different views of an organization. While any EM approach can be subject to this analysis, four have been indicatively selected for our study: (i) the Enterprise Knowledge Development (EKD) approach, which provides a holistic view of an organization [2], (ii) i^* , which is a requirements engineering approach focusing on social intentionality within an organization, (iii) e^3 value, which is a value modeling approach focused on economic value exchanges between actors; and (iv) the Business Modeling Ontology (BMO), which provides an upper level ontology that allows describing the business model of a company accurately and in detail.

Enterprise Knowledge Development (EKD) is an EM approach that relies on six integrated “sub-models” to provide a holistic view of the organization while maintaining traceability [2]; a Goals Model (the organization’s vision and strategy), a Business Rules Model (business policies and rules), a Concepts Model (the business ontology and vocabulary), a Business Process Model (the procedural aspects of business operations), an Actors and Resources Model (organizational structure), and a Technical Component & Requirements Model (addressing IS needs).

i^* is a goal modeling technique used in requirements engineering, to capture social intentionality among actors, including possible alternatives, and to operationalize stakeholders’ business goals through concrete actions and design decisions [7]. It includes two model types, the Strategic Dependency Model (SDM) where all actors

are identified along with their interdependencies, and the Strategic Rationale Model (SRM), where within each actor all intentional elements are identified/ascribed.

The e^3 value is a business modeling ontology and approach that enables the representation and analysis of a network of enterprises exchanging resources of economic value with each other [8]. The main modeling constructs include *actors* who exchange economic resources (*value objects*), *value activities* producing these resources, and the provisioning and transfer of the resources through *services*. The e^3 value has been further extended with e^3 *forces* constructs to enable modeling of a business strategy perspective on a service offering by an enterprise and in relation to its networked value constellation, i.e. environmental forces [9].

The Business Model Ontology (BMO) provides an ontology that allows describing the business model of a firm accurately and in detail [10]. The BMO takes the perspective of a single enterprise facing a particular customer's demands and consists of nine core concepts in four categories: Product, Customer Interface, Infrastructure Management, and Financial Aspects. Key concepts are Value proposition (an overall view of a company's bundle of products and services that are of value to the customer), Target Customer (a segment of customers to which a company wants to offer value), Value Configuration (the arrangement of activities and resources necessary to create value for the customer) and Capability (the ability to execute a repeatable pattern of actions necessary in order to create value for the customer).

3 Business Strategy: UBSMM

For the scope of our work, EM approaches should be analyzed against a complete view of business strategy. This would limit the risk of our analysis to overlook strategic notions. Completeness requires all business strategy formulations are considered for the analysis, which is not feasible. Instead, based on three complementary views on business strategy where strategy shaping is driven from different perspectives [11], we aim at including all these views. The unified business strategy meta-model (UBSMM) is an integration of business strategy formulations within Strategic Management. The purpose of UBSMM is to become an interface of business strategy to IT [6] by integrating a formulation from each of these three views and allowing the progressive integration of others, both existing and emergent.

The three views [11] include: the *resource based view*, where strategy formulation is driven by the capabilities of the organization; the *industrial organization view*, where positioning the organization against competition is the main driver; and the *Schumpeterian view*, where radical innovations are in focus disrupting the environment in which the organization operates.

UBSMM includes Strategy Maps and Balanced Scorecards (SMBSC) [4], the resource-based view, and the Value Configuration (VC), based on the Value Chain [5], the industrial organization view. For our analysis, UBSMM has been extended to include Blue Ocean Strategy (BOS) [12], from the Schumpeterian view of strategy, using a conceptualization of the formulation [13]. This provides an integration of the three complementary views of business strategy, which constitutes an interface to IT.

