

# Organizational modeling in a semantic wiki

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## Abstract

The world has always experienced changes. But now these changes happen faster than ever. This has several consequences, especially in organizations. Today, more than ever, an organization must be quicker to react to these events. To be capable of that, an organization needs to be self-aware: its employees need to know what the organization is and their role in it.

In this context appears the field of organization modeling which aims to create organization models. These models help create a state of self-awareness in the organization. There are many approaches to organizational modeling. One of them is the CEO framework from the Organizational Engineering Center where this work was conducted.

In this work, the CEO framework was studied and some proposals were made to change some aspects of it. But one of the most important results of this work was the modification of Semantic MediaWiki, a semantic wiki, to support the CEO framework. A way to represent organizations in a semantic wiki according to the CEO framework was proposed. The Semantic MediaWiki was the chosen wiki to carry this task.

Semantic wikis are very easy tools to use. People don't need to be computer specialists to learn how to use them. The final goal is to make possible to all the people from an organization to be capable of creating an organizational state of self-awareness through the use of semantic wikis

**Keywords:** Organizational engineering, organizational modeling, CEO framework, semantic wiki.

## 1 Introduction

The world has always experienced changes. But now these changes happen faster than ever. This has several consequences, especially in organizations. Today, more than ever, an organization must be quicker to react to these events. To be capable of that an organization needs to be self-aware.

For an organization to be self-aware the knowledge about its organizational aspects needs to be comprehensively shared and understood among all its stakeholders. This is not a simple issue: organizations are complex entities that deal with different kinds of concepts such as people, control and value chains, business processes and information systems and technology. Representing the knowledge about an organization proves to be a challenging task since it requires all of these aspects to be represented in a coherent and integrated way and not as a set of unrelated and independent elements (Sousa, Caetano, Vasconcelos, Pereira, & Tribolet, 2006).

If there is mismatch between the actual state of affairs and the state perceived by the different stakeholders the organization won't be able to react in a proper manner. This gap will hold back the definition and implementation of the changes that are required for an organization to evolve. In addition, with the ubiquitous proliferation of information systems and technology, the above problems are accentuated as, on the one hand, the pressure to change grows and, on the other, the systems facilitate information sharing and process automation, regardless of the quality of information and how the processes are actually aligned with the organization goals. Despite the investments made on the research and development of systems and technology, most organizations still do not have adequate tools or methodologies that enable the management and coordination of these systems in such a way as to support planning, changing, decision making, controlling and, especially, as a means to use these systems to explicitly leverage competitive advantage (Sousa, Caetano, Vasconcelos, Pereira, & Tribolet, 2006).

The contribution of this work was the study of a semantic wiki as a means to create a state of self-awareness in organizations. The CEO framework, a framework proposed by the Organizational Engineering Center for modeling organizations, was studied and some modifications to it were proposed. A semantic wiki, Semantic MediaWiki, was modified to be able to support the CEO framework. Some examples were used to assess the modified Semantic MediaWiki in supporting this framework.

Section 2 introduces the CEO framework as originally proposed by the Organizational Engineering Center. Section 3 describes the modifications proposed to this framework. Section 4 illustrates how the modified Semantic MediaWiki can support organizational modeling according to the CEO framework. Finally, in section 4, the conclusions about this work are presented.

## 2 CEO Framework

The CEO framework is a set of concepts, models and rules whose aim is to describe the knowledge about an organization. According to the CEO framework, an organization can be represented with three types of concepts: entities, activities and roles. An entity represents a thing that exists in an organization and that is relevant for the purpose of the model. An activity represents work that is done in an organization: describes how the work is done and how value is added. A role describes a kind of contribution that an entity has in the context of an activity. The relationship among these concepts is shown in Figure 1. All the relations between activities and entities are mediated by roles (Sousa, Caetano, Vasconcelos, Pereira, & Tribolet, 2006).



Figure 1 – Relationship among the three types of concepts

### 2.1 Entities

Entities are things that exist in an organization. An entity can represent a person, a place, a machine, a concept or an event about which some information may be stored because it is relevant for the business.

