Context is King: an Enterprise Model that Connects the Internal Structure with the Business Environment

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To appear in:

2021 IEEE 25th International Enterprise Distributed Object Computing Workshop (EDOCW)

Final version available via DOI (to be added once published):

www.model-engineering.info

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***Abstract*—If an Enterprise Model is to be used in the strategic decision-making, it should represent the connections between the elements of internal structure, like processes, machines, people, and the elements of the business environment, like market segments, competitors, regulators. The paper presents and discusses a modeling technique – Fractal Enterprise Model (FEM) – that allows to represent such connections, and a computerized toolkit – FEM toolkit – that supports the modeling process. The presentation is done based on a running example. The attendees will learn about an innovative presentation of a business environment in an enterprise model.**

Keywords—enterprise model, environment, modeling tool, FEM

I. A New Way of Representing Business Environments

Enterprise Models (EMs) have a wide area of application, one of them is to be used by management for decision-making. In this case, the model should present the details of how an organization operates in a way understandable for the management [1]. As a model always simplifies the reality, the type of models to be employed depends on which type of decision-making the model should be used in. For the strategic decision making, it is important not only to represent the internal structure of the organization, but also the business environment, or context, in which it operates. To such an environment, for example, belongs market segments, competitors, and regulators [2]. Note that in this paper, we treat *business environment* and *context* as synonyms.

Understanding and representing the business context is not a trivial task, as different parts of an organization have different views on the contextual elements. For example, for the sales department, a competitor is a company that provides the same kind of products and/or services as the ones the given organization provides. However, for the Human Resources, a competitor is an organization that recruits the same kind of specialists. Such a competitor does not need to be on the list of competitors in the sales department. Also, a competitor in one area can be a collaborator in another area.

Thus, the elements of the context in an EM should be tightly connected to the elements that represent internal activities of the organization. This can be achieved by using a so-called Fractal Enterprise Model [3]. Initially, FEM was aimed at representing, mostly, the internal activities of an organization. It had a form of a directed graph with two types of nodes, processes and assets. The arrows (edges) from assets to processes show which assets are used in which processes and arrows from processes to assets show which processes help to have specific assets in "healthy" and working order. The arrows are labeled with meta-tags that show in what way a given asset is used, e.g., as *workforce*, *reputation*, *infrastructure*, etc., or in what way a given process helps to have the given assets "in working order", i.e., *acquire*, *maintain* or *retire*.

Recently, two new elements were added to FEM to represent the external environment– external pools and external actors – that can be connected with the internal processes. An external pool can represent a market segment, e.g., a labor market, and an external actor can represent an external organization or private person acting on the market. The extended FEM showed to be useful for strategic work [4] [5].

The FEM toolkit is a computerized tool, which is to be presented during the demo session of the conference. It supports drawing FEM diagrams and tying them together; it also provides means for navigating through a set of interconnected diagrams. It is built on the ADOxx metamodeling environment [6], [7], and it works as a standalone application for a variety of operational environments: Windows, Mac, and Linux. It can be freely downloaded from [8].

Elements of the environment can also be represented in a modeling language using general abstract concepts. Such solutions can be found in the literature. For example, [9] presents a model of simultaneous cooperation and competition using the goal modeling language i*. Authors of [10] present a model where elements of the environments can be analyzed using e^3value concepts. Moreover, [9] introduces some requirements on the modeling language to be able to represent competition and cooperation, and analyzes fulfillment of these requirements in a number of modeling languages. The approach taken in FEM is different, namely, it uses dedicated concepts for the important elements of the environment, external pools and external actors, and it represents the business from the point of view of a specific organization. It also has means (archetypes, explained later) that make it easy to find relevant elements of the environment while building an enterprise model of an organization.

The rest of the paper is structured in the following way. In Section II, we review the FEM concept focusing on the elements that represent the business environment. In Section III, we discuss an example used for the demonstration. Section IV overviews the FEM toolkit and discusses plans for the future.

The first author's work was partly supported by the Estonian Research Council (grant PRG1226).

II. Fractal Enterprise Model: Main Concepts

In this section, we give an overview of Fractal Enterprise Models (FEM) introduced in our earlier works, especially in [3], and in the extended form in [4]. FEM includes five types of elements: business processes (more exactly, business process types), assets, external pools, external actors and relations between them, see Fig. 1 in which a FEM of an institution of higher education is presented, the example being taken from [5].

