Model-Driven Strategic Awareness: From a Unified Business Strategy Meta-Model (UBSMM) to Enterprise Architecture

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Abstract. Business strategy should be well understood in order to support an enterprise to achieve its vision and to define an architecture supporting that vision. While business views are identified in many Enterprise Architecture (EA) proposals, business strategy formulations from the area of Strategic Management are overlooked. Thus, IT solutions cannot be traced back to business strategy in a clear and unambiguous way. Our intended proposal, a Unified Business Strategy Meta-Model (UBSMM), aims at establishing such a link. UBSMM is a formalization of the integration of known business strategy formulations with precise semantics enabling its model-level usage to provide strategic awareness to Enterprise Architecture. In this paper we present the development process of UBSMM, and further, we propose conceptual relationships towards Enterprise Architecture (EA).

Keywords: Business strategy, model-driven engineering, meta-model, enterprise architecture.

1 Introduction

Business strategy requires a continuous management of the resources of an enterprise to ensure its realization. Focusing on IT, enterprises fail to establish traceability from business strategy towards IT operations thus hindering their optimal utilization.

Possible ways to address the lack of such links include business-IT alignment approaches, whether that is alignment between business strategy and distinct enterprise models, or business strategy and Enterprise Architecture (EA). However, alignment approaches are falling short in two ways. From one side, business strategy formulations from *Strategic Management*, such as *Strategy Maps and Balanced Scorecards* (SMBSC) [1], Porter's *Value Chain* [2], and others, are overlooked in [3, 4, 5, 6]. On the other hand, approaches referring to such business strategy formulations focus on particular enterprise models [6, 7, 8, 9]. Consequently,

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alignment approaches establish links between business and IT within particular context, thus not addressing alignment overall in an adequate manner [10].

Business strategy formulations used in Strategic Management are traditionally natural language-based, usually accompanied by schematic representations. In such a form, establishing meaningful traceable links towards IT, as expressed by enterprise models and enterprise architecture, is unattainable due to the ambiguity of the formalisms. Therefore, business strategy formulations need to be formalized, thus transforming their notions and rules from natural language to a process-able form. The degree of formalization may vary according to the purpose of use, from manual to fully automated. Business strategy formulations, such as Strategy Maps and Balanced Scorecards (SMBSC) [1], and the Value Configuration (VC) [2, 11] have been formalized in [12, 13], and [14] respectively, providing unambiguous descriptions of their concepts.

On the other hand, EA provide the principles, methods, and models used to design and realize an enterprise's organizational structure, processes, information systems and infrastructure [15], and are widely present in the industry. EA proposals such as Zachman [16], ARIS [17], TOGAF [18], and Archimate [19], to name a few, include business elements without linking them to business strategy formulations.

The need to establish meaningful links between business strategy and EA to improve practitioners' understanding of their business strategy has been long acknowledged, in the aforementioned EA proposals and the Enterprise Business Architecture proposed in [20]. Yet recent evidence indicates a lack of business strategy insights in EA. Among 176 practitioners of a 2011 EA webinar, answering whether they understand their business strategy, 1% stated they had no business strategy, 6% didn't know the state of their business strategy, 16% stated business strategy is not clearly communicated, 44% stated business strategy is not understood or supported, and only 33% stated their business strategy is well understood [21].

The goal of this paper is to provide a unified business strategy meta-model (UBSMM) which does not currently exist, allowing it to (i) serve as a pivot model between business strategy formulations, and (ii) provide strategic awareness to EA via model-to-model linkages. The purpose of UBSMM is:

- to add precision to business strategy formulations through formalization,
- to contribute and complement business alignment, allowing an enterprise to align various business strategies, or to integrate with the strategies of others,
- to serve as a pivot model between business strategy formulations; an enterprise can be modeled from a resource-based view and through UBSMM to get a competition-view of its current strategy, and vice-versa,
- to enhance strategy communication among actors, when more than two actors are involved, one-to-one mappings between strategy formulations each actor uses are inefficient. Thus, UBSMM can become the common point of reference for such mappings,
- to be extendable to embed more business strategy formulations, therefore, aiming at not being static and at being updated and enriched, thus supporting up-to-date mappings.

