

Towards Capturing Strategic Planning in EA

Carlos L. B. Azevedo^{1,2}, João Paulo A. Almeida¹, Marten van Sinderen² and Luís Ferreira Pires²

¹Ontology and Conceptual Modeling Research Group (NEMO),
Federal University of Espírito Santo (UFES), Vitória, ES, Brazil

²Services, Cybersecurity and Safety Research Group, Centre for Telematics and Information Technology,
University of Twente, Enschede, The Netherlands

clbazevedo@inf.ufes.br, jpalmeida@ieee.org, {m.j.vansinderen, l.ferreirapires}@utwente.nl

Abstract— Strategic planning aims at improving both the financial and behavioral performance of an enterprise. It concerns the enterprise and its desired future, helping set priorities, concentrate capabilities and resources on key operations, ensure that stakeholders are working toward common goals and assess and adjust the enterprise’s direction. Although it motivates and drives Enterprise Architecture (EA) choices, strategic planning is currently not explicitly reflected in EA models. This paper addresses this gap by presenting a principled approach to support strategic planning modeling in EA. We first analyze the strategic planning literature, developing a conceptual model for strategic planning that is aligned with a foundational ontology. We then propose a language metamodel that incorporates the conceptual model into the ArchiMate modeling language. In order to show the usefulness of our approach, we use our proposed language constructs to model the strategic plan of a medium-to-large pension fund.

Keywords— Strategic Planning, Enterprise Architecture Modelling, ArchiMate

I. INTRODUCTION

Empirical studies have shown that defining and following a strategic plan can improve an enterprise’s financial performance [1] [2] [3] [4] [5]. Strategic plans define an enterprise’s strategy for a certain period of time, considering which goals the enterprise wants to achieve and how the enterprise plans to pursue them. It establishes where the enterprise should focus its energy and resources, and which operations it needs to strengthen. It also helps stakeholders work toward common goals and align the enterprise’s operations towards achieving those goals [6]. In this sense, strategic plan provides a ‘direction’ for the enterprise and, as such, influences its products, services, capabilities and behavior.

Strategic planning concerns considerations for the enterprise in different time frames (e.g., short-term, mid-term and long-term), and at different levels of detail (e.g., ranging from detailed prescriptions of activities and related quantitative targets, to broader and more loosely defined overarching initiatives). Commonly, goals planned by an enterprise to be achieved in the short term are more detailed than plans for long-term goals. This type of strategy is termed as ‘umbrella strategy’ [7], in which general guidelines are defined for long-term goals and its details are left to be deliberated (or emerge) later in the process [7]. This is a means to deal with uncertainty about the future and to enable flexibility to react to unexpected events as they unfold.

Due to their relevance and range of influence, strategic plans are also used to provide an initial direction for an Enterprise Architecture (EA) and to motivate architectural decisions and changes on established EAs [8]. The EA, in its turn, is used to support the enterprise, including the delivery of its products and services, and as such, is already aligned with the enterprise strategy, even if informally or indirectly [8] [9].

Despite its importance in motivating and driving Enterprise Architecture (EA) choices [8] [9], strategic plans are currently not explicitly reflected in EA practices [10]. We argue that a more explicit alignment of EA and strategic management would be beneficial to both practices. From the EA point of view, knowledge concerning future capabilities, products and services would contribute to the planning of EA transformations over time, aiming at supporting those planned capabilities, products and services with controlled effort and adequate timing. From the strategic planning point of view, EA could serve as a middle ground between enterprise’s operations and its strategic plan, improving the assessment of business transformation [11] and the traceability between strategic plans and EA choices [10].

In this paper, we propose an approach to capture the results of strategic planning in EA models. We analyze the strategic planning literature, developing a conceptual model for strategic planning. We then propose a language metamodel that incorporates the conceptual model into the ArchiMate modeling language. In order to show the usefulness of our approach, we used the proposed language constructs to model a real strategic plan from a Brazilian mid-to-large pension fund. In order to clarify the semantics of the proposed constructs, we use notions of the UFO foundational ontology [12] [13] and Bratman’s planning theory [14] in the definition of a conceptual model for strategic planning.

This paper is further structured as follows: Section 2 briefly introduces some preliminary notions that we employ later to characterize strategic planning. Section 3 presents a conceptual model for strategic planning based on the strategic planning literature and on the notions discussed in Section 2. Section 4 presents a language metamodel to incorporate strategic modeling constructs in ArchiMate, as an extension of ArchiMate’s Motivation Extension. We also show how this extension can be instantiated, using the pension fund case. Section 5 discusses related work in EA frameworks and goal modeling languages, by considering their suitability for strategic planning, and finally, Section 6 discusses conclusions and directions for future work.

II. PRELIMINARIES

A. Ontological Foundations

In order to address the notions that are involved in the strategic planning domain with a sound conceptual basis, we first introduce some general notions of the foundational ontology we employ, more specifically the fragment for intentional and social agents of the Unified Foundational Ontology (UFO). It defines key notions for our analysis, from general notions (e.g., to explain objects, properties, events) to more specific ones (e.g., to explain agents, actions and intentional phenomena). Given the focus of this paper, we discuss the part of UFO's taxonomy of individuals that is relevant for this paper. For a full discussion regarding this ontological foundation, including the taxonomy of types ("universals") we refer to [12], [13] and [15]. This section is based on the discussions presented in [16] and [17].

In the taxonomy of individuals, UFO makes a top-level distinction between *endurants* (object-like entities) and *events* (occurrences). Endurants are further qualified as substantials or moments. A *substantial* is an *endurant* that does not depend existentially on any other *individual*, and it is usually referred to by the common sense term "object". In contrast with *substantials*, *moments* (also known as 'abstract particulars' and Tropes [18], [19] are existentially dependent entities, i.e., for a *moment* x to exist, another *individual* must exist, named its *bearer*. Examples of *moments* include the color of an apple, a marriage between two persons, an agent's belief, etc. Existential dependence is used to differentiate *intrinsic* and *relational moments*. *Intrinsic moments* are dependent on a single *individual*, while *relational moments* (also called *relators*) depend on a plurality of *individuals*. Examples of the first include weight and color, while examples of the latter include the covalent bond between atoms, marriage, employment and social commitments in general. A special category of moments is that of *dispositions*. *Dispositions* are *moments* that are only manifested in particular *situations*, but they can also fail to be manifested. When manifested, they do so through the occurrence of *events*, taking the world from one *situation* to another. Take, for example, the *disposition* of a magnet m to attract metallic material. The object m has this *disposition* even if it is never manifested, for example, because m was never close to any magnetic material. Nonetheless, m can certainly be said to possess that intrinsic property [20] [21] [22], which may be manifested by attracting iron. While this is an example of physical disposition, dispositions are also important in the enterprise to account for the notion of capability of persons and organizational units [23].