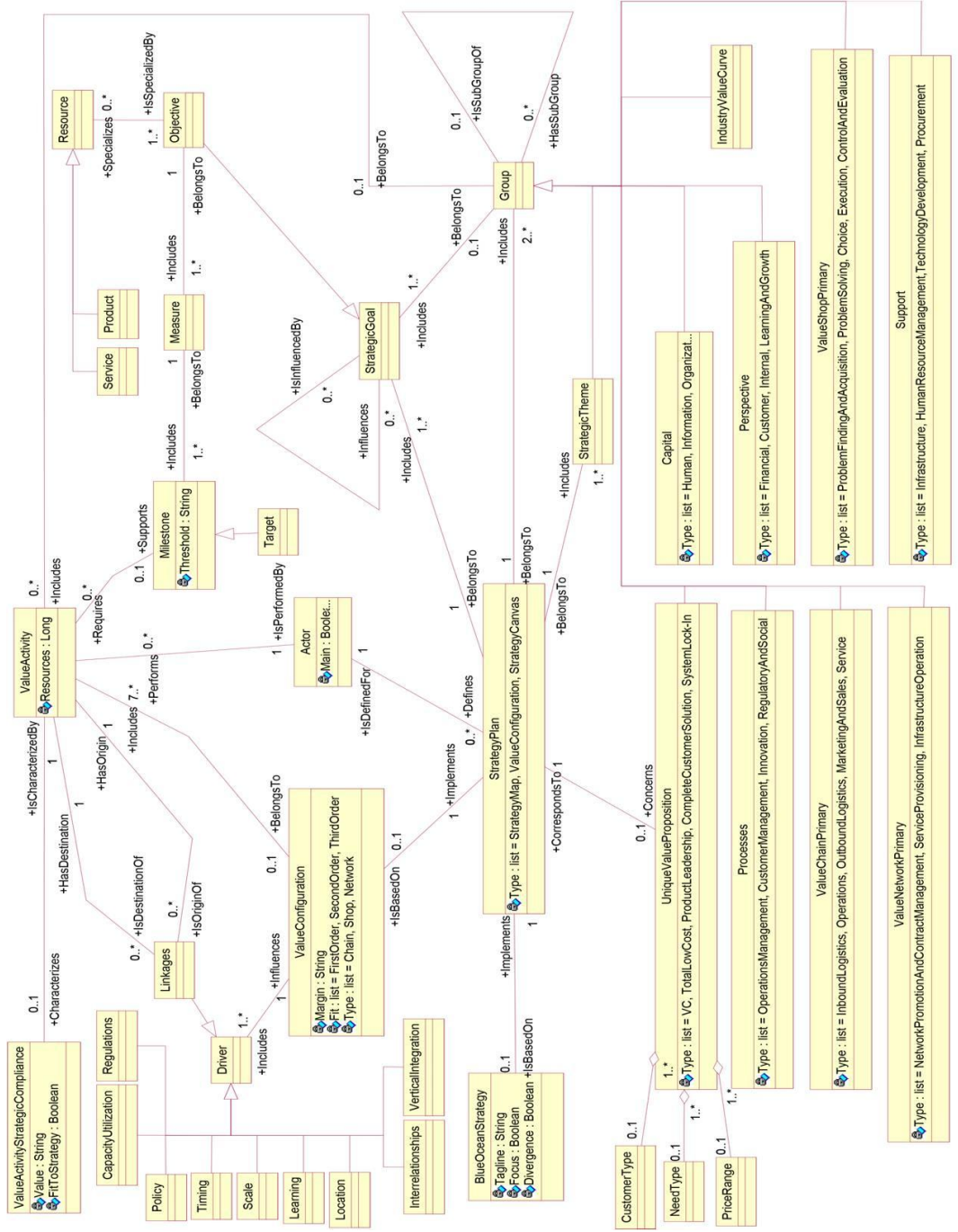


Fig. 1. The updated Unified Business Strategy Meta-model (UBSMM).

The updated UBSMM (figure 1) also includes sets of constraints that need to be applied to instantiate each of the different business strategy formulations it includes. A complete specification of UBSMM with class descriptions and constraints can be found in [14], chapter 9.

In this paper, we examine the UBSMM instantiation of Strategy Maps and Balanced Scorecards (denoted as UBSMM.SMBSC). SMBSC is a business strategy formulation serving as a mediator between the mission, core values, and the vision of an organization. A strategy map template is used to represent how an organization can create value. Starting from a mission statement and core values, a strategic vision is defined, which projects the organization's overall goal. A set of goals is then defined and grouped within the financial and customer perspectives, along with goals for all processes and all types of capital, both human and economic [4]. Goals are extended to a set of targets using measures to evaluate their achievement, and thereafter, initiatives are identified to achieve the targets. This extension of the strategy map is the balanced scorecards, which are essential for monitoring and assessing the cause-effect links between strategic goals across an organization.

