
AN ONTOLOGICAL-BASED MODEL FOR COMPETENCES IN SUSTAINABLE DEVELOPMENT PROJECTS: A CASE STUDY FOR PROJECT'S COMMERCIAL ACTIVITIES

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Abstract

The paper presents a project management competencies model, using an ontological approach. The ontology, named *PMCatalog*, was developed in the framework of the project CONTO, financed by Romanian through the grant 91-037/2007. *PMCatalog* is consistent with the competence definition and PM competence elements included in the International Competence Baseline, the competency standard of the International Project Management Association. The main *PMCatalog*'s use cases for commercial activities in sustainable development projects are described. Ontology was developed using the Protégé editor.

Keywords: competence, project management, sustainable development, commercial activities

JEL Classification: M31

Introduction

The definition of the sustainable development is coming from the Brundtland Commission Report of 1987, which stated that we must “meet the needs for the present without compromising the ability of future generations to meet their own needs” (World Commission 1987). It is mean that, when people make decisions about the Earth's resources usage they must take into consideration the processes which are used to get these resources, and who has access to them. The next generations will have still enough resources and will the environment be left as you know it today or even better in order to be normal living conditions? For these questions the decision makers should find answers.

The sustainable development has the following pillars: environmental, economic and social. The environment dimension is the necessary basis for sustainable development, the economy is the tool and the good life for people (the social dimension) is the target of

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sustainable development (EEA 2006).

The sustainable development projects have a high level of complexity, due to the multiple interactions between environmental, economical and social dimensions. The figure no. 1 presents these interactions at the interested parties' level.

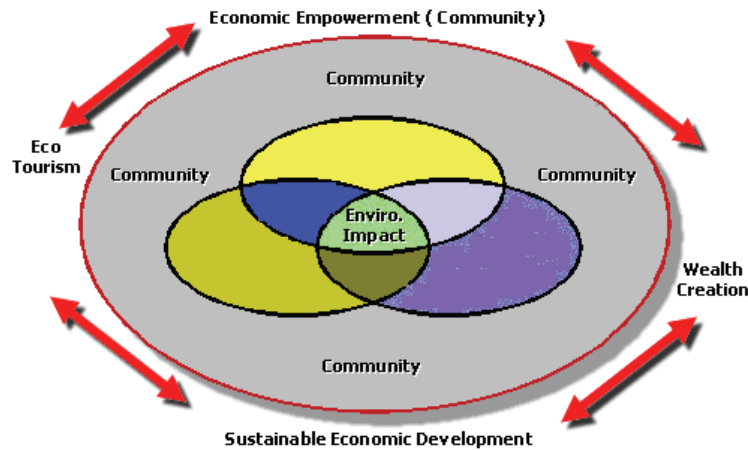


Figure no. 1: Interested parties in the sustainable development projects

Source: adapted from <http://en.wikipedia.org/wiki/Sustainability>

The ecosystem is under damage from human activity. Fulfilling actual needs while reducing the impact of human activity is the main interest expressed of the community for the projects which have impact on the environment. It is a fundamental part of this challenge to secure the living and physical environment, including natural resources, processes and balances (MWI 2008). Very specific constraints for projects implementation has to be formulated, such as: limiting global warming, stopping the biodiversity loosing, controlling and limiting emission of persistent pollutants.

Economic policy and market mechanisms have to be applied for achieving sustainable development. In this regards, we consider the economy as a very powerful tool for sustainable development. Combating poverty and assuring economic welfare are very important interests for the sustainable development projects community. However, not all economic growth implies sustainable development, but only that at reduced environmental impact. These incentives must work in favour of making sustainable investments both in the public and private sectors profitable and focusing research to provide solutions for sustainable development (EEA 2006).

One of the main characteristics of the sustainable development projects is the necessity for effective partnerships, among key actors related to development and human security, from sectors such as: agriculture, energy, industry, and trade at the country and regional levels. Particularly at the regional level (MWI 2008), there is a need to increase synergies between on-going policies (e.g. the European Neighbourhood Policy, the Barcelona Convention and its Protocols etc.), strategies (e.g., the Mediterranean Strategy for Sustainable Development,

the EU Marine Strategy etc.), initiatives (the ‘Horizon 2020’ Initiative, the Mediterranean Component of the EU Water Initiative etc.), funding instruments and programmes (e.g. the European Neighbourhood and Partnership Instrument, the Seventh EU Framework Programme, the United Nations Development Programme, the Global Environment Facility, the European Investment Bank, the World Bank etc.) as well as international organizations (e.g. UN ESCWA, UNECE, OECD etc.) and tools (e.g. the MED EUWI / WFD Joint Process etc.) and other political frameworks such as the League of Arab States. Along with that, further synergies should be developed among regional networks of stakeholders.