The UFO general part is specialized with a layer of intentional and social elements. For example, an *agent* is a specialization of *substantial*, representing entities capable of bearing *intentional moments*. These include mental states such as individual *beliefs*, *desires* and *intentions*. Intentionality should not be understood as the notion of "intending something", but as the capacity to refer to possible situations of reality. This is captured in UFO with the notion that every *intentional moment* has an associated *proposition*, which is called the *propositional content* of the *moment*. In general, the *propositional content* of an *intentional moment* can be satisfied (in the logical sense) by

situations in reality. Every intentional moment has a type (belief, desire or intention). The propositional content of a *belief* is that which an agent holds as true. Examples include one's belief that the Eiffel Tower is in Paris and that the Earth orbits around the Sun. A *desire* expresses the will of an agent towards a state of affairs (e.g., a desire that Brazil wins the Next World Cup), while an *intention* express desired state of affairs for which the agent commits at pursuing (*internal commitment*) (e.g., my intention of going to Paris to see the Eiffel Tower). The *propositional content* of an *intention* is termed a *goal*. Events that an agent performs motivated by its drive to satisfy its *goals* are called *actions*. Only *agents* are said to perform *actions* [13], as opposed to *non-agentive objects*, which *participate* (non-intentionally) in *events*. *Agents* can be further specialized into *physical agents* (e.g., a person) and *social agents* (e.g., an organization). *Social agents* are further specialized into *institutional agents* and *collective social agents*. *Institutional agents* are composed of a number of other *agents*, exemplifying what is termed a *functional complex*. "The parts of a *functional complex* have in common that they all possess a functional link with the complex. In other words, they all contribute to the functionality (or the behavior) of the complex" [12].

Similarly to agents, *non-agentive objects* can be specialized into *physical objects* and *social objects*. A category of social objects of particular interest to us is that of *normative descriptions*, which are social objects that create social entities recognized in that context. Examples of normative descriptions include a company's regulations and public laws. Examples of social entities that can be defined by normative descriptions include *social roles* (e.g., president, manager, sales representative), *social role mixins* (whose instances are played by entities of different kinds, e.g., customer, which can be played by persons and organizations), *social agent universals* (e.g., that of political party, education institution), *social agents* (e.g., the Brazilian Labor Party, the University of Twente), *social object universals* (e.g., currency) and other *social objects* (e.g., the US dollar) or other *normative descriptions* (e.g., a piece of legislation). *Normative descriptions* are recognized by at least one *social agent*.

A category of social element of particular importance in organizations is a *social relator* between agents (e.g., a marriage, an employment, an agreement). *Social relators* entail *commitments* and *claims* by the related *agents*, and depend on a *normative description* or *speech act* valid in the social context (e.g., a written contract, a verbal agreement). *Delegation* occurs when two *agents* (namely *delegator* and *delegatee*) are related through a special kind of *social relator* (termed *delegatum*). The foundation of this relation is the *social relator* (i.e. a bundle of *commitment/claim* pairs) established between the two *agents* involved in this delegation. *Commitments* are classified in open and closed. In an *open commitment*, the *agents* responsible for fulfilling the *commitment* are free to define how they will fulfill it. In a *closed commitment*, the *agent* must fulfill the *commitment* by performing *actions* that are instances of the *actions (type)* defined by another *agent*.

The temporal properties of events have their values (their qualia) taken by projecting these properties into a quality structure [12] [15]. UFO takes the time conceptual space to be a

structure “composed of” Time Intervals. Time intervals themselves are “composed of” Time Points. UFO admits: (i) intervals that are delimited by begin and end points as well as open intervals; (ii) continuous and non-continuous intervals; (iii) intervals with and without duration (instants). In particular, it allows a diversity of temporal structures such as linear, branching, parallel and circular time. Figure 1 shows a fragment of the specializations of individuals and intentions in UFO that are relevant to this paper.

B. Bratman’s Planning Theory

We complement the UFO concepts with notions explored by Bratman in his theory of intention and practical reasoning [14]. He discusses that what makes an action intentional is that it “stands in an appropriated relation” to the agent’s relevant desires and beliefs. In this sense, he explains the source of intentions, as a background of “desire-beliefs reasons for action”. He clarifies the distinction between desires and intentions by stating that desires are *potential influencers of actions*, while intentions are *conduct-controlling pro-attitudes*. An intention involves thus a kind of choice or special commitment to (future) action that desires do not involve. Intentions play a role in practical reasoning in that prior intentions constrain further intentions. An intention involves certain characteristic reasoning-centered dispositions: “a disposition to retain the intention without reconsideration, a disposition to reason from this retained intention to yet further intentions, and to constrain other intentions in the light of this intention.”

Bratman also discusses that *plans* share properties of intentions, but, because of their increased complexity, plans reveal other properties: *partiality* and having a *hierarchical structure*. Plans are *partial* in that they can be filled in later as required, with specifications of means, preliminary steps, and more specific courses of action. They are *hierarchical* in that a more general intention may be fixed while deliberating about how more specifically to realize it. Plans must satisfy certain constraints if they are to support coordination and deliberation on later conduct; they need to be internally consistent and consistent with the agent’s beliefs, and they need to be “means-end coherent” (i.e., filled with specifications that are as detailed as

needed for their eventual successful execution).

III. A CONCEPTUAL MODEL FOR STRATEGIC PLANNING

In this section we discuss strategic planning and propose a conceptual model for strategic planning in line with the management literature. Our modeling choices reflect our objective to align enterprise architecture with strategic planning.

Two main categories of theories are used to support strategic planning in the management area: *prescription theories* [24] [25], also known as deliberate strategies; and *description theories*, also known as emergent strategies [7]. *Prescription theories* are based on a clear distinction between the design of the strategic plan and its implementation. The strategy is first completely designed in terms of the goals the enterprise wants to achieve, when and how, and only then the strategy is communicated to the enterprise and implemented. In contrast, *description theories* assume that the realm of strategies is too complex and that the prescription theories underestimates it, so that it is not possible to define what goals to achieve and how to achieve them a priori. Description theories assume the strategy to be designed during its implementation. However, few, if any, strategies are purely *prescriptive*, just as few are purely *emergent* [7]. Most companies pursue a strategy informally termed as ‘umbrella strategy’, in which there is a mix of deliberate and emergent strategies [7]. The most usual model for performing strategic planning is the goal-based strategic model, also known as the vision-based strategic model [26] [27].

Strategic planning often focuses on an entire enterprise, although a strategic plan can also be defined for a specific part or department of an enterprise. The outcomes and the way in which a strategic plan is developed depend on the nature of the enterprise and on the nature of the challenges the enterprise is facing.

The *goal-based* strategic model described here is mainly based on [7], [26] and [27]. To describe the goal-based strategic model, it is necessary to express enterprises’ goals, which can be its mission, vision or regular goals to be achieved in long-term, mid-term or short-term.