The scope of this paper encompasses the development of UBSMM through rigorous schema integration, and further, identification of conceptual relationships towards EA, for which the ISO/IEC/IEEE 42010-2011 standard is used [22]. The paper is structured as follows: Section 2 presents the schema integration process followed to build UBSMM; Section 3 elaborates the conceptual relationships to EA; Section 4 presents related work on EAs using business elements, and Section 5 concludes the paper and discusses future work.

2 Schema Integration (UBSMM)

Unifying meta-models of business strategy formulations can be achieved through schema integration [23], where schema integration refers to both view integration and database integration. However, for the scope of this paper the schema integration process followed is rooted in the foundational work of [24] which identifies four phases: *pre-integration, schema comparison, conforming to schemata,* and *merging and restructuring*. Due to space limitations, this paper provides an illustration of the integration process followed, while a more detailed presentation can be found in [25].

2.1 Pre-integration

During this phase the selection of schemata to be integrated and their representations takes place. According to [25] this selection is based on relevance, completeness and reliability, the integration order, and assignment of preferences and strategic decisions for integration, e.g. the involvement of users or designers along with relevant information collected for an integrated set of constraints depending on the view (user, designer, etc.).

Select Schemata for Integration. The schemata chosen for integration are the Strategy Maps and Balanced Scorecards meta-model (SMBSC) [12, 13] and the Value Configuration meta-model (VC) [14] because in terms of relevance, completeness and reliability they are complete conceptualizations of the aforementioned business strategy formulations validated through correct instantiations of the meta-models as well as through their ontological formalization capable to instantiate each business strategy formulation.

SMBSC (Figure 1) formulates strategy upon establishing four perspectives of an organization, where goals are identified for each perspective and they are altogether related via cause-effect links, the strategy map [1]. Goals are then extended to a set of targets using measures to evaluate their achievement. Initiatives are identified to achieve the targets, the balanced scorecard.

The VC (Figure 2) refers to the Value Chain [2], the Value Shop, and the Value Network [11], formulating strategy based on a setup of value activities and margin aiming at a unique value proposition. Value activities are all the activities a company performs to create value for its buyers, divided into primary, and support, while margin is the difference between the total value and the total cost of performing the

value activities. Primary activities capture the activities that bring value to the VC and vary between value chain, value shop, and value network. Support activities aim at supporting the primary activities.

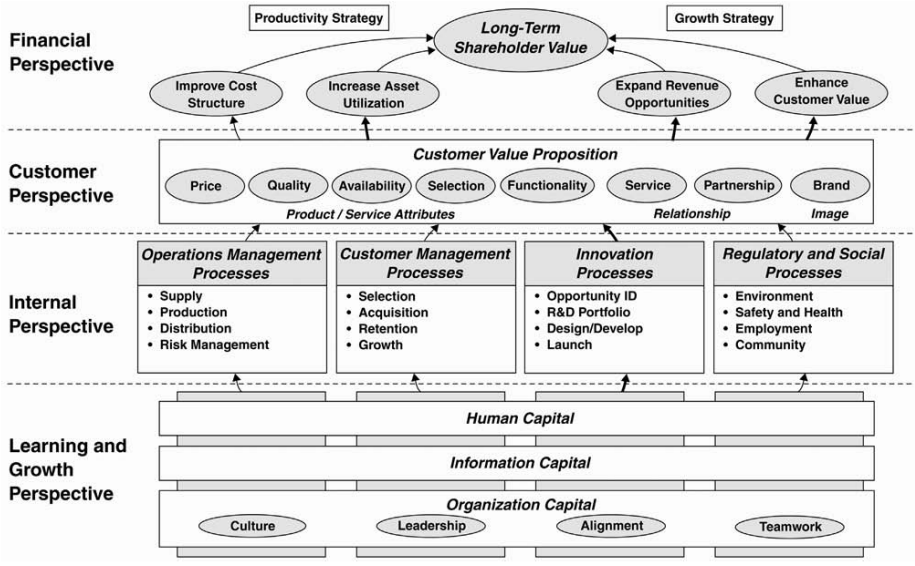

Fig. 1. The Strategy Map template [1]

Select Schemata Representation. Both business strategy formulations are conceptualized and represented as UML conceptual models accompanied with constraints expressed in statements [12, 13, 14].