Entities are defined by their attributes, methods and relations that they have with other concepts. There are two types of attributes: intrinsic attributes and extrinsic attributes. Intrinsic attributes describe the entity in isolation, while extrinsic attributes arise from the relationships an entity has when it plays roles in activities. The same happens with methods: methods can be either intrinsic or extrinsic (Sousa, Caetano, Vasconcelos, Pereira, & Tribolet, 2006).

### 2.2 Roles

Roles describe the observable behavior of an entity in the context of an activity. An entity can play several roles in different activities. A role can be played by different entities facilitating its reutilization (Caetano, Silva, & Tribolet, 2004).

The behavior defined by a role can also be described, like an entity, with methods and attributes. When an entity plays a certain role, it acquires all the methods and attributes of this role. These methods and attributes become the entity's extrinsic methods and attributes. These features will only belong to the entity while it plays the role.

Roles are described in role models where, in addition to the definition of methods and attributes, relationships within roles are defined (Caetano, Silva, & Tribolet, 2004), (Caetano, Silva, & Tribolet, 2005b). In these models is also possible to define constraints that roles must satisfy.

### 2.3 Activities

An activity is an abstraction representing how a number of entities collaborate through roles in order to produce a specific outcome (Sousa, Caetano, Vasconcelos, Pereira, & Tribolet, 2006). To describe an activity one can decompose it into sub activities and model their coordination. These sub activities can be further decomposed to add detail to the representation. According to the CEO framework, an activity must have at least one observable state, fulfill a business goal, be conducted by an actor and change resources.

### 2.4 Structural relations

The previous three types of concepts are building blocks to create more complex models. Each one of these types can be specialized to form other types of concepts that exist in organizations. A concept is a specialization of other concept when the first shares the description of the second and even adds some detail to its definition. A concept can also be composed of other concepts, meaning that the first concept has all the other concepts as part of its definition. These two kinds of relations are the

structural relations from the CEO framework. These relations can only exist between concepts of the same type: between entities, between roles or between activities. Figure 2 shows some examples of structural relations between activities.

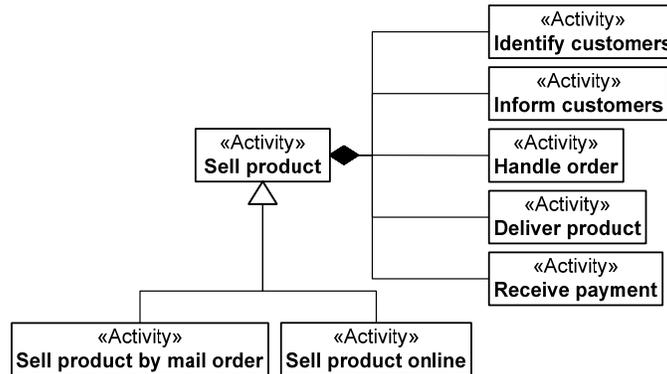


Figure 2 – Example of structural relations between concepts (Caetano, Silva, & Tribolet, 2005a)

## 2.5 Architectural views

Some concepts, specialized from the three fundamental concepts (entities, roles and activities), were proposed by CEO to represent organizations. These were divided into five different architectural views: Organizational Architecture, Business Architecture, Information Architecture, Application Architecture and Technological Architecture (Figure 3). Each one of them has the purpose of showing different aspects of an organization. This way is possible to reduce the organizational complexity and focus on the concepts that are of interest at a specific moment. These architectural views are further detailed in (Sousa, Caetano, Vasconcelos, Pereira, & Tribolet, 2006).