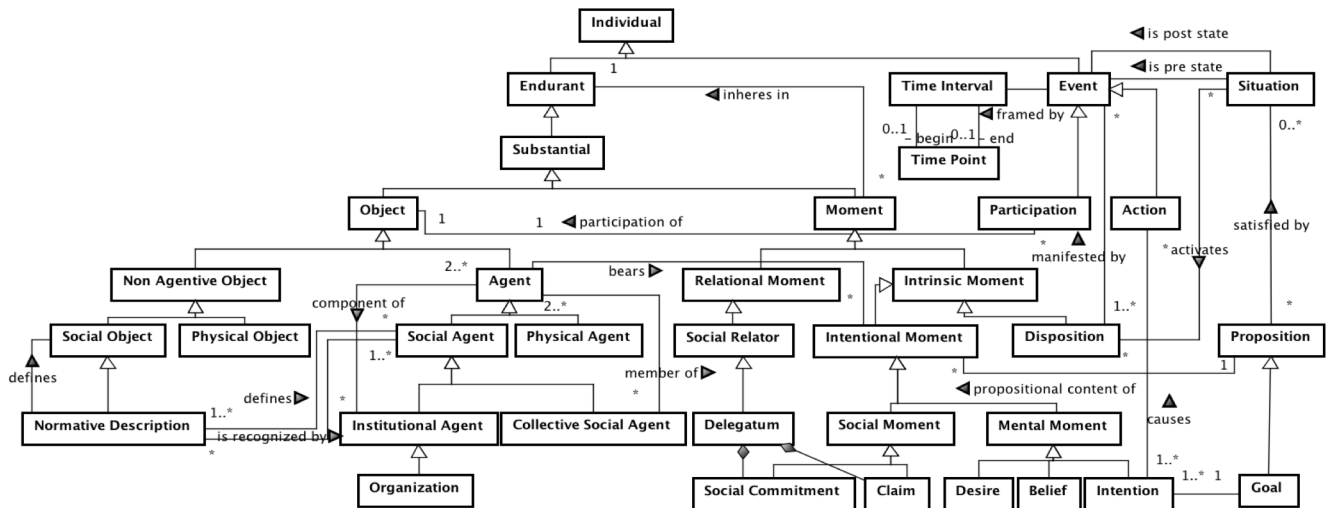


Figure 1 - Fragment of UFO depicting the specializations of Individual relevant for this paper

A. Strategic Plan Goals

The enterprise goals are among the most important elements of the *goal-based* strategic model [26] [27]. Usually, the first goals described are to be achieved on the long-term (e.g., five years from ‘now’). They encompass the enterprise’s mission and vision. Further, it is common that intermediate goals or milestones are described, as well as short-term goals (e.g., one year or less). Usually, goals in strategic plans are to be accomplished with timing constraints. Each of these goals can be related to other goals, in a decomposition, refinement or contribution type of relation.

The enterprise mission is a statement of purpose [28]. Effective mission statements commonly define what business the organization is in, its beliefs about how business should be conducted, the markets and customers it serves, and the unique value it contributes to society at large [5] [28]. Mission statements rarely change significantly over time, although sometimes they may be expanded or modified to reflect shifts in business focus [5]. Mission statements are regarded as the critical starting point for almost every major strategic initiative [5] [8] [28]. In addition, mission statements are intended to motivate (and in so doing, control) the behaviors of organizational members toward common organizational goals [5]. Mission statements can be idealistic rather than simply matter of fact [28]. In Bratman’s terminology they can be seen as “radically partial”. For example, a health-care organization such as a hospital may have as mission “to improve people’s lives through high-quality affordable healthcare”. Vision statements, while still partial, should be future-oriented, compelling, bold, aspiring, and inspiring, but yet believable and achievable [28]. Effective visions describe a future that is more attractive than the present, it is the vision of where and how the enterprise would be in the defined number of years [28]. An example of a vision is “to be one of the largest European health-care providers within 5 years”.

In the conceptual model in Figure 2 we introduce the concept of *strategic plan goal*, which is specialized into a *strategic goal* or a *planned goal*. A *strategic goal* is either a *Mission* or a *Vision*. The strategic plan goal concept is interpreted in UFO as an agent’s intention. Thus, every strategic plan goal should be related to an agent, which bears the intention. The agent is an individual, which can represent a person, who might play roles in the organization (e.g., Chief-Executive Officer), the organization itself, or a unit of an organization. Given the requirements for plans as discussed by Bratman [14], since they are intentions of the same agent, mission and vision must be consistent.

B. Refinement and Decomposition Between Goals

Our conceptual model distinguishes between the *refinement* and the *decomposition* relations between strategic plan goals. The refinement relation encompasses partiality and reflects the preparation for some future, in line with Bratman’s notion of plan. Using UFO notions, goals in a refinement are satisfied in situations from which less effort would be required to reach the original goal, but other actions might still be required.

The decomposition relation between goals, on the other hand, is understood as a decomposition in which the goals resulting from the decomposition, whenever achieved *entail* the



Figure 2 - Fragment of the Conceptual Model Depicting Specializations of Strategic Plan Goals

achievement of the original goal. In this sense it does not provide us with a plan, but rather with the sufficient conditions under which we consider the overall goal is satisfied. For example, the health-care organization may decompose its vision into “having 30% of the European market share within 5 years” and “being present in the largest European member states within 5 years”. This means that it will consider these conditions as sufficient to reach its vision of “being one of the largest European health-care providers within 5 years”. Taken as intentions in UFO, we can understand decomposition as a logic relation between the propositional contents of the intentions in the decomposition. The decomposition relation is present in most goal modeling languages [29] (often with conjunctive and disjunctive variants). This is not the case for the refinement relation we introduce here, which is key to strategic planning.

In the case of the refinement relation, whenever a refinement is performed, the agent decides on pursuing new goals, motivated by his intention of achieving his original goal. The agent believes that when achieving his newly defined goals, his original goal would be easier to be achieved (i.e., the agent believes that when achieving those goals he will be ‘closer to’ achieving its original goal). However, achieving these goals does not entail that his original goal is achieved. It is still possible that agent achieves his newly defined goals and still does not achieve his original goal. The intentions that are created motivated by the original intention have a special type of ‘bond’ that ‘glue’ those intentions together (and not other intentions). The intention to pursue new goals, is in itself, a new intention. So, the agent had his original intention and that intention motivated him on having a new intention, which is to pursue other goals in order to achieve this original intention. This intermediate intention ‘glues’ the other intentions together. For that, we say that the agent has defined a way, i.e., a *strategy* of how to achieve his original goal.