Select Integration Process Strategy. There are four possible variations grouped into *binary*, for integrating two schemata at a time, and *n-ary*, for integrating *n* schemata at a time [24]. Binary strategies can be divided into *ladder*, when two schemata are integrated and another schema is integrated with the intermediate result, and *balanced* when schemata are divided into pairs and integrated symmetrically. For UBSMM a binary, ladder integration process is adapted aiming at progressive and gradual unification of business strategy formulations.

Assigning preferences is relevant mostly in n-ary integration strategies. However, for binary integration strategies is it efficient to consider preferences before choosing component schemata. For UBSMM, there are two pragmatic reasons why VC and SMBSC were preferred; a) to the best of the authors' knowledge no other business strategy formulations have been formalized, thus not available, and b) based on citations and literature search these two are well established in Strategic Management literature [10].

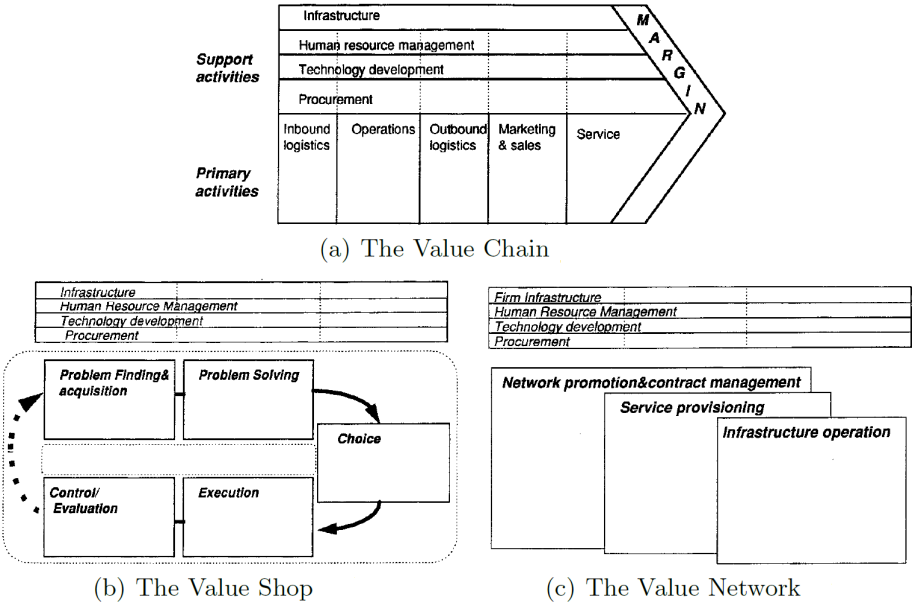

Fig. 2. The Value Configuration [2, 11]

2.2 Schema Comparison

During this second phase schemata are analyzed for correspondences to be identified, and compared for conflicts and inter-schema properties to be discovered, as well as to collect other relevant information.

Both schemata are annotated with acronyms; for Strategy Maps and Balanced Scorecards, *SMBSC* is used as a prefix, while for the Value Configuration, *VC*. Classes are presented in the form of schema.class, attributes are presented in the form of schema.class.attribute, and associations are presented capitalized as they appear in the schemata. Due to space limitations, examples of schemata comparisons are provided while the complete list of correspondences can be found in [25].

For schema analysis, schemata have been analyzed, correspondences have been identified and then schemata have been compared for conflicts. Additionally, inter-schema properties have been discovered; semantic relationships holding between a set of objects in one schema and a different set of objects in another schema. Example correspondences include: *VC.Strategy* with *SMBSC.StrategyMap*, *VC.Strategy.Type* with *SMBSC.CustomerValueProposition, VC.Strategy.Goal* with *SMBSC.Goal,* and *VC.ValueActivity* with *SMBSC.Initiative*.

These classes were then compared for identifying naming conflicts, aiming at identifying synonyms and homonyms between the two schemata, and structural conflicts. The aforementioned correspondences revealed:

- a naming conflict between *VC.ValueActivity* and *SMBSC.Initiative* as they are synonyms due to the former capturing the distinct activities used in a VC, thus all activities that support the strategy and the latter capturing activities identified

to be required towards the achievement of an objective, derived by a goal, thus all activities that support the strategy.