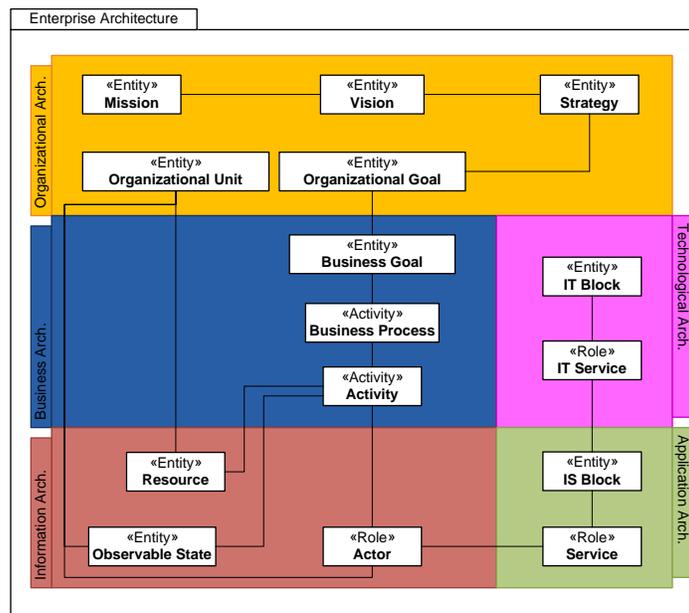


Figure 3 – The five architectural views from the CEO framework

## 2.6 Example

Figure 4 represents a model of “Cook an omelet” activity. This model uses all the three general types of concepts as building blocks and belongs to the Business Architectural View. Entities and activities are represented in boxes and roles are the arrows connecting entities to activities. The directed arrows define control flow relations between activities.

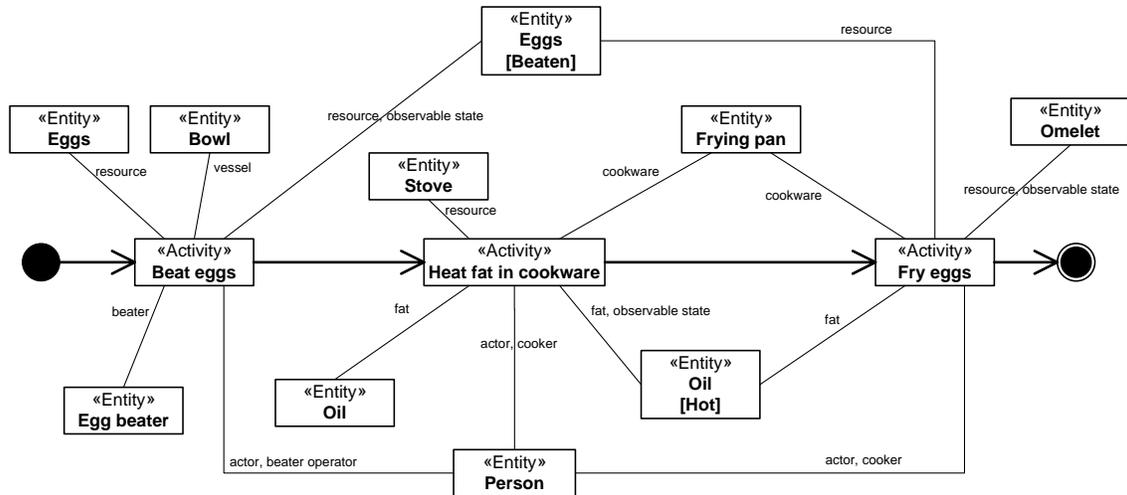


Figure 4 – Representation of “Cook an omelet” activity (Sousa, Caetano, Vasconcelos, Pereira, & Tribolet, 2006)

### 3 Proposed modifications to the CEO framework

In the last section the CEO framework, as originally proposed, was presented. The research conducted in this work led to believe that some aspects of the CEO framework restrict too much the models that are possible to create. One of these aspects is the impossibility of creating relations, other than structural, between concepts of the same type. According to the CEO framework this is not possible. However, there are relations between activities (between concepts of the same type) representing control flows, which is somehow inconsistent. The fundamental relation between concepts (Figure 1) is rigid: a relation between an activity and an entity always has to be mediated by a role, even when the entity is inanimate (doesn't have any specific behavior) in that activity. And when an activity class (as the one in Figure 4) is being modeled it's irrelevant to represent the type of active entities (that produce behavior) involved in that activity, it should only be needed to represent the behavior itself through roles. To address these problems some modifications to the CEO framework were proposed. They are presented in the following sections.

#### 3.1 Modification of the fundamental relation between concepts

The proposed fundamental relation between concepts is shown in Figure 5. Business object represents the union of entity, role and activity, that is, entities, roles and activities are specializations of business objects. This relation says that any business object can relate directly to any other. The arrow between the two business objects is a relation instance which has three attributes: a predicate, a subject (the business object at the left) and an object (the business object at the right). Relation instances belong to relation classes. A relation class describes the main characteristics of its instances. Figure 6 shows the proposed kinds of concepts that exist in an organization.