C. Strategy

Strategy is understood in our conceptual model as an intention, whose creation has been motivated with the purpose of achieving one or more goals. The strategy is an intention, composed of a collection of intentions, which by its turn can be intentions - to perform actions, achieve desired situations, acquire desired capabilities or control resources. Regarding our scope, this model of strategy is aligned with definitions from the management field. Porter states that corporate strategy is: “a combination of the ends (goals) for which the firm is striving and the means (policies) by which it is seeking to get there”

[24]. Quinn states that: “strategy is the pattern or plan that integrates an organization’s major goals, policies and action sequences into a cohesive whole” [30]. We generalize Quinn’s definition in our approach not constraining strategy to only ‘major’ goals, especially since we do not intend to define what are enterprise’s major goals. Our modeling is also aligned with Kenneth Andrews definition of corporate strategy: “Corporate strategy is the pattern of decisions in a company that determines and reveals its objectives, purposes, or goals, produces the principal policies and plans for achieving those goals, and defines the range of business the company is to pursue [...]” [31].

Figure 3 introduces the strategy concept in our model. Additionally, each of the goals might have one or more possible decompositions or refinements, and the usage of one decomposition or refinement does not entail that other decompositions or refinements might not be possible as different ways to achieve the same goal; usually to increase the probability of success or decrease risks during strategy implementation [27]. The conceptual model does not allow a regular *goal* to be refined into an enterprise *mission* or *vision* [26] [27], defining thus a hierarchy between strategic goals and planned goals.

D. Further Goals Relations and Properties

Strategic plan goals usually are to be accomplished in timing constraints [26] [27]. *Goals* might have a *precedence* order or might need to be accomplished before or after a certain date [27]. Additionally, goals might require a time window in which they should be addressed and achieved (e.g., because of regulatory compliance; in the case of perishable products). These are represented in the conceptual model in Figure 3 as the *precedes* relation and the *Time Interval* and *Time Point* concepts. Precedence between goals is interpreted in UFO as that the situation that satisfies the preceding goal has events that are pre-state of the situations that satisfy the preceded goal. *Time Interval* and *Time Point* point to the homonymous concepts in Section II.A and in detail in [15]. However, we restrict our conceptual model to forbid *end* Time Points that ‘happen’ before *begin* Time Points in the same Time Interval.

Goals might also be treated by the enterprise individually or in a bundle, and might influence one another [7] [32] [33]. Particularly, it should be assessed whether goals being planned are compatible with previously defined goals [14]. In case a goal contradicts a previously defined goal, one of them should be revised.

Goals can be the responsibility of specific departments, of individuals or the whole enterprise. In the conceptual model presented in Figure 3, this is represented by the *agent* concept and its relations of *owns* and *responsible for* to a *goal*. This comprises the cases in which an agent has a goal and delegates it to a different agent, which is actually responsible for the goal achievement. This is interpreted in UFO as the *delegation social relation*, in which the *agent* that owns the *goal* can *delegate* it to a different *agent* and, as such, can perform *claims* and the delegated *agent* has a *social commitment* to the first agent.

In addition, organizations need to plan how their goals should be achieved. For short-term goals, it might be relevant to describe the operations required to realize them [26] [27]. It also might be relevant to describe their required capabilities and resources [34]. For mid-term and long-term goals, although the same approach can be applied, enterprise’s might prefer not to detail the achievement of the goal [7], or might choose to refer only to the capabilities and resources required for achievement, in a strategy as capability-based planning [10] [34]. This is represented in the conceptual model on Figure 3 as the (incomplete) specializations of planned goals.

In some organizations, the strategic planning is separately performed in different departments as well as different management levels, in which each department and management level has different responsibilities on the strategic planning. For example, high-level managers may describe the strategic part of the strategic planning and release it to lower-level managers, who refine the plan and describe how that plan should be implemented. A strategic plan is treated as an enterprise plan that defines a strategy in order to achieve some goal. The strategic plan model is a result of this plan and, as such, the strategic plan concept is not represented in the conceptual model.

IV. MODELING STRATEGIC PLANNING IN EA

In this section we present the current ArchiMate Motivation Extension (ME). Then, based on the conceptual model developed in Section III, we propose a metamodel to model strategic planning and strategy. Among the reasons to choose ArchiMate, we highlight its efforts to address two important concerns, viz. motivational concerns and versioning concerns. Motivational concerns and versioning concerns are addressed in the Motivation Extension and the Implementation and Migration Extension, respectively, both incorporated in the ArchiMate standard [35]. Further, the ArchiMate language has been target for many ontological analysis, such as in [16] [17]

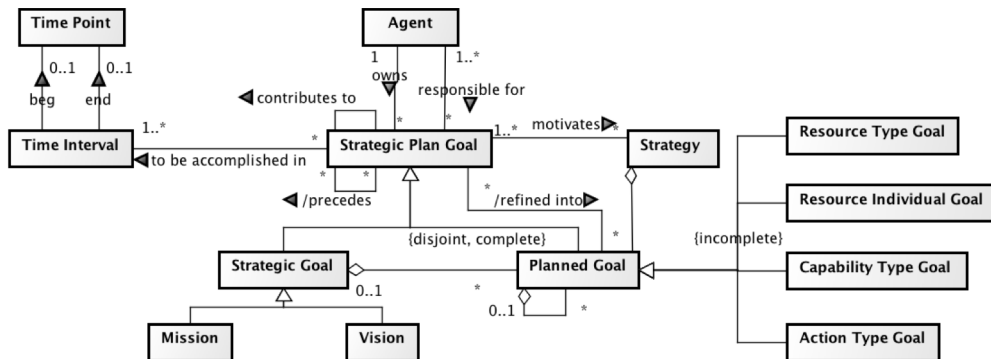


Figure 3 – Conceptual Model on Strategy and Strategic Planning

[36], which facilitates the semantic integration of the language.

The ArchiMate ME has been introduced in [35]. As stated in the ArchiMate specification, “[m]otivational concepts are used to model the motivations, or reasons, that underlie the design or change of some enterprise architecture. These motivations influence, guide, and constrain the design” [35]. The addition of strategic planning elements to the language appears to be a step further towards the stated intention to keep track of the reasons “that underlie the design or change of some enterprise architecture”.

A. The Current ArchiMate Motivation Extension

Figure 4 presents the ArchiMate ME metamodel. The concepts and relationships definitions presented below are extracted ‘as is’ from the ArchiMate specification [35]:

- A *stakeholder* is defined as the role of an individual, team, or organization (or classes thereof) that represents their interests in, or concerns relative to, the outcome of the architecture.
- A *driver* is defined as something that creates, motivates, and fuels the change in an organization.
- An *assessment* is defined as the outcome of some analysis of some driver.
- A *goal* is defined as an end state that a stakeholder intends to achieve.
- A *requirement* is defined as a statement of need that must be realized by a system.
- A *constraint* is defined as a restriction on the way in which a system is realized.
- A *principle* is defined as a normative property of all systems in a given context, or the way in which they are realized.
- The *aggregation* relation models that some intention is divided into multiple intentions.
- The *realization* relation models that some end is realized by some means.
- The *influence* relation models that some motivational element has a positive or negative influence on another motivational element.