- a naming conflict between *VC.Strategy* and *SMBSC.StrategyMap as they* are homonyms due to both classes referring to a strategy, but with different meaning, using different names.
- a structural conflict between *VC.Strategy.Goal* and *SMBSC.Goal* as *VC.Strategy.Goal* is an attribute of *VC.Strategy* capturing the superior long-term return on investment generating real economic value and *SMBSC.Goal* is a class capturing all goals set across all four perspectives of SMBSC interrelated through causality relations, thus including goals of long-term shareholder value.
- an inter-schema property between *VC.Strategy.Type* and *SMBSC.CustomerValueProposition*, where the former captures three generic strategies: cost leadership, differentiation, and focus which reflects on the aggregation of *VC.ValueProposition* (*PriceRange*, *NeedType*, and *CustomerType*), and the latter captures four customer value proposition types within the customer perspective (low total cost, product leadership, complete customer solution, system lock-in) as a specialization of *SMBSC.Group*.

2.3 Conforming to Schemata

This phase of schema integration entails resolving the conflicts identified previously to align schemata for merging and restructuring. Therefore, semantic relationships between concepts involved in conflicts need to be identified as *identical*, *equivalent*, *compatible* and *incompatible* [24].

Concepts are considered *identical* when the same modeling constructs are used across schemata to represent the same concepts. *Equivalence* consists of three types: (i) *behavioral*; when corresponding instantiations of concepts can be queried and retrieved, (ii) *mapping*; when concept instances correspond one to one to each other, and (iii) *transformational*; when a concept is transformed to preserve equivalence with a correspondent concept. Concepts are *compatible* when they are neither identical nor equivalent and their modeling constructs, design principles and constraints are not contradicting each other's. Concepts are *incompatible* when their specification is contracting each other's [24].

Consequently for the examples presented in schema comparison semantic relationships were identified and resolutions have been provided:

- Synonyms *VC.ValueActivity* and *SMBSC.Initiative* are identical; therefore, the latter is renamed into *SMBSC.ValueActivity*.
- Homonyms *VC.Strategy* and *SMBSC.StrategyMap* can be transformed to preserve equivalence; therefore, they are renamed into *VC.StrategyPlan* and *SMBSC. StrategyPlan* respectively.
- For structural conflict between *VC.Strategy.Goal* and *SMBSC.Goal*, transformation can preserve the equivalence; therefore, attribute *VC.Strategy.Goal* becomes a class. *VC.Strategy Includes* exactly 1 *VC.Goal* and

VC.Goal BelongsTo exactly 1 *VC.Strategy*, which becomes homonym to *SMBSC.Goal* as they have different constraints. Consequently, they are both renamed to *VC.StrategicGoal* and *SMBSC.StrategicGoal*.

2.4 Schema Merging and Restructuring

The conformed schemata are merged and restructured to embed the inter-schema properties identified earlier through various types of operations, such as transformations that produce common generalizations, joins that produce common subtypes, aggregation, attribution creation, etc. [24].

The example of inter-schema property between *VC.Strategy.Type* and *SMBSC.CustomerValueProposition*, is addressed as follows:

- *UniqueValueProposition* is introduced (Figure 3), carrying and attribute with Type: *LowTotalCost*, *ProductLeadership*, *CompleteCustomerSolution*, and *SystemLock-In*. The three generic strategy types of VC correspond to the customer value proposition types in SMBSC which includes a forth. Price corresponds to low total cost, need corresponds to product leadership, customer corresponds to complete customer solution, and system lock-in is also added as used in SMBSC.
- *UniqueValueProposition* is associated with a 1..1 association to *StrategyPlan* for equivalence with *VC.Strategy.Type*.
- *PriceRange*, *NeedType* and *CustomerType* are parts of *UniqueValueProposition* through aggregation associations for equivalence with *VC.ValueProposition*.
- *UniqueValueProposition* is a specialization of *Group* allowing the representation of *StrategicGoal* as goal on the customer value proposition as subgroup of the customer perspective for equivalence with *SMBSC.CustomeValueProposition*.

The outcome of merging and restructuring of the two schemata is presented in figure 3. Due to space limitations, *StrategyPlan* and *StrategicGoal* class and constraint descriptions are presented, aligned with the correspondences presented in previously. A list of class and constraint descriptions can be found in [25].

