CEO FRAMEWORK ENTERPRISE MODELS CONFORMANCE WITH ISO14258

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Keywords: Enterprise Modelling, Enterprise Engineering, UML, ISO14258, Business Processes.

Abstract: Several international standards for Enterprise Engineering were developed in order to: promote the quality and reliability of the communication between the partners involved in business processes; upgrade the compatibility and alignment between the systems which support business processes. In this area an international standard was develop – ISO 14258 – which specifies rules and concepts for enterprise modelling. CEO Framework is an analysis framework that provides a formal way of describing enterprises. This article describes the how to verify that an enterprise modelling frameworks generates models in conformance with ISO14248. This sequence of steps is applied to verify CEO framework.

1 INTRODUCTION

The Center for Organizational Engineering (CEO) has developed research work on enterprise modelling (Vasconcelos, 2003) (Bringuel,2004) (Mendes,2003), in partnership with several Portuguese organisations. CEO project development in industrial environment, where international standards on instrumentation and electrical areas must be used, created the need for the study of the regulation standards of organisational engineering and their applications.

As a rule, standards are developed by joint work between scientific and industrial communities to establish a common terminology and a set of common rules and principles that apply to a specific domain. In Integration Engineering and Enterprise Engineering (Liles, 1995) the standards have the following purposes:

- To increase the quality and accuracy of communication between the intervenient (clients, vendors, consultants, managers, and software developers).
- To develop compatibility between the applications that supports the Enterprise Architecture specification.
- To promote the compatibility and alignment between the systems that supports the enterprise.

In this area an international standard was develop that specifies rules and concepts for enterprise modelling – the ISO 14258 – Concepts and rules for Enterprise Models (ISO,1998) (NIST, 2004) (Cimosa,2003) (Deno, 2001). This standard does not define an enterprise model or its representation, instead it aims to define a set of common concepts and properties that all models should satisfy. The concepts and rules for enterprise modelling are

Macedo P., Ferreira C. and Tribolet J. (2006).
CEO FRAMEWORK ENTERPRISE MODELS CONFORMANCE WITH ISO14258.
In *Proceedings of the Eighth International Conference on Enterprise Information Systems - ISAS*, pages 559-564
DOI: 10.5220/0002463105590564

based on Systems Theory, where the enterprise, processes, and products are considered as a system.

The CEO Framework (FCEO) was developed in CEO with purpose of providing a formal way to describe enterprises, goals, business processes, information systems, and the dependencies between them (Eriksson, 2000).

The aims of this article are:

- to describe the set of points that should be checked in order to conclude if an enterprise framework generates models in conformance with ISO14248
- to apply those procedure to analyse FCEO .

The next section presents an overview of the main principles and rules of ISO14258. Section 3 summarises the FCEO. Section 4 shows that CEO enterprise models comply to standard ISO14248. Section 5 presents a case study on a Pulp and Paper Portuguese Mill. Conclusions and future work are presented in Section 6.

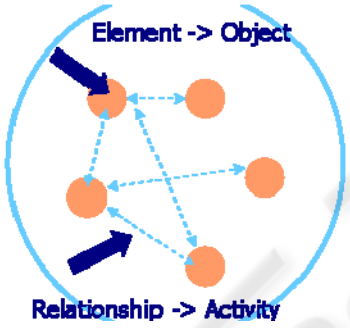


Figure 1: System Theory applied to enterprise.

2 PROCEDURE TO VERIFY ISO14258 COMPILANCE

ISO14258 (ISO,1998) specifies rules and concepts necessary to create enterprise models. It is not the purpose of the standard to define an Enterprise Model, a language to represent it or a framework. It aims is to define a set of common concepts and proprieties that all models should satisfy.

