Towards collaborative Strategy Content Management using Ontologies

Simon Paradies, Sonja Zillner, and Michal Skubacz

Siemens AG
Corporate Technology CT IC 1
Otto-Hahn-Ring 6
81739 München, Germany
http://www.ct.siemens.com

{simon.paradies.ext,sonja.zillner,michal.skubacz}@siemens.com

Abstract. We propose the use of ontologies for managing strategy content, which is generated and processed during strategy planning processes. We introduce a Protégé extension aiming at facilitating this task. It provides views on the strategy content codified in the ontology in form of diagrams and supports the concurrent graphical editing of these by multiple users at the same time.

Key words: Strategic Management, Strategy, Ontology, Protégé, Plugin, Collaboration

1 Introduction

"To be, or not to be: that is the question" [1]. This question not only is fundamental to Hamlet but also to the majority of organizations that struggle for their justification to exist (in most cases the increase of the shareholder value) or the achievement of other (subsequent) goals. In the best case, decisions and actions resulting thereof are coordinated accordingly in the best possible manner. Such coordination is often called a *Strategy*.

The field of strategic management research is among other things dealing with the question how strategies emerge, are planned, formulated, and implemented. Strategic management research is a heterogeneous field; less reductionist but constructivist; meaning that theories are built on individual experiences rather than built on the description of causal systems. It employs theories and methods inspired from economics, and others coming from an eclectic set of behavioral sciences like psychology, social psychology, and sociology [2]. The practical discipline of strategic management reflects this heterogeneity, as it makes use of a multitude of different methodologies to (amongst other things) generate strategy content (which includes strategies).

The contribution of the paper is to analyze how ontology structures and collaborative tools can be used for strategy content management. We will very

briefly introduce the characteristics of strategy content in Sect. 2, how it is commonly managed, and weaknesses of those approaches. In Sect. 3, the usage of ontologies and collaborative tools to structure, integrate, and manage strategy content is proposed. Since we have special requirements managing it, we developed a plugin for the Protégé ontology editor, which is introduced in Sect. 4. Section 5 describes the application of the plugin prototype in an example use case scenario, thereby showing its functionality. In Sect. 6, we introduce related work. Section 7 discusses the technical aspects of the plugin and possible improvements. Finally, Sect. 8 draws some final conclusions on the approach and shows ways for further research.

2 Strategy content management

Strategy content[1] makes up the strategy knowledge body of an organization. It describes how the organization means to act and at best even motivates why. In most cases, it is developed collaboratively by a team of experts with different backgrounds, particularly to allow for a greater variety of perspectives on the domain under observation or to establish coordination between distinct units of the organization. These different backgrounds at the same time may impede efficient collaboration because each expert - for efficient mental processing and filing - encodes information in his own mental schema, which may cause problems if other experts are unable to follow. Yet, the persons involved in strategy planning processes need a common understanding about the matter they are dealing with and means to effectively collaborate.

Overall, different sources of information are analyzed and brought into context. Examples include market and competitor data derived from business and competitive intelligence, appraisals of business development based on gut feelings of executives, or objectives of the super ordinate department. The resulting strategy content is complex in its characteristics. It encompasses multiple aspects and multiple domains, for instance markets and customers, as well as technology and trends, people and competences. It is used to describe the current and the desired state of an organization in the real world and the actions it plans to implement this transition. For capturing these different aspects, practitioners and scientists over times developed a multitude of specialized methods and methodologie*s* that contribute to the "crafting" of a strategy. Examples include the Balanced Scorecard [4], Blue Ocean [5], Porter's Five Forces [6], and many more. Each employs different views on an organization, thus being capable of capturing a particular part of the whole "strategy picture" and generating specific strategy content. However, there is no standard way to consolidate this specific strategy content into an integrated strategy picture.