Class *UBSMM.StrategyPlan* captures the strategy of an actor and carries a Type attribute, which indicates the business strategy formulation modeled as a list:

A *UBSMM.StrategyPlan* of *Type*: *StrategyMap*:

- *Includes* (exactly) one copy of each of the four predefined perspectives of the strategy map template.
- *Includes* at least one goal in each perspective, thus at least four goals.

A *UBSMM.StrategyPlan* of *Type*: *ValueConfiguration*:

- *Includes* (exactly) one copy of the three predefined primary activity groups, ValueChainPrimary, ValueNetworkPrimary, ValueShopPrimary in accordance to the *Type* of *ValueConfiguration IsBasedOn*.
- *Includes* exactly one goal which does not belong to any group.

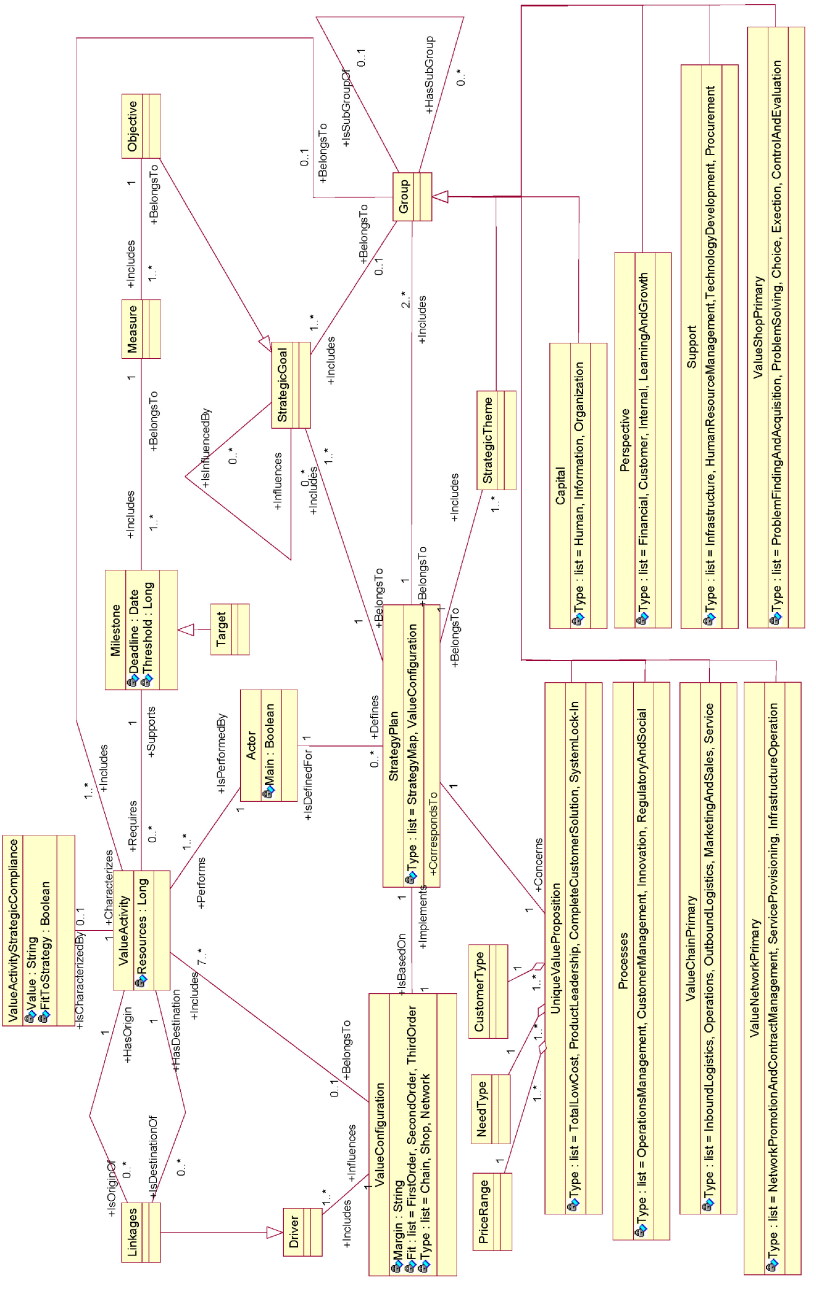

Fig. 3. The Unified Business Strategy Meta-model (UBSMM)

Class *UBSMM.StrategicGoal* captures goals set either across the four perspectives for *SMBSC* or the strategy overarching goal set in *VC* (usually: superior long-term return on investment). Causality relationships between *StrategicGoals* are captured through the self-association *Influences*, *IsInfluencedBy*.