With regards to the conceptual model described in Section III, in the current ArchiMate framework it is not possible to distinguish mission, vision and other kinds of goal. Further, the relations concerning goals, such as precedence, representation of time constraints for goal achievement, the delegation of a goal to another agent (to differentiate between the agent who owns a goal and the agent responsible for it) or the differences between partial and complete decompositions, and thus, sufficient and necessary conditions cannot be represented in the

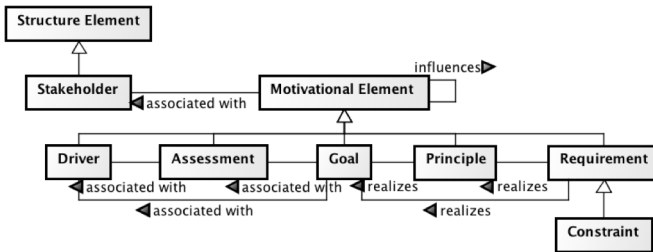


Figure 4 - Current ArchiMate Motivation Extension Metamodel

language. The only element to capture some notion of strategy is the *realizes* relation.

B. Proposed Extension for Modeling Strategic Planning in ArchiMate

In this section we propose improvements to the ArchiMate ME metamodel in order to represent strategic planning. We use as a basis the ArchiMate ME metamodel and follow the semantic analysis performed in [16]. We strive to reuse the existent language concepts and to introduce as few additional concepts as possible.

Figure 5 presents our proposed metamodel for ArchiMate. The highlighted elements (in blue) are the elements introduced to the language in the metamodel.

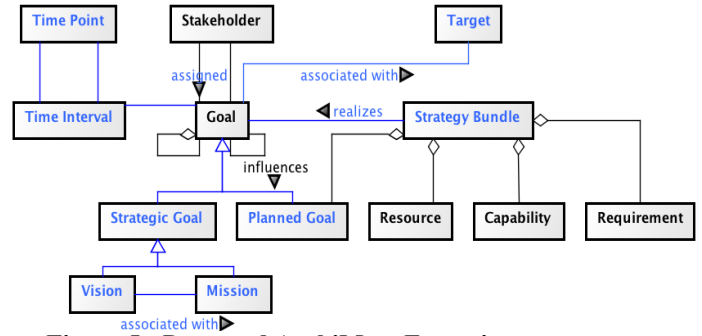


Figure 5 - Proposed ArchiMate Extension

Figure 6 presents a proposed concrete syntax, in order to represent the newly introduced constructs.



Figure 6 - Concrete Syntax

1) Goal and Stakeholder

The concepts of Goal, Stakeholder and Requirement have been previously analyzed in [16]. Thus, a brief description is given here and the reader should refer to [16] for a full discussion on the semantics of these concepts.

A goal in the metamodel is interpreted as a goal of an agent in UFO. A goal is the propositional content of an agent’s intention. The agent that has a goal (or any other motivational element) is represented in the ArchiMate current metamodel in Figure 4 by the association between the motivational element superclass and the stakeholder in which that motivational element inheres. The stakeholder concept, in turn, is interpreted as an agent or as a universal that can be instantiated by agents.

The Types of Goals defined in the proposed extension are Strategic Goal, Mission, Vision and Planned Goal. The mission concept has been interpreted as an agent’s intention in UFO, in which its propositional content refers to an intended desirable future, however not easily or readably achievable. The vision concept has also been interpreted as an agent’s intention in UFO. The propositional content, in turn, refers to an intended and achievable future.

The concept of planned goal has been introduced in the language to properly address concerns from the literature on strategic planning ([5] [24] [25] [26] [27] [28]), not allowing undesired representations, such as a *goal* being realized by the enterprise's *mission* or *vision*. As such, *goal* is defined as an abstract concept in the metamodel, so that the modeler needs to reveal the intended meaning (*mission*, *vision* or *planned goal*). The concrete syntax for *planned goal* is the same original syntax of a *goal* in ArchiMate. In Figure 7 we present the Mission and Vision of a pension fund.

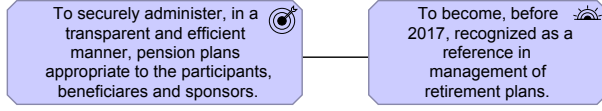


Figure 7 - Mission and Vision

2) The Strategy Bundle Concept

The Strategy concept from our conceptual model has been interpreted in UFO as an intention, whose creation is motivated with a purpose of achieving one or more goals. Strategy is composed of a collection of intentions. The strategy bundle construct in the ArchiMate concrete syntax is intended to represent this. We should interpret the strategy bundle in the pattern *strategy realizes a goal*. This is interpreted in UFO as an intention, whose creation is motivated with the purpose of achieving one or more goals, represented by the goal construct. The part-whole relation in the conceptual model, thus, is represented in the ArchiMate concrete syntax as the aggregation relations between the strategy and the planned goal, resource, capability and requirement. The presence of the planned goal, resource, capability or requirement in a strategy bundle is intended to represent the intentions to achieve a situation specified by a specific intention, to control individual resources or resources of a specific type, to acquire desired capabilities and to achieve the situations specified in the requirement. As discussed in Section III, the agent believes the strategy is satisfied in situations from which less effort would be required to reach the motivated goal, but other actions might still be required.

Figure 8 shows the representation of strategies to achieve the pension fund goals ‘Adequate administrative costs’, ‘Model Current Business Processes’ and ‘Model Remaining processes’, which are part of different strategies to ultimately achieve the goal of ‘Adequate administrative costs’ and the mission and vision of the pension fund (represented in Figure 7). The strategy bundle concept allows the enterprise to model its strategies to achieve each goal. It shows the ‘bond’ between the different goals and what they aim at achieving. The refinement relations are represented in a pattern involving: (i) realization of a goal by a strategy bundle and (ii) aggregation relations between the bundle and its elements, represented graphically as containment. The aggregation relation between goals representing decomposition is also presented in Figure 8 showing that the enterprise believes that achieving the goals on the aggregation relation entails the achievement of the aggregated goal, e.g., those are the sufficient conditions to achieve the ‘Model remaining processes’ goal. The derived realization relation between the goals in the strategy bundle and the goal the bundle is supposed to realize presents the enterprise with the possibility of tracing which goals in fact contribute to each of its ‘high-

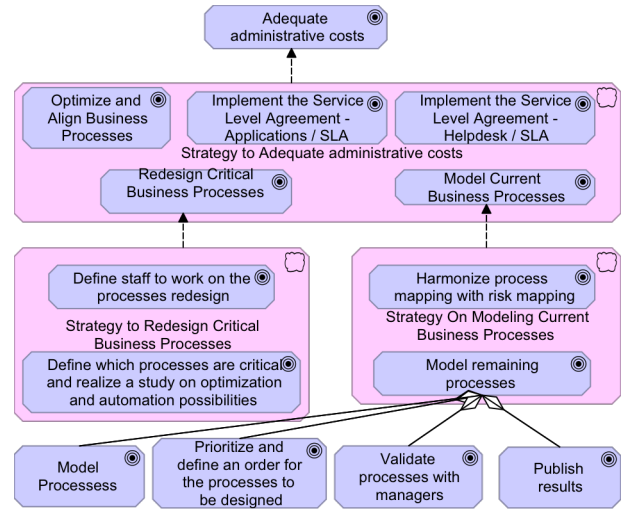


Figure 8 - Strategy and Decomposition

er-level’ goals. It could further provide the enterprise with the possibility of assessing the core elements that are related with the ‘higher-level’ goals achievement, whenever they are related with the ‘lower-level’ goals achievement, facilitating the applicability of a capability-based approach, as in [10] [34].