[1] Cf. [3] for a discussion about the distinction between strategy process, content, and context

2.1 Common strategy content management

Organizing strategy content is not an easy task, as there are basically two conflicting concerns. On the one hand, the flexibility to support a multitude of methods with different underlying concepts, and on the other hand, the need to structure and integrate the generated strategy content to be able to relate the knowledge, provide means for common understanding, foster reuse, communication and collaboration, and ideally to provide means for automation (i.e. an enhanced IT-support). By means of a central storage, furthermore the data management, revision, versioning, information access and exchange is made considerably easier. In typical scenarios in organizations however, the strategy knowledge that is generated often is fragmented and stored in multiple repositories, including wordprocessing and spreadsheet programs, or maybe special databases at least. Using a fragmented, decentralised storage concept, unfavorable side-effects occur:

- Problems related to document management in general in a larger and/or collaborative environment apply, e.g.:
  - Synchronization problems: Multiple versions of a document or sets of documents that are mutually not consistent.
  - Versioning complexity
  - Collaboration obstacles: Concurrent document editing is not possible.
- Knowledge integration and linking barriers:
  - The inter-relation of concepts is complicated (concepts need to be copied back and forth between or within the documents).
  - There is no mechanism to provide an overview about selected concerns and to easily navigate or drill down to the details.
- Little guidance for structuring strategy content (except plain forms or tables):
  - The strategy modeler is not supported in structuring his stream of thought into separate and meaningful concerns and needs to figure out an conceptual scheme himself.
  - Reuse is impeded: A second modeler likely is unfamiliar with the conceptual scheme of the first modeler.
  - Secondary information is left out since the modeler takes it for granted.
  - A common understanding is difficult (implications, causal chains, etc.).
- Strategy content is barely amenable to automation, e.g. a faceted search or automated comparison.

3 Ontology-based knowledge structures to manage strategy content

To overcome these limitations, we looked for new ways to organize strategy content and to improve the strategy content modeling process. As ontologies can be used to build formal models of reality and the ontology knowledge model

supports the storage of unstructured knowledge and, at the same time, provides means to structure it using taxonomies and restrictions, the use of ontologies was considered promising. As ontology representation language we decided to use OWL due to its role as a building block for the semantic web, its large user community, and good tooling support. For ontology engineering Protégé-OWL [7] was chosen, primarily because of its free availability, active and vivid community, extensibility, and an already large pool of extensions for diverse needs. One of these extensions, the Collaboration plugin [8], was especially useful for our purposes.

3.1 Towards strategy knowledge models

A Description logic can be decomposed into TBox (taxonomy and additional predicates) and ABox (instances). We decided to use the TBox as a guiding model to structure the strategy content stored in the ABox and call it *strategy knowledge model* (or SKM). Admittedly, a general overarching model to model a detailed strategy plan is not reasonable in our opinion due to the multitude of methods and contexts in strategy planning and the varying granularity needed at different organizational units. In the future, we seek to provide a meta-methodology or strategy knowledge-engineering methodology (SKEM) respectively, which is able to elicit the requirements on a SKM that is usable at a specific step in the strategy planning process (i.e. supporting the gathering of strategy content generated by a specific strategy management tool such as a value chain analysis).

3.2 Strategy process support

The actual strategy content is then provided by the users/strategists in terms of ABox instances. To provide an improved interface to the user (additional visualization and editing capabilities) which enables them to efficiently and collectively manage the strategy content they generate during a specific planning process step and at the same time help ensuring the adherence to the SKM specific to the process step, we developed a Protégé extension (i.e. a slot-widget plugin prototype) called *OWL-Diagramming*.

4 The OWL-Diagramming plugin

The OWL-Diagramming plugin builds on top of the Collaboration plugin and allows for a visual representation and manipulation of ontology instances and their relations. It is inspired by common modeling tools used for instance in the domain of Business Process Management for workflow modeling and by the graph-widget plugin that ships with Protégé. Its most important properties are:

- It provides user *definable views* on selected parts (concepts) of the ontology.
- It can be used to instantiate instances, delete, and relate them by simple *drag and drop* (“d’n’d”) and point and click operations.

– It can be used in conjunction with Protégé server in *collaborative mode*. Changes made to one model are reflected in others as soon as the server propagates these changes.
– It makes *context specific suggestions* and enforces modeling restrictions according to the underlying knowledge model (TBox). This is achieved by programmatically interpreting cardinality restrictions to enforce cardinality constraints and by interpreting the range and domain of a property as normative. This is in contrast to the common purpose of restrictions, property domain, and property range in OWL for inference and is discussed in Section 7.
– The underlying graphical framework (JGraph X) [9] is available with sources under a LGPL license. It will probably be finally released as JGraph 6 under a BSD style license.