A *UBSMM.StrategicGoal BelongsTo StrategyPlan* of *Type*: *StrategyMap*:

- included in a *StrategicTheme* is also included in the *StrategyPlan* to which the *StrategicTheme BelongsTo*.
- belonging to *Perspective* of *Type*:*Financial* which is a *Group* does not derive any *ValueActivity* because *Target* captures the results of *ValueActivity* from the other perspectives.
- belonging *Perspective* either of *Type*:*Financial* or *Type:Internal* which is a *Group* may influence another *StrategicGoal BelongsTo StrategyPlan* of *Type*: *StrategyMap* that *BelongsTo* either the same perspective or above.
- belonging to *Perspective* of *Type*:*LearningAndGrowth* which is a *Group* can only be *InfluencedBy* another *StrategicGoal BelongsTo StrategyPlan* of *Type*: *StrategyMap* that *BelongsTo* the same perspective (there exists no one below).
- belonging to P*erspective* of *Type*:*Financial* which is a *Group* can only *Influence* another *StrategicGoal BelongsTo StrategyPlan* of *Type*: *StrategyMap* that *BelongsTo* the same perspective (there exists no perspective above).
- must *Influence* another *StrategicGoal BelongsTo StrategyPlan* of *Type*: *StrategyMap*, except if it BelongsTo P*erspective* of *Type*:*Financial* which is a *Group* where a top-goal may exist.
- belonging to a *Group* must belong to the same *StrategyPlan* in which this *Group* belongs to.

3 Aligning UBSMM to Enterprise Architecture

Enterprise architecture provides holistically the methods, and models used to realize an enterprise's organizational structure, processes, information systems and infrastructure [15]. When addressing the alignment of business strategy to EA, UBSMM captures business strategy providing a common interface towards EA, where a common interface is desirable as well; for that, we consider the ISO/IEC/IEEE 42010-2011 standard [22], as explained in what follows.

3.1 Conceptual Relationships between UBSMM and Enterprise Architecture

ISO/IEC/IEEE 42010-2011 (figure 4) describes software system architectures through a set of generic concepts and terms of reference accepted for an architecture description, as well as a conceptual model of a system of interest [22].

Enterprise architecture frameworks such as TOGAF [18], etc. are aligned with the concepts of the architecture description model provided above. Therefore, when considering an enterprise as a system-of-interest, thus aiming at an architecture description of an enterprise, conceptual relationships between UBSMM and ISO/IEC/IEEE 42010-2011 models are identified thus allowing the consequent identification of an enterprise architecture description based on business strategy.

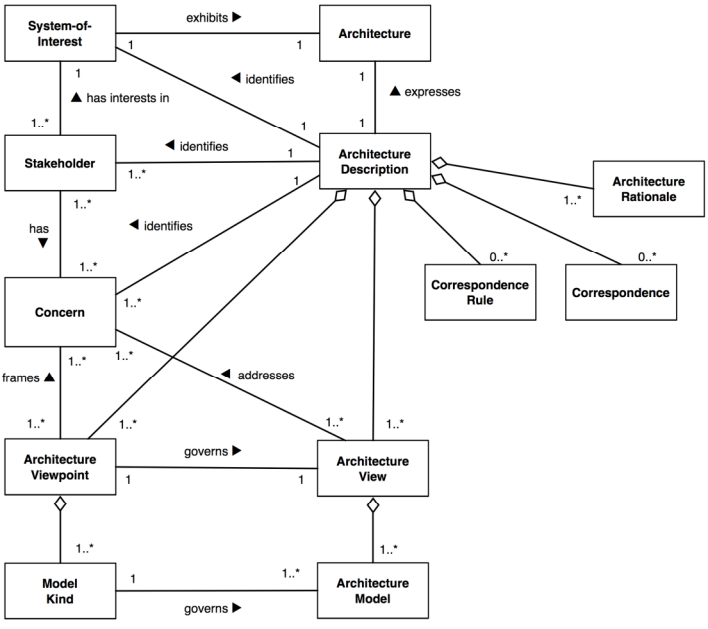

Fig. 4. The ISO/IEC/IEEE 42010-2011 Meta-model [22]