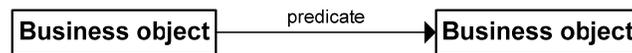


Figure 5 – Proposed fundamental relation between concepts

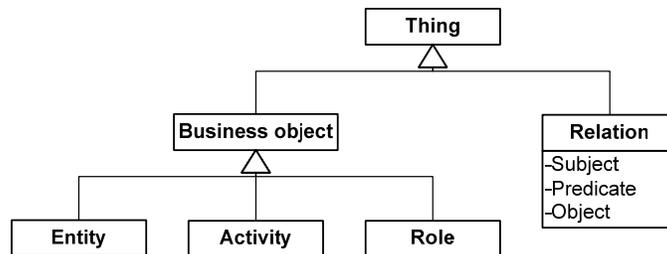


Figure 6 – Types of concepts that exist in an organization

This proposal was based in the work from (Aveiro, 2007). According to this author the universe is composed of entities. All entities relate to all the other entities, directly or indirectly, because there aren't isolated entities in the universe. The relations in the universe are of the type "Subject – Predicate – Object", where subject and object are entities belonging to the universe. He applies this idea to organizations. An organization, according to this author, can be described through entities and relations between them. But his entities are far more general than the entities from this proposal. His entities are equivalent to the concept "thing" used here. Therefore, a relation is an entity and so there can be relations between relations, which may cause infinite recursive related problems.

### 3.2 Activity modeling

To model an activity, in addition to represent the coordination relations between activities, one should also depict the other concepts also involved in the activity, either entities or roles. It should be clear whether the things involved have an active or an inactive behavior. If a thing has an active behavior in an activity it should be modeled as a role, if it has an inactive behavior it should be modeled as an entity. This way the activity represented in Figure 4 would be represented differently, as shown in Figure 7. The numbers next to the arrows represent cardinality constraints in relations.

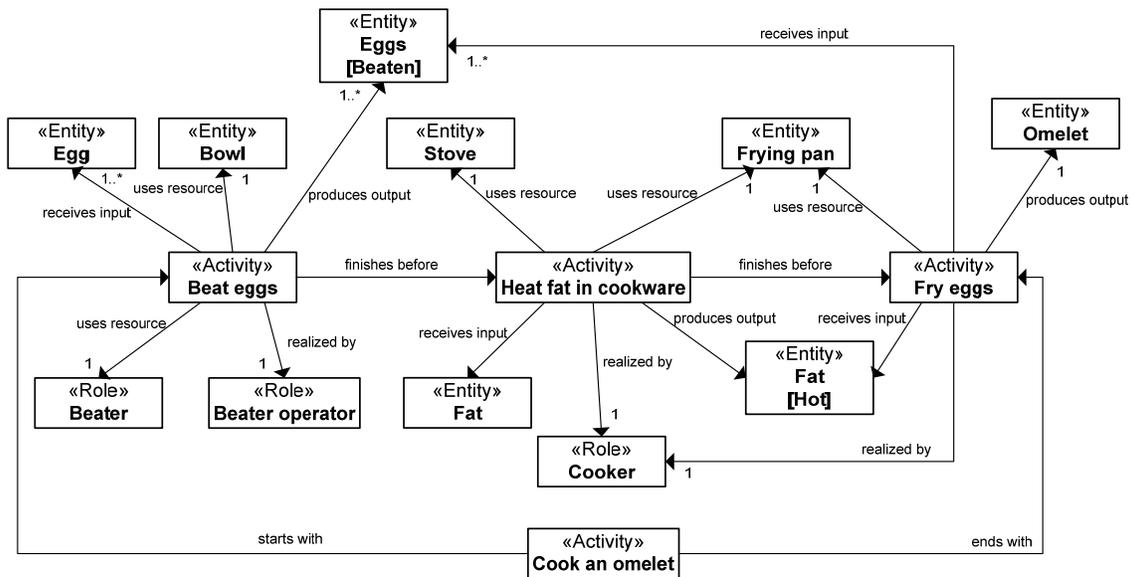


Figure 7 – New representation of “Cook an omelet” activity

This is different from original proposed manner to model activities. Formerly, either active or inactive things were modeled as entities which were related to the activity through roles (Caetano, Silva, & Tribolet, 2005a). Now, at design time when modeling classes of activities (like “Cook an omelet”), active things relate to activities by roles (like “Cooker”) and inactive things by classes of entities (like “Frying pan”). At run time, when instances of activities are being run (like specific acts of cooking an omelet), instances of entities belonging to the classes specified in the activity class (like a specific frying pan) and instances of entities capable of executing the behavior in the roles associated with the activity class (like someone or something capable of cooking) are linked to the activity instance.