From the complete UBSMM (figure 1), classes relevant to UBSMM.SMBSC are listed below (for detailed specification of class descriptions and constraints see [14], section 10.1) and are used for the analysis of EM approaches with respect to Strategy Maps and Balanced Scorecards:

- **StrategyPlan.** captures a complete strategy map.
- **StrategicTheme** captures a grouping of particular interest within a strategy map usually focusing on areas of critical importance for executives.
- **Actor** captures the organization/unit for whom the strategy map is defined.
- **StrategicGoal** captures the goals set across the four perspectives of a strategy map.
- **Objective** captures measurable goals that are used for building balanced scorecards
- **Group** captures all groupings and subgroupings included in a strategy map
- **Objective** captures measurable goals used for building balanced scorecards.
- **Perspective** captures the highest level of grouping in a strategy map (financial, customer, internal, learning and growth).
- **UniqueValueProposition.** captures how the actor delivers unique value (low total cost, product leadership, complete customer solution, and system lock-in).
- **Processes** captures groupings within the internal perspective of a strategy map.
- **Capital** captures groupings within the learning and growth perspective of a strategy map.
- **Measure** captures the way/scale to evaluate the achievement of an objective.
- **Milestone** captures any short-term or intermediate target of an objective.
- **Target** captures a final desired state, usually long-term, of an objective.
- **ValueActivity** captures an activity performed to achieve an objective.

4 Enterprise Modeling Analysis for UBSMM.SMBSC

The EM approaches included in this study are analyzed in terms of their capability to capture the notions of UBSMM.SMBSC. The findings of this analysis are presented

in the following subsections and are summarized in Table 1. For each notion in UBSMM.SMBSC and each EM approach, we determine and justify if and how the EM approach supports the UBSMM.SMBSC notion. There are four possibilities:

- **Directly Supported** denotes that to a UBSMM class, there exists exactly one corresponding class in the EM approach with similar meaning (with respect to naming, structure, attributes).
- **Indirectly Supported** denotes that to a UBSMM class, there exists no corresponding class in the EM approach with similar meaning (with respect to naming, structure, attributes). However, the EM approach can still fully capture the UBSMM.SMBSC class in another way.
- **Partially Supported** denotes that to a UBSMM class, there exists no corresponding class in the EM approach with similar meaning (with respect to naming, structure, attributes). However, the EM approach can partially capture the UBSMM.SMBSC class in some way.
- **Not Supported** denotes that to a UBSMM class, there exists no corresponding class in the EM approach with similar meaning (with respect to naming, structure, attributes), and the EM approach cannot capture the UBSMM.SMBSC class in another way.

Table 1. Summary of the analysis findings of EM approaches.

UBSMM.SMBSC	EKD	i*	e ³ value	BMO
StrategyPlan	Partially	Partially	Partially	Partially
Actor	Directly	Directly	Directly	Partially
StrategicGoal	Directly	Directly	Not	Not
StrategicTheme	Indirectly	Partially	Not	Not
Group	Indirectly	Indirectly	Partially	Not
Perspective	Indirectly	Partially	Not	Partially
UniqueValueProposition	Partially	Partially	Indirectly	Indirectly
Processes	Indirectly	Partially	Not	Partially
Capital	Not	Partially	Not	Partially
Objective	Indirectly	Directly	Not	Not
Measure	Indirectly	Partially	Not	Not
Milestone	Not	Partially	Not	Not
Target	Not	Partially	Not	Not
ValueActivity	Indirectly	Directly	Partially	Indirectly

4.1 EKD

- **StrategyPlan: Partially Supported.** Based on the overall assessment of SMBSC with respect to EKD, there exist SMBSC notions not supported by EKD.
- **Actor: Directly Supported.** An Actor in EKD can be an Individual, an Organizational Unit, a Non-Human Resource (e.g. a machine), or a Role that can be played by instances of other types of actors [2]. Actors define Intentional Components (i.e. Business Goals and Opportunities) and are responsible for the fulfillment of Business Goals. They can also perform Processes.