An *Architecture Viewpoint* (Table 1) frames an enterprise's concerns, which when considered holistically they constitute its strategic interests and thus constituting business strategy as its Architecture Viewpoint. Based on this proposal more conceptual relationships are identified:

- *Stakeholders*, represented by *Actor* in UBSMM, are all those having an interest in the long-term profitability and continuity of the enterprise, those that share its purpose of existence, thus its mission and vision.
- Business strategy as an *Architecture Viewpoint* frames stakeholders' concerns expressed as the generic strategies of an enterprise: *being low cost*, *being a product leader,* or *being focused* [2]. As such, business strategy governs particular business strategy formulation as Architecture Views.
- Business strategies such as VC and SMBSC are candidates as architecture views as they address stakeholders' concerns, the three generic strategies.
- *Model Kind* for business strategy being an architecture viewpoint is UBSMM with instantiations: UBSMM.SMBSC and UBSMM.VC, as Architecture Models.
- *Correspondences* between *Architecture Description* elements can be assessed to hold or violate the *Correspondence Rules* as defined by UBSMM through constraints to instantiate either SMBSC or VC.

- *Architecture Rationale* captures the justification for choosing SMBSC or VC as *Architecture View*, as well as the justification for instantiations of all relevant strategy concepts of UBSMM.

Table 1. The concepts of ISO/IEC/IEEE 42010-2011 [22] adjusted for an enterprise

ISO/IEC 42010	**For an enterprise**
System-of-Interest	*An enterprise.*
Stakeholder	*An individual/team/organization with an interest on the Enterprise ascribing purposes to it.*
Concern	*An interest in the enterprise relevant to one or more of its stakeholders.*
Architecture	*Fundamental properties of the enterprise in its environment embodied in its elements, relationships, and in the principles of its design and evolution. An enterprise is situated in an environment, where the environment determines the totality of influences upon the enterprise through its life cycle.*
Architecture Description (AD)	*A work product used to express architecture for an enterprise.*
Architecture Rationale	*Explanation, justification and reasoning for architecture decisions that should be recorded.*
Correspondence	*A relation between AD elements used to express, record, enforce and analyze consistency between AD elements for an enterprise identifying rules governing it.*
Correspondence Rule	*A rule enforcing the application of correspondences between AD elements of an enterprise.*
Architecture Viewpoint	*A work product establishing the conventions for the construction, interpretation and use of architecture views to frame specific enterprise concerns.*
Model Kind	*Includes the languages, notations, conventions, modeling techniques, analytical methods and operations appropriate to the enterprise concerns framed by an architecture viewpoint.*
Architecture View	*A work product expressing the architecture of the enterprise from the perspective of specific enterprise concerns.*
Architecture Model	*A model adhering to a model kind appropriate for the enterprise concerns addressed by the architecture view*
Architecture Framework	*Conventions, principles, and practices for the description of an enterprise architecture established within a specific domain of application and/or community stakeholders.*

For distinct elements of UBSMM for VC and SMBSC different conceptual relationships are also identified for SMBSC (Table 2) and VC (Table 3).

Table 2. Relationships between ISO/IEC/IEEE 42010-2011 [22] and UBSMM.SMBSC

ISO/IEC 42010	UBSMM.SMBSC	Description
Concern	StrategicGoal	*Set across the four perspectives.*
Architecture Viewpoint	Perspective	*Four viewpoints grouping strategic goals /framing concerns. E.g. Customer Perspective.*
Architecture View	ValueActivity	*The set of ValueActivity derived (governed) from the StrategicGoal can be considered as corresponding views because they address StrategicGoal within a specific Perspective. e.g. for Customer it addresses the goals relevant to the UniqueValueProposition.*
Model Kind	Perspective:Type	*e.g. Perspective of Type:Customer provides modeling conventions appropriate for a UniqueValueProposition which includes the interplay of CustomerType, NeedType and PriceType.*

Table 3. Relationships between ISO/IEC/IEEE 42010-2011 [22] and UBSMM.VC

ISO/IEC 42010	UBSMM.SMBSC	Description
Architecture Viewpoint	ValueConfiguration	*e.g. Stakeholders in a manufacturing enterprise are concerned with the enterprise's value chain being unique to bring value.*
Architecture View	Primary/Support	*Groupings of primary and support activities (depending on the configuration type), which address the particular concerns of the stakeholders interested in an enterprise. E.g. ValueActivity is structured in the groups of ValueChainPrimary and Support.*
Model Kind	ValueConfiguration:Type	*Selection of type determines the model of strategy. e.g. ValueConfiguration:Type. Chain.*

3.2 Usage Scenarios

Alignment via a unified business strategy meta-model to enterprise architecture has a number of applications.