To show how strategy content management could be improved by the use of ontologies and appropriate tooling, and to present the plugin, we will introduce a use case scenario meeting a typical setting in global companies.

5 A strategy planning use case scenario

We regard a small, shared unit of a global company. This unit does consulting in the area of knowledge management solutions as an internal technology service and solution provider. Its two branches, besides its headquarters in Europe, are located in the U.S. and Asia.

5.1 An example strategy planning process

To maintain and expand its strategic position, it conducts a lightweight, qualitative strategy planning process on a regular basis involving the department head and the two branch managers, which we call strategists in the following. They need to accomplish the following tasks:

– Describe and monitor the current strategic environment, i.e. putting issues on the strategic agenda that become apparent and are considered potentially strategically relevant at present or in the future. Detailed information sources motivating the consideration of those issues and providing additional information should be referenced in all cases.
– (Re-)assessing issues that have manifested or changed since the last strategy planning. Each issue shall be subjected to an analysis to find out how it has to be judged, using a classical SWOT (cf. [10]) analysis.
– Setting goals for the next fiscal year, considering and referencing the findings.
– Framing ways for goal achievement, including proposals for concrete actions.

5.2 A strategy knowledge model

From the description of the strategy process described above, we derived the following concepts and properties (uppercase) to structure and constitute the strategy content in a SKM. It exemplifies a possible outcome of the SKEM (cf. Sec. 3.1) that we eventually strive for:

- *Influencer*: The Influencer[2] concept is used to describe issues of strategic relevance. It has at least one Information Source property for further explanations, which also used to motivates its incorporation in and relevance for the strategy planning.
- *Strength*, *Weakness*, *Opportunity*, and *Threat*: These concepts depict judgments resulting from an Influencer's SWOT analysis.
- *Goal*: Describes a future state that the unit aims to achieve. It has an optional Objective property which could be used to quantify the Goal. It is decomposable into at most three sub Goals and is supported by at most three Strategies. This restriction was made to help ensuring the strategic focus of the unit, i.e. to focus on few but therefore more important Strategies for the achievement of the Goal.
- *Strategy*: Describes a course of action to channel Goal achievement. In the SKM used, a Strategy supports at least one and at most three Goals. This constraint was introduced to help enforcing the focus on less but more specific Strategies. The Strategy's implementation details can be further specified using its Implementation Details property. (see Fig. 5 and 4 for examples)
- *Resource*: Represents a resource (or capability) that the unit may deploy.

All above concepts have a mandatory Description property. Mandatory and cardinality restricted properties are realized using OWL-restrictions. An additional View concept is introduced, which is not used to conceptualize strategy content but acts as a container for the different views that can be defined (cf. Fig. 1).

5.3 Supporting the strategy planning process using the OWL-Diagramming plugin

In our use case scenario, a Protégé server session serves as "strategy content repository" hosting the SKM and strategy content ontology. On the appointed date and time, the strategists log in from their respective local offices. The unit head instantiates a new View and labels it "Assessment 2009/Q1". It shows an empty canvas and a palette populated by the concepts previously defined in the SKM. In the initial phase of the planning process, influencers are explicated (cf. Sect. 5.1). For instance, the "Journal of Knowledge Management" recently published an article about the management of unstructured data and concluded that "the amount of unstructured data will increase significantly". This information is important in the context of assessing knowledge management technologies and

[2] a concept borrowed from [11] to describe issues that have "the capability to produce an effect without apparent exertion of tangible force or direct exercise of command".