3) Time Point, Time Interval and Target

The Time Interval and Time Point concepts are defined in the metamodel in order for ArchiMate to be able to define timing constraints on goals. The reification of the concepts is required since the language does not allow the introduction of these conceptualizations in any other way. However, in practice tools might instantiate these as properties of affected concepts. Time might also be important for other aspects of ArchiMate, such as its *Implementation and Migration Extension* [35]. However, it is out of scope of this work to review the whole ArchiMate language.

The Target concept has been introduced to represent the idea of measurable targets associated with goals. The interpretation of defining a measurable target in UFO is understood to be a new (or further) specification of the intention’s proposition, and, as such, it is a redefinition of the agent’s intention. The agent redefines its goal, stating sufficient (objective) conditions to consider its intention achieved. However, the ArchiMate language does not have any element that could represent this further definition of the agent’s intention. Thus, our proposal introduces the target concept to represent this notion. Figure 9 presents a fragment of the strategic plan of the pension fund in which there is the assignment of the stakeholder responsible for goal achievement and the sufficient targets defined for considering that goals have been achieved.

4) Resource, Capability, Requirements and Common Relationships

The Resource, Capability and Requirement concepts and the common relationships have been ontologically analyzed in [16], [17] and [23]. In this subsection we briefly present these definitions.

The capability concept represents the power to bring about a desired outcome. This power is understood in a broad sense,

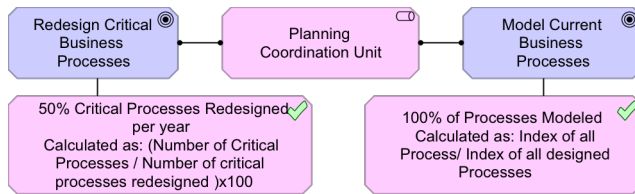


Figure 9 – Responsible and Target

as, for example, a mug has the power of constraining coffee, which is the desired outcome. Capabilities can be used to state a broad range of behaviors, ranging from simple ones as a mug’s behavior, to complex behaviors, such as ‘design business process’ that can be assumed to inhere in an organization. Capabilities are interpreted as UFO dispositions [17] [23]. This interpretation allows the organization to model the capabilities it can “socially perform”. This is applicable for a variety of cases that use delegation, such as, for example, cases in which an organization hires a different company to bring about some desired outcome and needs to state that the original (hiring) organization has the *capability* of bringing about that desired outcome (because it has the *capability* of delegating it [15] [37]).

The resource concept in UFO represents a role or a role mix that objects may play in particular contexts of usage. ‘Being controlled by an organization’ is understood as ‘being available for the organization’ (e.g., by an employment contract between employers and employees, or by having the right/ownership over a certain object) [17] [23].

A requirement is interpreted as a desire, in which its *propositional content* (representing the *requirement*) is formulated as a *normative description* that states that if a system is to exist, then it must satisfy the requirement’s proposition [16]. Ideally, the *desire* would lead to the adoption of *intentions* to satisfy the requirement, for example, by committing to *actions* to develop systems that satisfy the *requirement*. Nevertheless, this may not be the case for requirements with a low priority or requirements whose realization may not be worthwhile (in which case the stakeholder will not commit to the actions that pursue requirements satisfaction).

We now focus on common relationships, such as the influence and the aggregation relations that apply to all motivational elements. The influence relationship models that “some motivational element has a positive or negative influence on another motivational element”. In a positive influence, less effort is required to reach a situation that satisfies the propositional content of B from the situation that satisfies the propositional content of A. In a negative influence, more effort is required to reach a situation that satisfies the propositional content of B from the situation that satisfies the propositional content of A [16].

In the aggregation ontological interpretation presented in [16], the relationship has been defined as a logic relation between propositions. In [16], the logic proposition had an optional term representing the ambiguity in the language, which was suggested to be treated as non-complete aggregation and in which the optional term captured the ambiguity regarding the notion of incompleteness associated with the aggregation concept. In this work, the optional term is not necessary for the

Goal concept, since the ambiguity on the partiality for this concepts is covered. Nevertheless, until the ArchiMate specification covers the question on partiality or non-partiality for its part-whole relations, the optional term still needs to be used for the aggregation of other concepts.

V. RELATED WORK

The importance of enterprise strategy for Enterprise Architecture was recognized at least two decades ago with the addition of the Motivation column to the Zachman framework [38]. However, most EA approaches are still struggling with the goal domain and its modeling, and are not yet designed to deal with enterprise’s high-level concerns, such as enterprise strategy and strategic planning [29]. In this section we analyze the frameworks: Zachman [39], MoDAF [40], DoDAF [41], ISO RM-ODP [42], ARIS [43] [44] and the OMG BMM [45] according to its strategic aspects concerns. We also analyze the goal modeling languages I*/Tropos [32] and Kaos [33] according to its suitability to model strategic planning.

A. Strategic Planning in Enterprise Architecture Frameworks

The concept of *strategy* is supported by the Zachman framework [39], together with the concept of *objective*. The concepts can be related by means-ends-relations between *objectives* and *strategies*. There is also a *conflict* relation in the framework that can be used between *objectives*. The Zachman framework does not further elaborate on a language for representation of his “why” column.

The MoDAF and DoDAF frameworks support the concept of vision and relate it to *desired effects* and *goals*, respectively. The MoDAF framework states that *Enterprise Phase has vision Enterprise Vision* and *Enterprise Vision has tasks Enterprise Tasks*. It states that vision can have tasks. DoDAF, however represents that *vision is realized by desired effect*. *Desired effect* can be related to activities, in which a *desired effect directs an activity*. However, other strategic planning conceptualizations are not represented in these frameworks.

The concept of *goal*, sometimes called *objective*, which is a crucial concept for strategic planning, also appears in the ARIS and the ISO RM-ODP frameworks. In the ARIS framework, an *object* can *belong to* another *objective* and might be supported by a *function*. The semantics of this notion is unclear. In the ISO RM-ODP, an *objective* can be *refined* into other *objectives*. This concept can be related to *process*, *community* or *roles*. Possible relations are that a *community has an objective*, which might represent ownership, and *refined goals* can be *assigned* to both *processes* or *roles*. However, these frameworks are not expressive enough to represent the other strategic planning concepts.