The normative concepts and rules presented this international standard are based on relevant elements of system theory. This concepts and proprieties defined in System Theory are applied to enterprise model, where elements are the objects of the enterprise. The connection between two elements is mapped to an activity (see Figure 1)

2.1 Structural, Hierarchical, and Behavioural Aspects

Each system can be analyzing through three aspects:

Structural – Defines the structure of the enterprise and the interdependencies between its elements (activities and resources)

Hierarchical – There are two types of hierarchies: part-of hierarchies and kind-of hierarchies. Part-of hierarchies describe the composition of elements or decomposition of systems and are used to construct detailed models, or to link models with different purposes. Kind-of hierarchies describe different levels of abstraction ordered by generalization and specialization and is used to classify the entities building blocks.

Behavioural –Enterprise models must have the capability to describe behaviour; that is, to represent sequentially events, actions, conditions, states, and to describe transformation functions. Dynamic and static behaviour should be supported.

2.2 Views

The standard says also that each model should provide more than one view, where each view illustrates a different aspect of the enterprise. According the ISO14258 Information view and Function view are required for all models. The Information view represents the information requirements to operate the system. The function view shows the enterprise processes.

2.3 Life Cycle

Each system (enterprise project or product) has a life cycle that is partitioned in phases: plan/build, use/operate and recycle/dispose. Each phase of the life cycle can be represented by different models.

2.4 Activity Classification

Activities can be classified in the following 3 types:

- Activity W – define *what* to do
- Activity H – define *how* to do
- Activity D – define the execution (*do*)

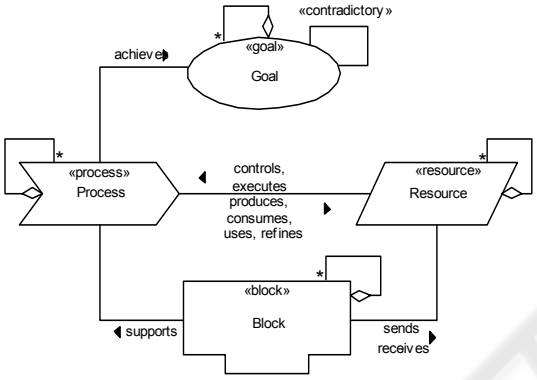
Each type of activity can be represented by different models. Activities are recursive, decomposable, and iterative.

3 CEO FRAMEWORK

The FCEO is an enterprise modelling framework. This framework comprises three interdependent levels. The first level describes the current set of goals of the enterprise. The business processes and the business resources are described in the second level. In level three, the aim is to describe the Information System supporting the business processes.

Figure 2: UML Metamodel for CEO framework.

The modelling language used to implement FCEO is UML. In order to improve the description



of business concepts, an UML extension was proposed (Eriksson, 2000). This extension is represented by the meta-model shown in

This meta-model was created through the definition of stereotypes, properties, constrains, and tagged values provided by UML.

The work presented on this paper is concerned with layer 2 of the FCEO. Layer 2 defines processes, resources and their relationships:

The process stereotype represents a unit of work. Its execution may be connected to the execution of other process(es) by resource flow(s).

Resources are objects within the business that are manipulated through processes. Resources can be arranged in structures and have relations with each other. Resources can be produced, consumed, used or refined in processes.

4 FCEO CONFORMANCE WITH ISO14258

This section discusses the conformance of FCEO enterprise models and ISO14258. FCEO defines a meta-model of UML, so all principles, rules and proprieties of UML can be applied to the FCEO models.

4.1 Structure, Hierarchy and Behaviour

Structure – The enterprise structure is defined according to its business processes (Eriksson, 1998). Business resources represent system elements and processes represent the relationship between elements. On FCEO, business resources are represented by the <<resource>> stereotype, and business processes by <<process>> stereotype. Processes can use, or transform recourses as specified on FCEO model (see Figure 2)

Hierarchy – Product tree, mill hierarchy, and organization hierarchy are examples of part-of hierarchies that should be represented on Enterprise modelling. Usually the aggregation and composition features of UML are used to represent part-of hierarchies .When a product has a recursive structure (as for example, recycled products) a simple association has to be used to represent the relationship between product components. Process and resource classification are examples of kind-of hierarchies. To represent classification of processes and resources the generalization feature of UML is applied (see Figure 3).