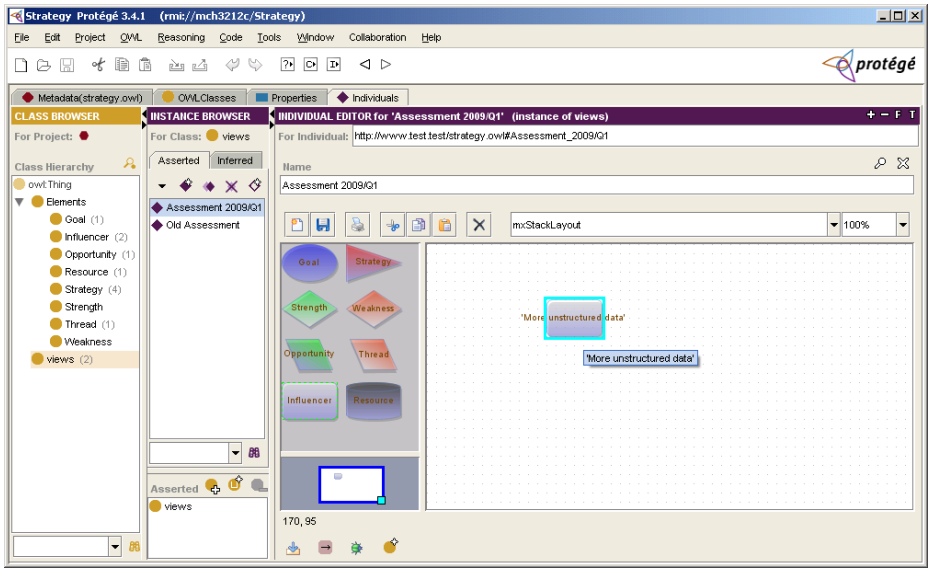

Fig. 1. The OWL-Diagramming Plugin showing a recently instantiated Influencer concept

thus introduced in the strategy content model by instantiating the Influencer concept named "More unstructured data". This is achieved e.g. by simply dragging and dropping an Influencer node from the palette to the canvas (see Fig. 1). The description "Amount of unstructured data in project/system business will increase" is added by double-clicking the newly introduced Influencer instance and filling out the form in the individual editor that pops up. The information source that motivates the Influencer ("Journal of Knowledge Management") is added as well. The change made to the model of one client is promptly propagated to all clients connected to the server and their canvases are updated accordingly. Meanwhile, the Collaboration plugin keeps track of changes to the model (e.g. time and initiator). After introducing the Influencer, a discussion starts among the strategists (using the chat tab of the Collaboration plugin) about its potential impact to the current strategic setting of the unit. They conclude that this Influencer represents an Opportunity, since the unit possesses major expertise with unstructured data. Therefore, an Opportunity concept named "Exploit expertise with unstructured data" is instantiated and related to the Influencer by dragging and dropping from the Influencer to the empty canvas. The OWL-Diagramming plugin checks for valid outgoing relations (object properties) from the Influencer and which values they could take. Accordingly, it suggests instantiating a Strength, Weakness, Opportunity, or Threat concept (see Fig. 2). The strategists choose the Opportunity concept. The "judged as" relation is inserted automatically, since according to the SKM it is the only valid (see Fig. 3). Since the strategists forgot to add a Description as demanded

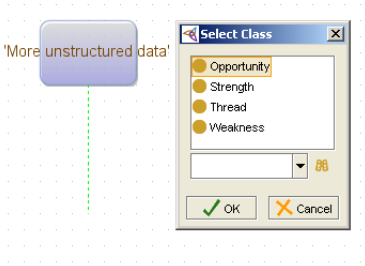

Fig. 2. Only concepts connectable to the Influencer can be chosen

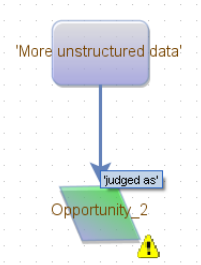

Fig. 3. The only valid predicate is selected automatically

by the SKM, the Opportunity instance shows a warning sign (see Fig. 3). The warning is resolved by adding the description "Our unit could possibly exploit the trend towards unstructured data". To make clear that the assessment result is motivated by the fact that the unit possesses major expertise with unstructured data, a Resource concept is instantiated and related to the Opportunity to provide an explicit reference to the unit's ability ("Major expertise with unstructured data"). Since this directly leads to a potential Goal, a Goal concept is instantiated labeled "Exploit and extend expertise with unstructured data". The strategists then start brainstorming about the best means to realize the Goal. Each member of the group puts some Strategies into play, ending up with four potential Strategies that they relate to the Goal. Each Strategy is specified by adding concrete implementation details (see Fig. 4). Since the SKM allows for at most three Strategies supporting a Goal, a warning sign appears at the Goal indicating a cardinality constraint violation. It is resolved after a discussion and the removal of the Strategy considered least effective to support the Goal.