- **StrategicGoal: Directly Supported.** Business Goals in EKD describe the future state-of-affairs that the enterprise aims to achieve. They provide the underlying motivation for developing process, concept, and IS architecture models. The modeling guidelines of EKD recommend goal operationalization i.e. refinement of goals into sub-goals while capturing the mutual influence among goals.
- **StrategicTheme: Indirectly Supported.** EKD is composed of different models that are connected using inter-model relationships to give an overall view of the organization and its supporting IS. The purpose is to describe the organization from different perspectives. StrategicTheme is not directly expressed in EKD. However, it can be achieved by arranging parts of the models in separate schemata, each focusing on a specific theme, thus using multiple schemata.
- **Group: Indirectly Supported.** The ability to create groups of modeling components for a certain purpose is not part of the EKD meta-model. But, grouping of modeling components can be done by introducing auxiliary components.
- **Perspective: Indirectly Supported.** EKD offers various perspectives of the organization, delimited by the type of knowledge that is being modeled (static, dynamic, intentional, etc.) rather than management boundaries. Thematic perspectives in EKD are modeled by allocating a particular model schema or view to a specific perspective, which is applicable to SMBSC perspectives.
- **UniqueValueProposition: Partially Supported.** EKD captures and represents organizational design using conceptual models. The delivered value is expressed collectively by the set of models or modeling components. But EKD does not have an explicit construct for representing value.
- **Processes: Indirectly Supported.** EKD includes the business process model (BPM) to describe processes within an organization. Though specific process types are not distinguished, processes are captured on different levels of abstraction, and can then be associated to the Goals model to allow groupings of process goals.
- **Capital: Not Supported.** Even though EKD is able to capture Opportunities that can represent growth and learning potential, the current definition of this concept falls short of expressing the multi-faceted Capital in SMBSC.
- **Objective: Indirectly Supported.** Operationalization of Business Goals in EKD enables the refinement of high-level strategic goals into more specific goals that usually have specific fulfillment criteria (expressed using the SMART goal principle), thus facilitating the measurement of the extent of goal fulfillment. Measurements are not modeled directly, but Goals can be linked to Concepts (in the Concepts model) to specify measurements and monitor goal achievement.
- **Measure: Indirectly Supported.** A dedicated modeling component for measures is not part of EKD. However, it is possible to represent measurable objectives with links to business concepts that represent measures.
- **Milestone, Target: Not Supported.** EKD has no means to capture neither intermediate (Milestone) nor final (Target) checkpoints to fulfill objectives.
- **ValueActivity: Indirectly Supported.** A Process in EKD represents activities that are needed to realize a goal. Concepts (Resources) that are Consumed and Produced by a Process, as well as Events that affect the performance of the process, are captured in the business process model (BPM).

4.2 i*

- **StrategyPlan: Partially Supported.** A complete SMBSC can be captured by both the SDM and SRM in i*, which respectively capture all dependencies within an organizational/unit and intentional elements (goals, soft-goals, tasks, etc.). An SDM within the boundaries of an actor consisting of four interdependent roles. Roles and the direction of dependencies can be set to include the four perspectives in the hierarchical order of SMBSC. An SRM model can be elaborated for each role to include all subgroupings as internal roles and all intentional elements.
- **Actor: Directly Supported.** In i* actor is an active entity (refers to generically any unit to which intentional dependencies can be ascribed) that carries out actions to achieve goals. Similarly the SMBSC actor (organization/unit) for whom a strategy map is defined entails undertaking actions to achieve goals.
- **StrategicGoal: Directly Supported.** i* includes the notion of soft goal, a goal whose criteria for satisfaction are not clear-cut, meaning satisfaction is described via contribution links from other elements. Thus, strategic goals can be represented as soft goals with the causality relationships across a strategy map describing how they can be sufficiently satisfied based on other goals or objectives.
- **StrategicTheme: Partially Supported.** i* does not include any such grouping notions. However it includes the notion of vulnerability over dependencies across actors, which is expressed through a classification of dependencies into open, committed and critical. Thus, a StrategicTheme can be introduced through critical goal and soft goal dependencies across roles representing SMBSC groupings, however this is limited to dependencies across roles and not within roles.
- **Group: Indirectly Supported.** i* can express groupings by introducing roles within an actor, as roles refer to the abstract behavior for a social actor within some specialized context of domain. Groups of goals/objectives can be attributed to roles and be represented within their boundaries. Group nesting can be supported by IsPartOf associations among roles.
- **Perspective, UniqueValueProposition, Processes, Capital: Partially Supported.** i* does not include any of these grouping notions, however, as per the above partial relation between Groups and roles, these groupings can be represented through a predefined set of roles representing the SMBSC groupings. Perspectives can be defined as role boundaries and subgroupings for each perspective can be represented through a role and the IsPartOf association towards their parent grouping.
- **Objective: Directly Supported.** A goal in i* expresses the intentional desire of an actor (hard goal) and includes clear criteria for satisfaction, making it measurable. Thus, Objectives can be captured as i* goals with the specifics of how the goal is to be satisfied described through the value activities relevant to the objective.
- **Measure, Milestone, Target: Partially Supported.** i* does not include notions like measure, milestone and target. However, these can be partially captured through heuristics by i) naming the goal to include the measure, ii) introducing a task to achieve the goal through a means-end link to (in i* a goal can be decomposed to sub goals through a task and then through task decomposition into other goals), iii) introduce goals through task decomposition, one for each milestone and target. An

objective along with its measures, milestones and target can be represented by an i^* goal, decomposed through means-end link to a task stating the goal's achievement, and through task decomposition to goals (one for each milestone and target).