The OMG BMM framework is primarily divided into Ends and Means. An End is “something the business seeks to accomplish”. It includes concepts such as *vision*, *goals* and *objectives*. Means represents elements “that may be called upon, activated, or enforced to achieve Ends”. Means are further specialized into Courses of Action (Strategy and Tactics) and Directives. Although the BMM framework introduces concepts that appear to be aligned with strategic planning, the framework lacks important notions for strategic planning. The framework higher-level elements (e.g., goals, strategies) can

not be related with the responsables for achieving it (only to whom have established it). For example, it is not possible to define responsables for achieving a strategy or a goal in the framework without defining a business process and, then, who is to perform it. This is especially relevant for cases in which multiple business processes are executed and there are different responsables for executing each process. Further, resources that are required in order to achieve a goal (or strategy) are to be defined in its usage, for example, at the business process level. Additionally, in the BMM framework [45] there is no proper concept to represent timing constraints, which are only represented in the label of the timed constrained model element (e.g., on the goal label).

Thus, however on a first glance the BMM appears to support the proper concepts, the framework lacks capabilities for modeling strategic planning at the level required by high-level managers, which are interested in capturing what is to be achieved and how it should be achieved only in a high level of abstraction, frequently in an open delegation (in which the responsible agent is to define how it should be achieved). Further, it would be impractical to plan on the delivery of required capabilities, resources, products and services for the enterprise with controlled effort and adequate timing using BMM.

B. Strategic Planning on Goal Modeling Languages

In this subsection we analyze the main goal modeling languages Kaos and I*/Tropos with respect to their suitability for modeling strategic planning.

The Kaos goals modeling language was designed to support the discovery and realization of system requirements [33]. The underlying idea is that goals are to be refined until they are realized by some actor, which could be the system to be, an internal actor or an external actor. The I*/Tropos language, in its turn, was designed for requirements engineering [32].

Both languages lack concepts to represent timing. There is no conceptualization for when, in time, the goals are to be realized. The modeler is also not able to capture precedence between goals, except the implicit one on refinements of the same goal in Kaos or decomposition in I*/Tropos. Indeed, it is not possible to state if a goal is to be accomplished in a short-term, mid-term or long-term. Usually, this leaves to an assumption, which might not be correct, that goals are to be achieved as soon as possible, or in a short-term.

On the partiality of goals decomposition or refinement and goal achievement, the Kaos language has no conceptualization to represent a contribution between goals, as well as no partiality of goal achievement. The models are supposedly complete, so, if goals resulting from a refinement are achieved, the refined goal is therefore achieved. The problem of this approach is that the organization cannot model something that facilitates achieving the desired result, but it is not guaranteed to deliver the desired result without other unknown or non-represented efforts, as frequently existent on strategic planning. The I*/Tropos, on the other hand, understands that the model is partial. However, the opposite can not be expressed, i.e., that a specific model or part of it is complete.

Goals, in I*/Tropos can be decomposed into other goals (partial decomposition). The conceptualization of ‘contribu-

tion’ between goals is possible for goals, plans and resources (the plan concept is a plan on tasks and cannot be used in a similar way as the strategy concept represented on Section III). The means-end relation can be related from a task, resource or plan to a goal and cannot be used as a relation between goals. In the Kaos language, it is also not possible to link goals with capabilities, neither with the resources that might be required to achieve that goal.

Thus, we conclude that none of the compared frameworks or the goal modeling languages supports the explicit representation of strategic planning concepts and its relations.

VI. FINAL REMARKS

In this paper, we have presented an approach to capture strategic planning in EA. We have presented a conceptual model for strategic planning and extended ArchiMate to support the representation of the concepts in the model.

The strategic planning conceptual model is aligned with the strategic management literature, as well as with the requirements presented in [10], which assessed strategic planning and identified requirements to align it with EA. The use of a foundational ontology and of the planning theory of Bratman [14] have been instrumental in clarifying the semantics of various notions in the strategic management literature.

In our case study, presented as a running example, we have been able to model a real-world strategic plan into the proposed EA extension. We argue that there is a limited support for describing enterprises’ strategic planning in EA and that the usage of EA for strategic planning should be mutually beneficial to the practices of strategic planning and EA. The introduction and usage of strategic planning into EA should improve the traceability between an enterprise’s strategic planning and EA choices. Further, we believe that the planning of EA transformations could be enhanced if it were aligned with strategic planning [9]. In particular, we understand that EA frameworks should be concerned with the controlled transformations of EA over time. The continuous transformations from baseline EA to target EA could benefit from the application of an approach like this, and the EA transformations could be planned in accordance to the goals each EA version has to support.

The modeling of strategic planning in EA is an important step towards this alignment. We have also outlined an initial approach for extending EA to achieve end-to-end traceability between strategic planning, EA, and the enterprise’s operations. Nevertheless, we also believe that EA can improve enterprises’ strategic planning monitoring and management. EA can be used as a middle ground between an enterprise’s operations and its strategic planning. EA can also be used for strategic planning at design time for the verification of change impact. The analysis can be relevant to decision-making.

In our future efforts, we intend to further investigate the integration of strategic planning with the EA and the whole enterprise. We intend to integrate these results with the results of [17] and [16], which address capabilities and motivational concepts for EA. We believe that the integration of this approach with a capability-based approach, as described in [17]

and [23] could lead the enterprise to an end-to-end traceability, from strategic planning to operations and, further, to an end-to-end planning.

ACKNOWLEDGMENTS

This research is partially funded by CNPq (485368/2013-7, 311313/2014-0, 461777/2014-2 and 201495/2014-7), CAPES (402991/2012-5) and FAPES (59971509/12).