The above step is repeated for other Influencer*s* and Goal*s* as well, leading to a lightweight strategy model which the unit seeks to align its activities in the next fiscal year with.

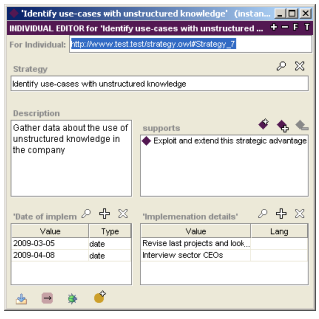

Fig. 4. Strategy implementation details

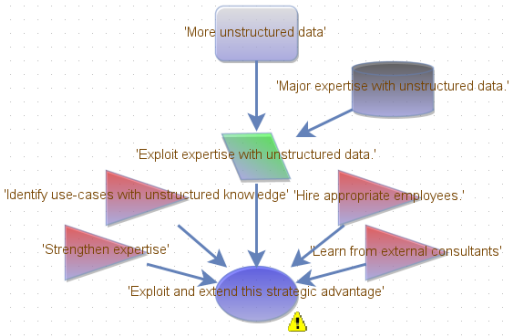

Fig. 5. Highlighting a modeling error

6 Related Work

Concerning the graphical visualization of ontologies (i.e., the relations between concepts or individuals), there are a lot of tools available for which [12] provides an overview. Only very few support the interactive editing of the contents they show, amongst them, the Graph widget-plugin [13] that already ships with Protégé. To our knowledge, none supports the interpretation of restrictions on properties and classes to guide the user in the ontology editing process or a concurrent graphical editing.

For structuring strategy content, there are models available which suggest concepts to model strategy content (e.g. BMM [11] or TOGAF [14]), strategy management tools incorporating models (e.g. the BSC's strategy map [4]), or ontologies developed for that purpose (cf. the TOVE project [15]).

7 Discussion

The guidance in modeling offered by the plugin by interpreting restrictions as constraints clearly helps the user to create a standardized and "valid" (regarding the intentions of the TBox modeler) output. However, the programmatical approach in interpreting restrictions as constraints could be significantly improved. It should be replaced by an efficient constraint checking mechanism supporting the full power of OWL's expressiveness. Recently, there has been some progress with respect to incremental reasoning and constraints checking (interpreting restrictions as constraints) using the pellet reasoner [16,17] which could potentially be very useful in our setting. Using a "probing" pattern, that is, inserting an instance in the ontology and checking if it violates any constraints or leads to contradictions, would - in combination - bring us very close to this goal. It would be even better if a reasoner could provide such functionality out of the box (without actually having to temporarily modify the ontology).

The graphical representation of the ontology supplied by the plugin helps non-experienced users populating and editing the ontology's ABox. Nonetheless, the use of the plugin still requires at least a basic understanding of ontologies. Hiding the technical details would further increase its usability and foster its acceptance by non ontology experts.

The collaboration features provided already ease the concurrent modeling significantly. The use of Web 2.0 technology could possibly offer a more lightweight and convenient approach in a collaborative environment. Since the graphical library used [9] is also (commercially) available in a JavaScript flavor, the porting to a web based version for the upcoming WebProtégé [18] is facilitated.

As an additional feature, the integration of external data sources could be contemplated, for instance, to color a possible Goal ("customer satisfaction") according to up-to-date data from an external CRM system.

Finally, the applicability of reasoning techniques beyond constraints checking, e.g. for inferring new knowledge in strategy content, is an interesting research question.

8 Conclusion

We showed the use of our prototypical Protégé OWL-Diagramming plugin in a simplistic strategy planning process supporting ontology based strategy content management. The plugin is appropriate for other domains as well, merely providing an easier and more user friendly way to populate ontologies and edit the relations between its instances graphically. Extending its application spectrum will be part of future work. The strategy knowledge model (i.e. TBox) used was well suited to the lightweight strategy planning process example. In the future, we will investigate means to support more complex settings (strategy processes and content) and aim at providing a strategy knowledge-engineering methodology (SKEM) (cf. Sect. 3.1), able to elicit customized Strategy Knowledge Models (SKM) appropriate for specific steps in strategy planning processes.

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