Behaviour – UML activity diagrams (Figure 9) are used to model static behaviour representing how activities are organized and how resources flow inside the enterprise. To model dynamic behaviour time has to be modelled. Depending on the characteristics of the processes (Macedo, 2004), time could be considered as discrete or continuous. Sequence diagrams and Time diagrams (available in UML 2.0) can be used to represent how resources or processes change through out time. To model the dynamic behaviour of a continuous process (for example, pulp manufacturing process and papermaking manufacturing), UML features are not enough (Macedo,2004.1)

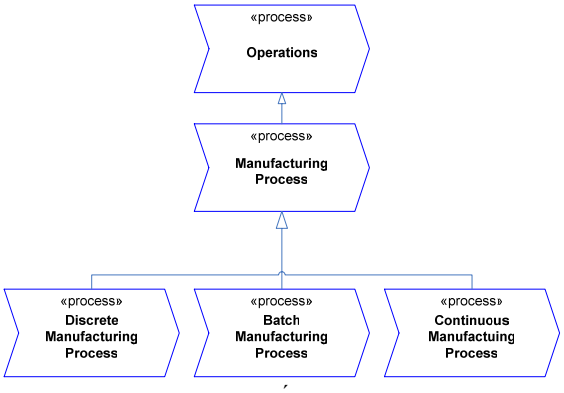


Figure 3: Manufacturing Process Hierarchy.

4.2 Life Cycle

According to ISO14258 each phase of the enterprise life cycle has to be represented. FCEO does not support the concept of life cycle; however it provides models with a good descriptive capability (Macedo,2004.1), thus making it possible to model each phase of the life-cycle.

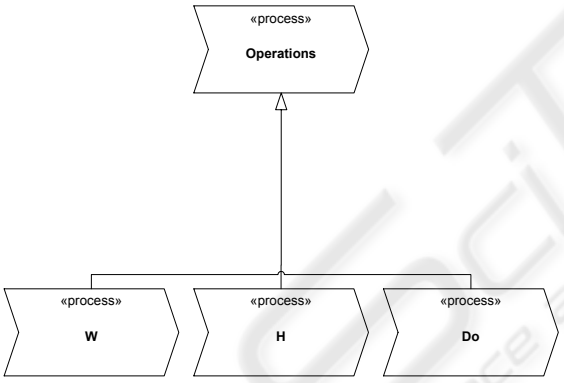


Figure 4: Specialization of class Operations.

4.3 Views

FCEO supports the definition of different views of an organisational system, where each view may define different abstraction details. The functional view can be obtained by using a process diagram of FCEO (Vasconcelos,2001)) where the structure of a process and its dependencies are shown. The information view shows how information resources are structured and which information resources are used, spent, or produced by each activity. Information view can be obtained throw a Process-Resource diagram where only the information resources are represented.

4.3.1 Activity Classification

FCEO approach does not classify activities in W, H, and D; instead it classifies activities according to Porter chain value (Porter, 1986). However, FCEO UML meta-model it is flexible enough to define a structure of activities classes. So, it is possible to define activity of type W, H, and D as specialization of process class Operations (see Figure 4).

Activities can be decomposed in sub-activities. Also, activities can either be recursive or iterative. Recursive activities can be supported by UML class composition mechanism where a recursive class can be defined through reflexive aggregation. Iterative activities can be supported by UML activity diagrams, where iterative execution of either a single activity or a set of activities can be defined. Note that activity diagrams refer to class instances, not classes.

5 CASE STUDY: PAPER MILL ENTERPRISE MODELLING

The case study presented here is the result of the work done in enterprise modelling on a Pulp and Paper Portuguese Mill during the years of 2003 and 2004. This work focused on applying the FCEO to the manufacturing process.