Graphically, a process is represented by an oval, an asset by a rectangle (box), an external pool by a cloud shape, and an external actor by a rectangle with rounded corners. A relation between elements is represented by an arrow. Processes and assets are mainly used for representing the internal structure of operational activities of an organization, whereas pools and external actors are used to present the external environment. A label inside an element names the given process, asset, pool or

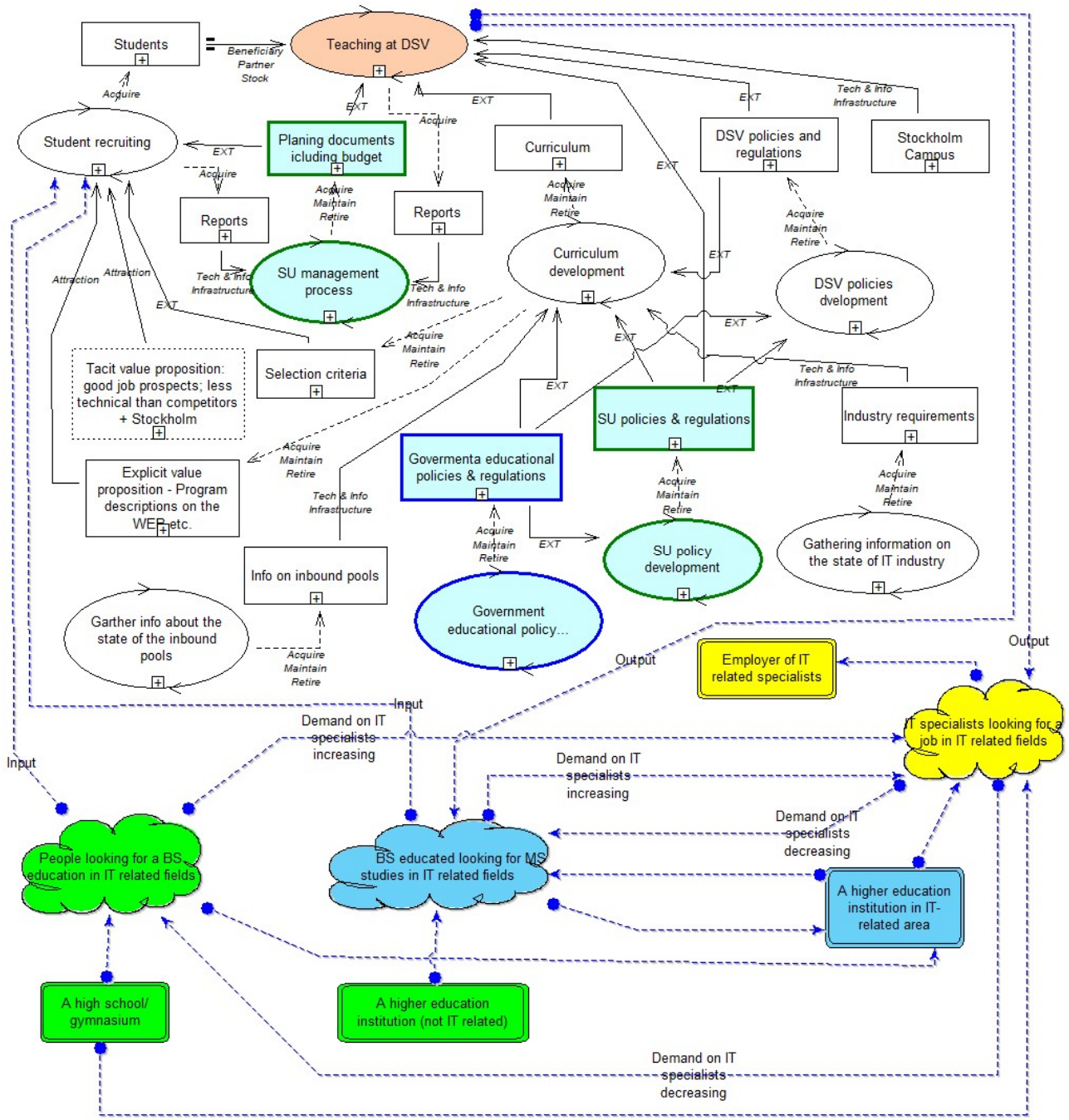

Fig. 1. An example of FEM in FEM toolkit

external actor. A label on an arrow, if any, identifies the type of relations between the elements it connects.