Modeling an activity class is like programming in that both are processes of specifying how the things are done for the several situations that can happen. Representing activity instances, automatically or manually, is like representing computer processes that are running. Both represent things that are really happening and are running according to the specification (activity classes in case of activity instances or computer code in case of computer processes).

### 3.3 Relations

There are relation classes and relation instances. A relation class describes the characteristics of its instances like the predicate and the types of subject and object they can have. A relation instance represents a specific connection between two business objects, either classes or instances. These business objects must be from the type specified in the instance relation's class (Aveiro, 2007).

The relation instances from the “Cook an omelet” activity are represented as directed arrows in the model of Figure 7. In this model the classes of the relations instances aren’t shown because the purpose of the model is to provide a coordination perspective. However, these classes can be represented in a diagram like the one in Figure 8.

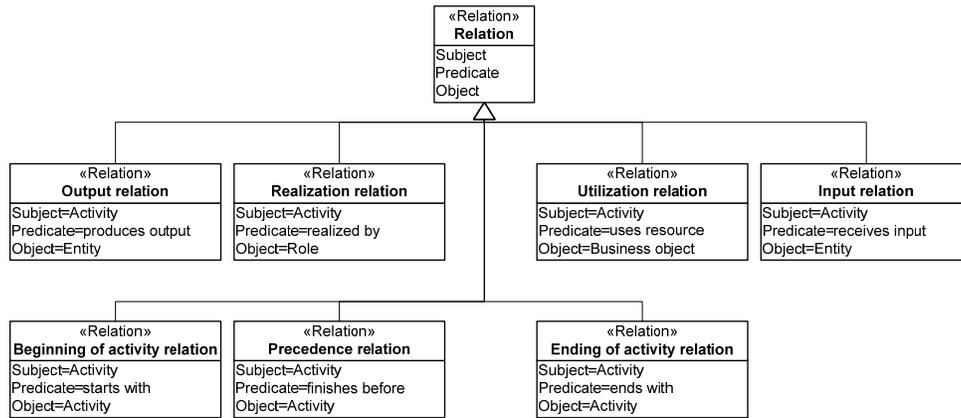


Figure 8 – Classes of the relation instances used

Finding the set of relations classes that should exist in order to correctly model any organization wasn’t the subject of this work. As a result, for a tool to be able to support the CEO framework, it must be flexible enough to let the users specify the relations classes they want to use to model an organization.

### 3.4 Organizational views

An organizational view (or architectural view) is a way of looking to the concepts that compose an organization. Each one shows different aspects of the same concepts because they have different goals. Figure 7 shows a view over the “Cook an omelet” activity that focus on coordination aspects. This view is interested in the relations of Figure 8. Other views could be made. For instance, specialization and composition relations could be important enough to create their own view, a structural view. Figure 9 shows this view over the same things that take part in the “Cook an omelet” activity.

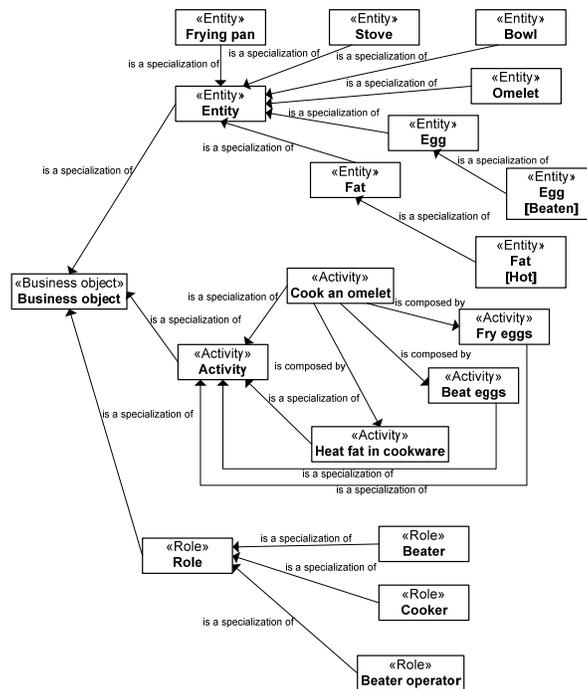


Figure 9 – Structural view of the things that participate in the “Cook an omelet” activity