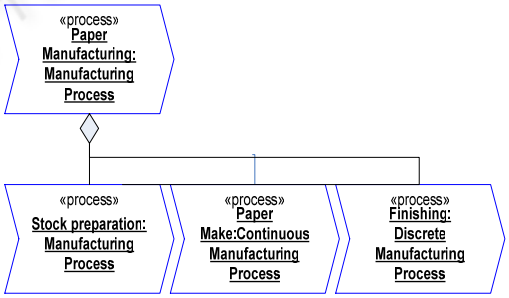


Figure 5: Class Process Diagram – Papermaking.

Next, a summary of the above case study is presented.

Structural Aspects

All core business processes were identified. Paper production and Pulp production were modelled with detail. Human resources, information resources and material resources were identified for each process.

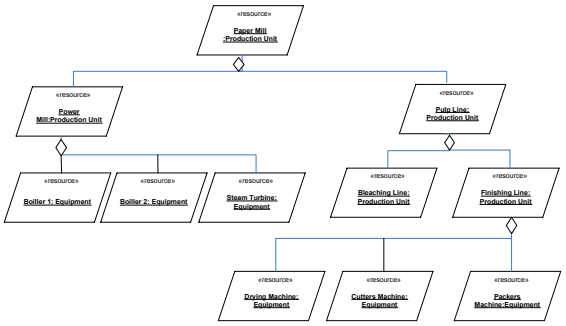


Figure 6: Mill Hierarchy.

Hierarchies Aspects

Processes were classified in Management or Manufacturing Processes. Manufacturing Processes were classified in Batch, Discrete, or Continuous Processes in order to represent the singularities of production (Macedo, 2004.1). The Figure 3 shows how generalization feature of UML is applied to classify Manufacturing Processes.

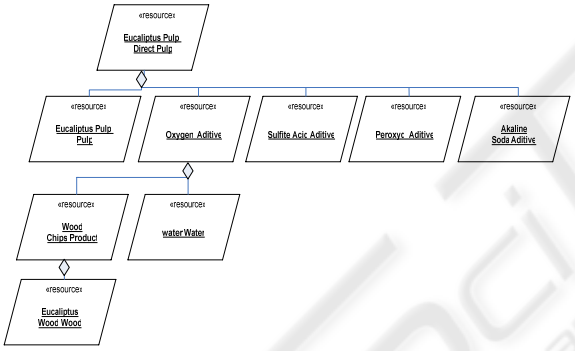


Figure 7: Eucalyptus Pulp – Product Tree.

Product Tree, Mill Hierarchy, and Organization Hierarchy were modelled to represent how resources are aggregated. Figure 5 represents how the Papermaking process is decomposed in sub-processes, while Figure 6 shows which production units compose the Paper Mill infrastructure. Figure 7 represents the Eucalyptus Pulp product tree, showing which material resources are necessary for the production of Eucalyptus Pulp.

Behavioural Aspects

Activity Diagrams were used to represent static behaviour.

Figure 9 shows the sequencing of activities and which resources are spent, produced, or used to produce starch in a batch process.

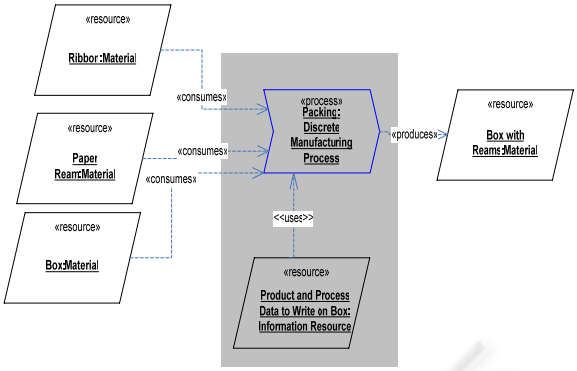


Figure 8: Packing Manufacturing Process.

Views

Informational view is obtained by extracting the information resources from the Process-Resources diagram. The grey rectangle in Figure 8 shows the information needed to execute the manufacturing process packing.