Different business strategies have different concerns. Given the number of business strategy formulations and enterprise architectures that may exist in a business context, a 1..1 mapping between strategy and enterprise architecture as presented in the previous section is desirable to avoid numerous pairs of mappings.

Different business strategies across enterprise units (such as for different local markets) may share a unique enterprise architecture, such as TOGAF [18], therefore; the use of UBSMM provides them benefits in the unification of strategy terms, maintenance, and compatibility; further, it becomes possible for every local enterprise unit to map directly their Strategy terms through the proposed conceptual relations to the terms used in the EA.

Communication and understanding between enterprises merging, or establishing partnerships, can be enhanced using a single business strategy meta-model like UBSMM when it comes to understanding and relating each other's' EA.

4 Related Work

The need for aligning EAs to business strategy has been argued in [20] stressing the need for thinking holistically. There exist proposals providing links between strategy and goals for information system (IS) architecture as part of a model-supported alignment framework between IS architecture and its surrounding organization [26]. But there also exist widely applied EAs in the industry. The Zachman Framework [16] includes the notion of business model aiming to capture what's important to the business through a set of three models focused on data, function and network, where strategies are perceived as means towards business objectives (ends). TOGAF [18] includes concepts of business strategy, technology strategy, business principles, objectives and drivers as part of the architecture vision as well as goals, objectives and measures as part of the business architecture. Archimate [19] includes a business layer with concepts addressing information, behavior, structure and motivation. Strategy constitutes a concern for the different viewpoints identified. Part of ARIS's [17] core layer focuses on strategy providing a strategic specification for process design, optimization, controlling and execution. GERAM [27] includes an entity concept that addresses mission, vision, strategy, objectives, etc.

While EAs do not overlook business concepts, they do not relate with business strategy formulations thus resulting into EA being agnostic to them. Moreover, EAs include methods, techniques, and tools used to design, model, develop, monitor, and maintain models and systems requiring concepts to be defined clearly. However, business strategy formulations are traditionally natural language-based, accompanied by schematic representations, where formalization is not seen as a priority.

Such difference also hinders the development of support tools for establishing linkages that can facilitate tracing actions, artifacts and decisions between business strategy and EA. To the best of the author's knowledge the only business strategy formulation formalization efforts that exist are the ones of OMG [28] focused on the balanced scorecards and the ones of [12, 13, 14] focused on SMBSC and VC.

5 Conclusion and Future Work

In this paper, UBSMM, a unified conceptualization of business strategy formulations is proposed, which is aimed to provide model-driven strategic awareness to EAs. UBSMM facilitates the alignment of different business strategies, or integration with strategies of others and can also serve as a pivot model between different business strategy formulations of a single or multiple enterprises.

EA is known to provide the methods and models to design and realize organizational structure, processes, and IS. However, alignment of EA with business strategy is an open issue. In this study UBSMM has been considered as an appropriate

solution to provide strategic awareness to EA via model-to-model linkages. Using UBSMM to link business strategy with EA has a number of benefits:

- A strategic view on EA can be established; from UBSMM towards IS development.
- Simplified model mappings - given the number of business strategies and EAs that may exist in a business context, 1-1 mapping between strategy and enterprise architecture through UBSMM and a template EA model (i.e. ISO 42010) eliminates the need for establishing numerous pairs of mappings.
- Communication and understanding within a single enterprise with the units following different strategies, or between enterprises merging or establishing partnerships, can be enhanced using a single business strategy meta-model like UBSMM to easier understand and relate each other's' EA.

In the future, the conceptual relationships identified can be extended through mappings of UBSMM to distinct EAs exploring potential benefits via real cases.

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