Relation types are closely related to views in such a way that defining views through the specification of relation types is proposed (Aveiro, 2007). For example, in the case of the structural view the relation types would be specializations and compositions.

The work conducted didn't pretend to reach to set of precisely defined views that should exist over an organization. The only proposal that is made in this aspect is to define views through a specification of relation types. Therefore, for a tool to be able to support the CEO framework in organization modeling, it has to provide a way for users to define the views they want to create over the organization using a list of relation types or predicates.

## 4 Organizational modeling in semantic wikis

One of the main goals of this work was to use a semantic wiki as a tool for organizational modeling supporting the CEO framework. After looking carefully to the organizational modeling process, some desired characteristics for a tool to be capable of supporting this kind of modeling were identified. They were: it has to provide ways to define business objects and relations between them, permit the definition of organizational views, perform semantic searches, detect invalid relations and give a correct support for several users. Some semantic wikis were studied and Semantic MediaWiki was chosen as a starting point to create a tool capable of supporting the CEO framework.

### 4.1 Inserting organizational information into the Semantic MediaWiki

To insert organizational information into the Semantic MediaWiki one uses the edit mode. Here is possible to introduce normal text and semantic relations. Each wiki page is associated with a thing (Figure 6). Semantic relations between wikis pages provided by this wiki are used to describe relation instances between business objects. Normal text is used to make easier to explain some aspects that would be more difficult to describe only through semantic relations. Figure 10 shows what should be introduced in the edit mode of the "Cook an omelet" activity's wiki page (some predicates might be slightly different from the ones previously mentioned). The other business objects should also be defined in a similar manner.



Figure 10 – Editing "Cook an omelet" activity in Semantic MediaWiki

### 4.2 Showing the organizational information

Up to this point nothing new was presented. This information could have been inserted this way almost in every semantic wiki. In addition, the act of inserting information isn't very useful itself. The

main contribution of the work realized was the modification of Semantic MediaWiki to make it more powerful in showing organizational information.

In addition to the edit mode there is another one: the visualization mode. Here, the information typed on the edit mode is rendered and presented in a more user friendly manner. In this process of rendering, the organizational views are created on the fly. To create the organizational views all the organizational information can be taken into account, not only the information typed on the edit mode of the page being visualized.

The organizational views are defined in a template called “Organizational Views”. This template is automatically rendered in every wiki page. This way, if the organizational views are modified in this template, every page from then on will render the new definition of the organizational views.

To allow the definition of complex organizational views in Semantic MediaWiki three features were added: a semantic search mechanism that is able to perform searches on the semantic information in a very flexible way; a function that represents activities from a coordination perspective (somehow similar to the representation of Figure 7); and a mechanism that allows the detection of invalid relations, though far from being complete. These features can be used in the “Organizational Views” template (in the same way a programmer invokes a computer function) to help define the organizational views.

Figure 11 shows part of the organizational views’ definition. Among other things, it contains several invocations to the semantic search mechanism in order to perform the semantic searches needed to render the organizational views.