REFERENCES

- [1] C. C. Miller and L. B. Cardinal, "Strategic Planning and Firm Performance: A Synthesis of More Than Two Decades of Research," *Acad. Manag. J.*, vol. 37, no. 6, pp. 1649–1665, 1994.
- [2] M. Song, S. Im, H. Van Der Bij, and L. Z. Song, "Does strategic planning enhance or impede innovation and firm performance?," *J. Prod. Innov. Manag.*, vol. 28, pp. 503–520, 2011.
- [3] H. I. Ansoff, "Critique of Henry Mintzberg's 'the Design School: Reconsidering the Basic Premises of Strategic Management,'" *Strateg. Manag. J.*, vol. 12, pp. 449–461, 1991.
- [4] H. A. Al-Shammari and R. T. Hussein, "Strategic planning-firm performance linkage: empirical investigation from an emergent market perspective," *Adv. Compet. Res.*, vol. 15, pp. 15–26, 2007.
- [5] C. K. Bart, N. Bontis, and S. Taggar, "A model of the impact of mission statements on firm performance," *Manag. Decis.*, vol. 39, no. 1, pp. 19–35, 2001.
- [6] J. M. Bryson, "A strategic planning process for public and non-profit organizations," *Lang Range Plan.*, vol. 21, no. 1, pp. 73–81, 1988.
- [7] H. Mintzberg, B. Ahlstrand, and J. Lampel, *Strategy safari: a guided tour through the wilds of strategic management*. 1998.
- [8] The Open Group, *TOGAF Version 9*. 2009.
- [9] J. W. Ross, P. Weill, and D. Robertson, *Enterprise architecture as strategy: Creating a foundation for business execution*. Harvard Business Press, 2006.
- [10] C. L. B. Azevedo, M. Van Sinderen, L. F. Pires, and J. P. A. Almeida, "Aligning Enterprise Architecture with Strategic Planning," in *Advanced Information Systems Engineering Workshops*, 2015, pp. 426–437.
- [11] D. Simon, K. Fischbach, and D. Schoder, "Enterprise architecture management and its role in corporate strategic management," *Inf. Syst. E-bus. Manag.*, vol. 12, no. 1, pp. 5–42, 2014.
- [12] G. Guizzardi, "Ontological foundations for structural conceptual models," Univeristy of Twente, 2005.
- [13] J. P. A. Almeida and G. Guizzardi, "An ontological analysis of the notion of community in the RM-ODP enterprise language," *Comput. Stand. Interfaces*, vol. 35, no. 3, pp. 257–268, Mar. 2013.
- [14] Michael E. Bratman, *Intention, Plans, and Practical Reason*. 1999.
- [15] A. C. O. Bringunte, R. A. Falbo, and G. Guizzardi, "Using a Foundational Ontology for Reengineering a Software Process Ontology," 2010.
- [16] C. L. B. Azevedo, J. P. A. Almeida, M. van Sinderen, D. A. C. Quartel, and G. Guizzardi, "An Ontology-Based Semantics for the Motivation Extension to ArchiMate," in *IEEE 15th International Enterprise Distributed Object Computing Conference*, 2011, pp. 25–34.
- [17] C. L. B. Azevedo, M.-E. Jacob, J. P. A. Almeida, M. van Sinderen, L. F. Pires, and G. Guizzardi, "An ontology-based well-founded proposal for modeling resources and capabilities in ArchiMate," in *17th IEEE International Enterprise Distributed Object Computing Conference (EDOC)*, 2013, pp. 39–48.
- [18] K. Campbell, *Abstract particulars*. Blackwell Oxford, 1990.
- [19] L. Schneider, "Designing foundational ontologies: The Object-Centered high-level reference ontology ochre as a case study," *Lect. notes Comput. Sci.*, pp. 91–104, 2003.
- [20] J. Heil, *From an ontological point of view*. Clarendon Press Oxford, 2003.
- [21] G. Molnar, *Powers: A study in metaphysics*. Oxford University Press, 2006.
- [22] S. Mumford, *Dispositions*. Oxford University Press, 2003.
- [23] C. L. B. Azevedo, M.-E. Jacob, J. P. A. Almeida, M. van Sinderen, L. F. Pires, and G. Guizzardi, "Modeling Resources and Capabilities in Enterprise Architecture: A Well-Founded Ontology-Based Proposal for ArchiMate," *Inf. Syst.*, 2015.
- [24] M. E. Porter, "Competitive Strategy," *Tech. Anal. Ind. Compet.*, vol. 1, p. 396, 1980.
- [25] M. E. Porter, "Towards a dynamic theory of strategy," *Strateg. Manag. J.*, vol. 12, pp. 95–117, 1991.
- [26] J. M. Bryson, *Strategic planning for public and nonprofit organizations: A guide to strengthening and sustaining organizational achievement*, vol. 1. John Wiley & Sons, 2011.
- [27] C. McNamara, "Strategic planning (in nonprofit or for-profit organizations)," *Free Manag. Libr.* http://www.managementhelp.org/plan_dec/str_plan/str_plan.htm (accessed April 19, 2015), 2001.
- [28] I. M. Levin, "Vision Revisited: Telling the Story of the Future," *J. Appl. Behav. Sci.*, vol. 36, no. 1, pp. 91–107, 2000.
- [29] E. C. S. Cardoso, J. P. A. Almeida, and R. S. S. Guizzardi, "On the Support for the Goal Domain in Enterprise Modelling Approaches," *2010 14th IEEE Int. Enterp. Distrib. Object Comput. Conf. Work.*, pp. 335–344, Oct. 2010.
- [30] H. Mintzberg and J. B. Quinn, *The Strategy Process (4th edition)*. 2003.
- [31] K. R. Andrews, "The Concept of Corporate Strategy," in *Resources, Firms, and Strategies: A Reader in the Resource-based Perspective*, 1997, pp. 52–59.
- [32] J. Mylopoulos, J. Castro, and M. Kolp, "The Evolution of Tropos," in *Seminal Contributions to Information Systems Engineering*, Springer, 2013, pp. 281–287.
- [33] A. Van Lamsweerde, *Requirements Engineering: From System Goals to UML Models to Software Specifications*. Wiley, 2009.
- [34] J. Stirna, J. Grabis, M. Henkel, and J. Zdravkovic, "Capability driven development—an approach to support evolving organizations," in *The Practice of Enterprise Modeling*, Springer, 2012, pp. 117–131.
- [35] The Open Group, *ArchiMate 2.0 Specification, C 118*. The Open Group, 2012.
- [36] J. C. Nardi, R. de A. Falbo, and J. P. A. Almeida, "An Ontological Analysis of Service Modeling at ArchiMate's Business Layer," in *Enterprise Distributed Object Computing Conference (EDOC), 2014 IEEE 18th International*, 2014, pp. 92–100.
- [37] R. Guizzardi and G. Guizzardi, "Ontology-based transformation framework from TROPOS to AORML," *Soc. Model. Requir. Eng. Coop. Inf. Syst. Ser.*, pp. 547–570, 2011.
- [38] J. F. Sowa and J. A. Zachman, "Extending and Formalising the Framework for Information Systems Architecture," *IBM Syst. J.*, vol. 31, pp. 590–616, 1992.
- [39] L. A. Kappelman and J. A. Zachman, "The Enterprise and its Architecture: Ontology & Challenges," *J. Comput. Inf. Syst.*, vol. 53, no. 4, 2013.
- [40] UK Ministry of Defense, *UK MoD. Architecture Framework (MODAF) M3 v1.2.004*. 2013.
- [41] Department of Defense Architecture Framework Working Group, "DoD architecture framework," 2007.
- [42] ISO—International Organization for Standardization, *Open Distributed Processing - Reference Model - Enterprise Language ISO/IEC 15414 | ITU-T Recommendation X.911*. 2004.
- [43] A.-W. Scheer, *ARIS - Business Process Modeling*, vol. 2., comple. 2000.
- [44] P. S. Santos Jr, J. P. A. Almeida and G. Guizzardi, "An ontology-based analysis and semantics for organizational structure modeling in the ARIS method," *Inf. Syst.*, vol. 38, no. 5, pp. 690–708, Jul. 2013.
- [45] Object Management Group, *Business Motivation Model v1.2*. 2014.