Figure 5 is an example of a functional view, where only the functions of the enterprise are shown.

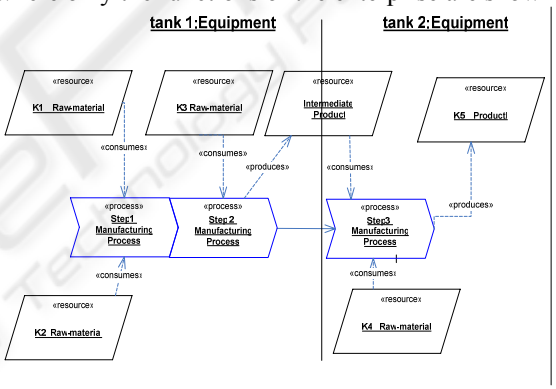


Figure 9: Starch Batch Production.

6 CONCLUSIONS AND FUTURE WORK

Enterprise models defined using FCEO meta-model are ISO14258 conformant. FCEO does not provide directly the principles of activity classification and of life-cycle, but as explained in Section 4, UML meta-model is flexible enough to support enterprise modelling according to this principles.

This article presents a sequence of steps necessary to check that CEO Framework generates enterprise models in conformance with ISO14248. The work presented here is not restricted to FCEO, as this sequence of steps can easily be applied to verify ISO14248 conformance of other enterprise modelling frameworks.

ISO 14258 is used as reference for other standards in Enterprise Engineering domain as is the case of ISO 15704 - *Requirement for Enterprise Reference Architecture and Methodologies.* The study of the conformance of FCEO with *ISO15704* is also relevant to identify which aspects the FCEO are in conformance with the standard *ISO15704*.

REFERENCES

Bringel, H. and A. Caetano and J. Tribolet, Business Process Modelling towards Data Quality Assurance: an Organizational Engineering Approach, 6th International Conference on Enterprise Information Systems, ICEIS 2004, Apr. 2004

CIMOSA Business Process Modelling and Standardisation retrieve in 2003 from http://www.cimosa.de/Standards/BPM_and_Standardisation.pdf

Deno,P. Emergent Enterprise Models , OMG Workshops Proceedings of UML, Burlingame, CA, USA, Dec. 2001.

Eriksson, H. E., Penker, M. –" Business Modelling with UML: Business Patterns at Work", OMG Press, 2000.

ISO14258 - Concept and Rules for Enterprise Models 1998 (http://www.iso.org)

Liles, D. H., M. Johnson, L. Meade, R. Underdown - Enterprise Engineering: A discipline, Society for Enterprise Engineering Conference Proceedings, Jun. 1995.

Macedo, P. and J. Tribolet, *Modelação de Processos de Produção em Engenharia Organizacional*, 5º Conferência da Associação Portuguesa de Sistemas de Informação, Nov. 2004.

Macedo, P. and P. Sinogas and J. Tribolet, *Information Systems Support for Manufacturing Processes : The Standard S95 Perspective*, 6th International Conference on Enterprise Information Systems, ICEIS 2004, Apr. 2004.

Mendes, and J. Mateus and E. Silva and J. Tribolet, Applying Business Process Modelling to Organizational Change, American Conference on Information Systems (AMCIS) 2003, Aug. 2003.

Michael Porter, Competitive Advantage, New York: Free Press, 1985.

NIST - http://www.mel.nist.gov/sc5wg1/, 2004

Vasconcelos, A. and R. Mendes and J. Tribolet, Using Organizational Modelling to Evaluate IS/IT Projects, Thirty Seventh Hawaii Conference on Systems Sciences (HICSS-37), Jan. 2004

Vasconcelos, A. Caeteano, J.Neves, P. Sinogas, R. Mendes, J. Tribolet, A Framework for Modelling Strategy, Business Processes and Information Systems, In Proceedings of International Conference on Enterprise Distributed Objects Computing, in Seattle. USA, 2001