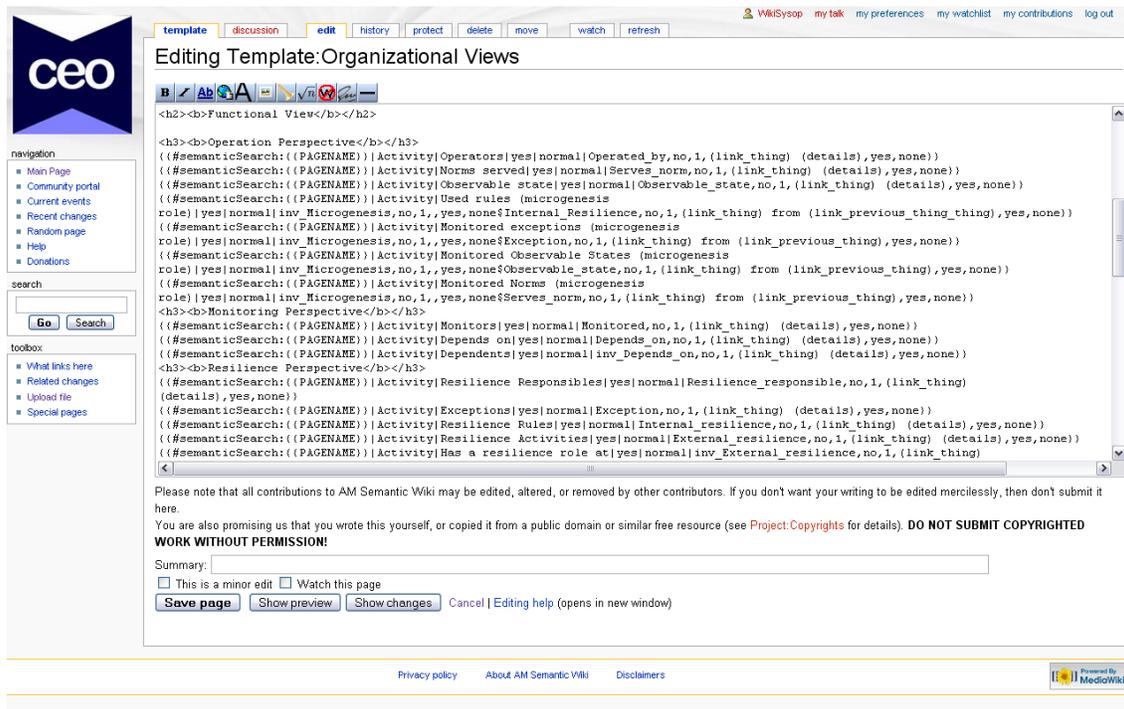


Figure 11 – Part of the organizational views’ definition

When rendering a wiki page, the semantic searches and invocations to other functions specified in the “Organizational Views” template are performed in order to present an up to date representation of the information. For the “Cook an omelet” activity’s wiki page the result would be the one in Figure 12. Only the first line was manually introduced in the edit mode of this wiki page. All the other information was automatically created on the fly, even the schematic representation of the activity.