We differentiate two types of relations between processes and assets in the fractal model. One type represents a relation of a process "using" an asset; in this case, the arrow points from the asset to the process and it has a solid line. The other type represents a relation of a process changing the asset; in this case, the arrow points from the process to the asset and it has a dashed line. A label on an arrow pointing from an asset to a process identifies the role the given asset plays in the process, for example, *Workforce*, or *Infrastructure*. A label on an arrow pointing from a process to an asset identifies the way in which the process affects the asset. In FEM, an asset is considered as a pool of entities capable of playing a given role in a given process. Labels leading into assets from processes reflect the way the pool is affected, for example, the label *Acquire* identifies that the process can/should increase the pool size.

Note that the same asset can be used in multiple processes playing the same or different roles in them, which is reflected by labels on the corresponding arrows. It is also possible that the same asset plays multiple roles in the same process. In this case, several labels can be placed on the arrow between the asset and the process. Similarly, a process could affect multiple assets, each in the same or in different ways, which is represented by the corresponding labels on the arrows. Moreover, it is possible that a single process affects a single asset in multiple ways, which is represented by having two or more labels on the corresponding arrow.

Labels inside elements of the model are not standardized. They can be set according to the terminology accepted in the given domain, or be specific for a given organization. Labels on arrows that connect processes to assets (which represent the relations between them) are standardized. This is done by using a relatively limited set of abstract relations, such as, *Workforce* or *Acquire*, which are clarified by the domain- and context-specific labels inside ovals and rectangles. Standardization improves the understandability of the models. While there are a number of types of relations that show how an asset is used in a process (see example in Fig. 1), there are only three types of relations that describe how an asset is managed by a process – *Acquire*, *Maintain* and *Retire*.

Two elements for representing the business environment have the following meaning. An *external pool* is a set of things or agents of a certain type. An *external actor* is an agent, like a company or person, acting outside the boundary of the organization. The label inside the external actor describes its nature. If the element represents a set of external actors the box has a double line. In Fig. 1, External pools and actors are highlighted; they have yellow, green and blue background colors, the meaning of which are explained later.

External pools and external actors may be related to each other and to other elements of the FEM diagram. Such a relation is shown by a dashed arrow that has a round dot start. More exactly:

- A business process may be connected to an external pool with an arrow directed from the pool to the process. In this case, the process needs to be an *Acquire* process to one or more assets. The arrow shows that the process uses the external pool to create new elements in the asset for which this process serves as an *Acquire* process.
- An external actor may be connected to an external pool with an arrow directed from the pool to the external actor. In this case, the arrow shows that the external actor uses the external pool as bases for one of its own acquire processes.
- A business process may be connected to an external pool with an arrow directed from the process to the pool. In this case the arrow shows that the process provides entities to the external pool.
- An external actor may be connected to an external pool with an arrow directed from the actor to the pool. In this case, the arrow shows that one of the actor's processes provides entities to the external pool.
- Two pools can be connected to each other, which means that elements from one pool can move to another based on external conditions.

External pools and actors represent the context in which an organization operates. External pools can be roughly associated with markets, e.g., a labor market. External actors represent other organizations that are connected to the external pools. Dependent on the nature of the external pool, an external actor connected to it can be a competitor, provider, or collaborator. Note that an external organization can be an asset, e.g., partner or customer, or an external actor. The difference reveals itself in how the organization is connected to the internal processes; an external actor is always connected via an external pool. If needed, an arrow that connects an external pool to some other element can be supplied with a label to clarify the condition on when or why the elements can be added to or withdrawn from the pool.