- **ValueActivity: Directly Supported.** i^* includes the notion of task, whose specification (e.g. how to be carried out) requires further decomposition. Information such as money and time can be expressed in i^* through task decomposition to resources (need to be consumed for the task to be performed).

4.3 e^3 value

- **StrategyPlan: Partially Supported.** In e^3 forces, an actor of the organization type, or a group of actors (constellation) has Business Strategy as a property, describing the direction and scope of the organization's configuration and the position in its environment; however, the notion is not explicitly modeled nor its relationships with the other constructs. StrategyPlan exists in e^3 value/forces, but it is not conceptualized, just represented as a text-based property of an actor.
- **Actor: Directly Supported.** In e^3 value, actors are organizations, or end-customers perceived from their environment as economically independent entities, capable of taking economic decisions. An actor in e^3 value/forces includes SMBSC. Actor that performs value activities, and extends it with the customer and constellation type actors, the first consuming what is provided by the value activities (value object) and the latter joining several organization-type actors cooperating to create a value.
- **StrategicGoal: Not Supported.** no corresponding notion is included.
- **Strategic Theme: Not Supported.** no corresponding notion is included .
- **Group: Partially Supported.** e^3 value/forces allows groupings and subgrouping with respect to actors as it can be composite, consisting of other Actors. e^3 value/forces considers an Actor as a concrete entity (e.g. an organization) or a role, such as Retailer referring to the abstract behavior within a business domain.
- **Perspective: Not Supported.** e^3 value/forces distinguishes intra-enterprise alignment, i.e. where business strategy, e-services, process and IT/IS are analyzed within an enterprise. However, these parameters are also considered for alignment among several enterprises to provide integrated values, through integrated processes and IS/IT [9]. Thus e^3 value/forces supports Perspective differently than of SMBSC.
- **Unique Value Proposition: Indirectly Supported.** e^3 value/forces define 3 Business Strategy types for value object proposition (cost-leadership, differentiation and focus). However, they are not explicitly modeled in the ontology but they are represented as a text-based type of the Business Strategy property of an Actor.
- **Processes: Not Supported.** e^3 value/forces is service-centered, meaning that it identifies services for realizing a business strategy and delivering values; the notion of process corresponds to activities needed to provide services (not in the ontology).
- **Capital, Objective, Measure, Milestone, Target: Not Supported.** e^3 value/forces does not include intentional elements nor elements closely related to them.
- **ValueActivity: Partially Supported.** In e^3 value, value activity is a set of operations yielding a profit to the actor(s) who perform it. As such, it is one of the core components of the ontology. Belonging to an actor, a value activity can be related to

a business strategy of the actor, and the corresponding strategic goals (not explicitly though), but these relationships are not conceptualized in e³value/forces.