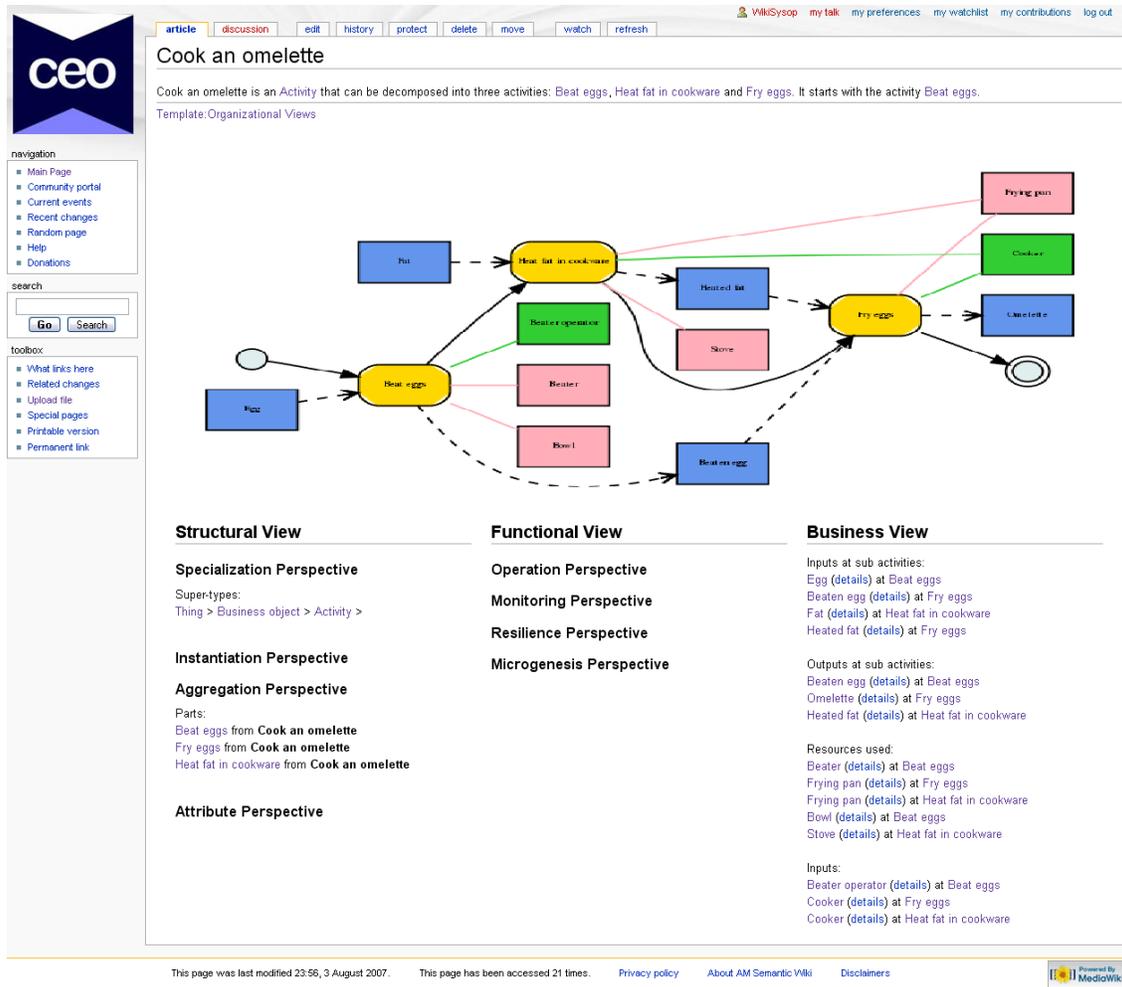


Figure 12 – Visualization mode of the “Cook an omelet” activity’s wiki page

### 4.3 Future work on the Semantic MediaWiki

Although the modifications done to Semantic MediaWiki have proved to be very useful in organizational modeling, some aspects of it need to be improved. The mechanism for detecting invalid relations should be made more complete. Now, it only detects relation instances violating the definition of their classes. There are other aspects that need to be monitored like assuring that an activity instance runs as specified in the definition of its activity class. The schematic representation of activities is not very user friendly and should be changed. In addition to insert semantic relations textually in the edit mode it should be made possible to insert them through an interactive interface. The Semantic MediaWiki’s performance should also be improved resorting, for example, to cache mechanisms.

## 5 Conclusions

The CEO framework for organization modeling was described. Some problems with it were identified and changes to it were proposed. One of them was related with the fundamental relation between concepts. It was proposed that any kind of concept (entity, activity or role) should be able to relate to any other kind of concept. The union of entity, activity and role was named business object. This proposal was strongly based on the work from (Aveiro, 2007).

It was also proposed another way to model activities. Formerly, an entity could only relate to an activity through a role. According to the new proposal made, at design time one should start by distinguish active concepts participating in an activity from the inactive concepts. The active concepts

are modeled as roles and no entity is needed. The inactive concepts are modeled as entities directly linked to the activity. At design time the entities and activities involved are classes. At run time they are replaced by instances, including the roles that are replaced by entities capable of performing their behavior.

A proposal related with this work was also made in (Aveiro, 2007). This author suggested that views should be defined using predicates. Though none view definition has been fully justified, three views were defined in order to assess Semantic MediaWiki in supporting organizational views and they proved to be very useful.

Semantic MediaWiki was chosen as a tool to support the CEO framework. It was suggested how organizational information should be inserted in this wiki. This wiki was also modified in order to correctly present the organizational views according to the ideas of the new proposed CEO framework. Three features were added: a semantic search mechanism, a function that creates schematic representations of activities and a mechanism that allows the detection of invalid relations.

In the end the modified Semantic MediaWiki proved that it has the potential to be a great tool in organization modeling. Some aspects of Semantic MediaWiki were identified to improve it in the future. Now, it would be important to assess its true usefulness in modeling real organizations.

## 6 References

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