To make the work of building a fractal model more systematic, FEM introduces archetypes (or patterns) to define fragments from which a particular model can be built. An archetype is a template defined as a fragment of a model where labels inside elements are omitted, but arrows are labelled. A fragment can include any combination of FEM elements, including external pools and actors. Instantiating an archetype means putting the fragment inside the model and labelling the elements; it is also possible to add elements absent in the archetype, or omit some elements that are present in the archetype. Archetypes help modelers, even unexperienced ones, to figure out what to look for when building a FEM. In particular, an archetype can hint where to add new environmental elements.

III. An Example

The model in Fig. 1 represents the operational activities and the environment of the Department of Computer and Systems sciences (DSV) of Stockholm University, for which the first two authors work. The root of the model is the *Teaching at DSV* process – a primary process in FEM terminology, i.e., a process that has beneficiaries that get some value from it for which the beneficiary, or somebody else is paying money. This process requires some assets, e.g., *Students*, *Teachers*, *Curriculum*.

These assets are supported by management processes. Note that *Curriculum* has a role of controlling mechanism, which is indicated by the label *EXT* (EXecutable Template). This example is used during the demo presentation.

The *Students* asset needs to be constantly refilled, as a bunch of them is graduating each year. This is done by the recruiting process which draws from the external pools *People looking for a BS education in IT related fields* and *BS educated looking for MS studies in IT related fields*, which are part of the environment/context of DSV business activities. These are called inbound pools and they are marked either with green or blue color (the meaning of blue is given in the next paragraph). A number of external actors are connected to these pools that are also considered as elements of the environment. Some of them provide elements to the pool (green background color), other draws from it which points to the *competition* (we mark such actors with red color, but there is no example of pure competitor in Fig. 1). Note that an external actor can be both a *provider* and *competitor*; such actors are marked with blue background color. In Fig. 1, there is one such actor - *A higher education institution in IT-related area*.

Graduated students fill two external pools *IT specialists looking for a job in IT related fields* and *BS educated looking for MS studies in IT related fields*. These are outbound pools, the first one is marked by the yellow background color (pure outbound pool) and the second one with the blue background color (both inbound and outbound pool). To these pools, external actors are connected that draw from the pools, e.g., *Employer of IT related specialists*, also marked with yellow background color. Those also belong to the DSV's environment.

The model in Fig. 1 has a number of other elements that point to the important actors of the environment. These have light blue background color, and have colored borders. The connection to the external world here, however, differs from the connection through the external pools. The connection is through DSV being obliged to use some elements produced by external actors as *EXT*, e.g., policies or regulations. This type of connections allows to identify regulators, e.g., organizations that can demand compliance to rules produced by them.

More detailed explanations of the model in Fig. 1 is presented in [5] where it was used for defining the organizational identity of DSV.

IV. Additional Features of the FEM Toolkit

The FEM toolkit was developed with the goal to support drawing of FEM diagrams. Besides ensuring syntactic correctness when drawing a diagram, the FEM toolkit also implements a number of useful features, which make the task of the modeler easier, namely the toolkit:

1) Supports archetypes that can automatically expand a FEM diagram. An archetype is invoked by pressing on the "+" sign at the bottom of the element of the model to which that archetype is to be applied to (see Fig. 1).

2) Supports ghosting to solve the problem of multiple instances of the same model element appearing in the same or different diagrams. A ghost is a copy of an already existing model element, which has an arrow on the upper-left side of the shape. Ghosting is accompanied with a navigation mechanism that allows to find all occurrences of the same element in the same or different diagrams (e.g., via clicking on the arrow).

3) Supports decomposing processes and assets.

4) Supports flexible subclassing defined by a modeler at "runtime", which are expressed by dedicated background colors of FEM elements. This is demonstrated in Fig. 1 where all background colors are defined with the help of subclassing.

Features 2-4 are explained in more details in [11]. The FEM toolkit is a relatively new tool created one and a half years ago. Currently, it is in a stable version 0.7, while version 0.8 is in preparation. Nevertheless, the toolkit has already been used in practical projects. The next version of the FEM toolkit will have additional features, e.g., to allow multiple subclassing schemes that can be changed on the fly without losing the data related to a previous classification.

More resources related to FEM and the FEM toolkit, including bibliography, video recording of presentations, and the latest version of the FEM toolkit for download are freely available from [8].

Acknowledgement. The authors are very grateful to Steven Leego, Erik Falenius and August Carlsson who independently tested the FEM toolkit in practical projects.

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