4.4 BMO

- **StrategyPlan: Partially Supported.** Notions of the SMBSC StrategyPlan are analyzed in terms of and compared to the Business Modeling Ontology (BMO). Overall, notions of the StrategyPlan in SMBSC are only partially supported by BMO primarily due to the lack of goal-related concepts.
- **Actor: Partially Supported.** In BMO actors are viewed from an internal perspective. The class Actor in BMO represents all actors except the one from whose perspective a BMO model is constructed [15]. Therefore, the BMO Actor corresponds to the SMBSC Actor i.e. that performs a value activity (not the Actor/Organization who defines the strategy).
- **StrategicGoal, StrategicTheme: Not Supported.** Strategic theme is in SMBSC an aggregation of Strategic Goals. BMO in general does not model the desired future state of the offering organization, e.g. strategic goals or themes.
- **Group: Partially Supported.** Groupings in SMBSC refer to a sub typing or part-of data abstraction, for example there exist groups of processes such as management processes, innovation processes etc., all of which are part of a higher level group such as Process. The meta-model of BMO does not contain any similar construct, however several BMO constructs can be de-composed into other constructs in that there exists a SetOf-association between the two.
- **Perspective: Partially Supported.** For SMBSC this captures the four perspectives of the strategy map template and includes aspects of goals (Objective, Measure etc.). However, perspectives in BMO do not model exactly the same thing, as goals are missing or not explicit in BMO. Nevertheless, the financial, customer and internal perspectives are directly supported in BMO with financial aspects, customer interface, and infrastructure management respectively. While the LearningAndGrowth perspective is said to correspond to Product (interface) in BMO, and mainly the value proposition [10], this can be debatable since they seem to capture different yet related concepts.
- **UniqueValueProposition: Indirectly Supported.** In BMO, a Value Proposition represents value for one or several Target Customers, i.e. how an organization differentiates what it offers from its competitors. A Value Proposition is decomposed into a set of Offerings. Each BMO Offering describes an elementary product or service, offered (directed) towards the target customers, which indirectly corresponds to the notion of SMBSC UniqueValueProposition.
- **Processes: Partially Supported.** In BMO this refers to Infrastructure Management. In particular, Processes map onto the Value Configuration part of Infrastructure Management in BMO, which describes the arrangement of activities and recourse that are necessary in order to create value for the customer. One difference between BMO and SMBSC in this respect is that SMBSC Processes refers to groupings of goals for processes and related concepts such as Objective, Target, and Measure etc. while BMO Infrastructure does not contain any corresponding concepts.

- **Capital: Partially Supported.** The concept may vaguely be modeled using the BMO concept of Resource, which in BMO is divided into tangible, intangible and human resources. Another candidate is BMO Capability, where a Capability describes whether or not a particular needed Value Configuration can be applied by a particular company to provide the value proposition and if the appropriate resources (i.e. services and resources) are available.
- **Objective, Measure, Milestone, Target: Not Supported.** BMO in general does not capture the desired future state of the offering organization.
- **Value Activity: Indirectly.** BMO does not explicitly have a way of representing objectives/goals though it does represent Value Configurations. Attributes and relationships of BMO Value configuration, i.e. resources, actors etc. are similar to those of SMBSC Value Activity. Moreover, the BMO notion Activity is defined as “an action a company performs to do business and achieve its goals” [10].

5 Discussion, Conclusions and Future Work

The analysis shows that there is a considerable overlap between the EM approaches examined, both with regard to strategy and also among themselves. The analysis also highlights differences; most notably in terms of how core strategy notions like goals, means, etc. are represented. In this respect, EKD and i* include many constructs that correspond to goal-related notions, while BMO and e3value almost lack explicit representations of such notions. This partially validates the observation of Osterwalder that strategy models and business models deal with the same concepts but on different business layers [10]. Business models and strategy models complement each other in that the former are implementations of the latter, e.g. a company’s strategy in terms of goals, means etc. are translated into value propositions, customer relations and value networks.

Overall none of the EM approaches examined directly supports all strategy notions. This limitation is expected as strategic notions are beyond the original intended scope of EM. Nevertheless, the analysis shows that either indirectly or partially examined EM approaches are able to model strategic notions.

The results of the study can be used in practice in several ways. Practitioners can get support for selecting the most appropriate EM language for modeling strategic aspects. For example, if strategic goals are in focus, i* or EKD are strong candidates, while BMO or e3value can be useful for designing and representing value configurations. Depending on the needs, several languages can also be used together in a complementary way. The results of the study can also support the development and extension of the EM approaches. For example, for EKD, an extension towards strategy formulations will provide a more streamlined development process offering inherent traceability from strategy modeling, through the different perspectives of an organization, to platform-specific implementations of IS.

Another aspect of the analysis lays in the use of the reference model UBSMM and its extensions to business strategy formulations i.e. UBSMM.SMBSC. Business strategy formulations are traditionally natural language-based, usually accompanied

by schematic representations. The ambiguity of such formulations risks making analysis of EM approaches unattainable. This difficulty can be overcome by mapping EM constructs onto UBSMM.SMBSC constructs, since the meta-model provides clear semantics for a set of strategy notions. Thus, UBSMM.SMBSC facilitates understanding of strategic notions in EM approaches and reduces their ambiguity.

Future work will consolidate the analysis by including strategy notions found in other business strategy formulations such as VC and BOS, which are all part of UBSMM. Furthermore, other EM languages can be analyzed using the same framework used in this study.

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