2. Project Management Competencies in the sustainable development projects

Sustainable development projects require specific project management (PM) competencies. According to the International Competence Baseline – ICB (IPMA 2006) of the International Project Management Association – IPMA, the project management competencies can be grouped in three components and three categories as depicted in Figure no. 2.

The PM competences *components* are:

- *Knowledge*. The knowledge in generally accepted practices of project management applied to specific technical disciplines.
- *Skills*. The capability to apply knowledge in an efficient, effective, professional, and successful manner.
- *Personal Attitude*. The commitment to perform in an appropriate and acceptable professional and ethical manner.
- *Experience*. The knowledge or skill that is gain from doing an activity.

Technical	Behavioral	Contextual
Personal Attitudes		
Skills		
Experience		
Knowledge		

Figure no. 2: The Project Management Competencies

The PM competence *categories* are:

- *Technical competencies* of delivering projects in a structured way, including the project management process.

- *Contextual competencies* in managing relations with projects within organisations, programmes and portfolios, based on the knowledge of project characteristics, projects in the organizational context and project environment.
- *Behavioural competencies* for a positive, collective, and dynamic thrust in nurturing project management professionalism such as leadership, communication, results-orientation, ethics, negotiation and so forth.

IPMA chose to define four levels of competence (IPMA 2006)

- *IPMA Level A*; At this level, the individual has to have demonstrated successful use of the competence elements in the coordination of programmes and/or portfolios; guided programme and/or project managers in their development and in the use of the competence elements; been involved in implementing the competence elements or relevant methodology, techniques or tools in projects or programmes; and contributed to the development of the project manager's profession by publishing articles or presenting papers on his experiences or by outlining new concepts.
- *IPMA Level B*; At this level, the individual has to have demonstrated successful use of the competence elements in complex project situations. He/She has also guide (sub) project managers in their application and implementation of the competence.
- *IPMA Level C*; At this level, the individual has to have demonstrated successful use of the competence element in project situations with limited complexity. He/she might need to be guided in the further development of the competence element.
- *IPMA Level D*; At this level, only knowledge related to the competence element is assessed by written examination.

The levels provide a suitable framework for developing career paths and organizational maturity models as well as for personnel development programmes of individuals, companies and other organizations.

The project personnel should continuously improve their project management competencies to meet the growth in demands and competition. Each project has its own specific needs which include the necessary competency needs of the project. Any gap between required and available competencies (in both internal and external resources) is a risk factor for the project's success.

Although no direct relationship exists, the education and training institutions probably want to improve the chance of their scholars, students or course participants achieving a certain certificate, for example:

- The project management programme of an advanced professional school or a training course aspires to prepare its students to develop their project management competences at level D.

- A project management master programme or postgraduate course wants to ensure that its candidates develop their project management competences at Level C (or B).

3. Project management competences related to the commercial activities in projects

There are several elements of competence related to the commercial activities in projects. According to the ICB, the technical competence element named “1.14 Procurement & contract” covers the main commercial activities.

Procurement involves obtaining the best value for money from suppliers of goods or services to the project (IPMA 2006). There is a need to formalize the work performed by the suppliers and involved organizations, clearly defining what is expected from them, the control to be exerted by the receiving organization and the obligations of each party. Procurement is usually carried out by a purchase and supply team, which can be part of the project or programme and will be part of the permanent organization. The purchase and supply team will have its own strategy and business processes. They will identify with the project or programme manager potential suppliers, seek quotations, put bids out to tender, select a supplier, negotiate long-term agreements with favoured suppliers and minimize inventory via ‘just in time’ delivery. Where the organization is a public entity, they would need to ensure that they conform to any legislation covering the tender process. Where problems arise, they would be expected to negotiate a resolution with the relevant suppliers.

A *contract* is a legally binding agreement between two or several parties to perform work or supply goods and services under specified conditions. A contract may be in the form of a verbal agreement, or exist as a document signed by the parties involved. Financial penalty clauses for not conforming to the terms of the contract are usually included. In large projects, main contractors may be appointed who would sub-contract parts of the work to others. The burden would be on the main contractor to ensure that any sub-contractors conform to the terms of the overall contract. The purpose of contract management is to control the process of formalizing a contract and, once agreed, managing the contract during the project life-cycle. The legal department of the permanent organization would normally be involved in drawing up and formalizing the contract with the various parties involved and in any action resulting from default by a customer or supplier. A competent contract manager will be intimately acquainted with the terms of the contract, but will use judgment on whether to invoke penalty clauses should the customer or a supplier default in some way. He has to consider the circumstances under which the default has occurred and the relationship he has with the customer or supplier (long term strategic partnership versus one-off contract).

The key competences of the project manager in relationship to the competence element “1.14 Procurement & contract” are the following (IPMA 2006):

- He/She has successfully directed the management of the procurement and contracts for important programmes and/or portfolios of an organization or an organizational unit (for Level A certification);
- He/She has successfully managed the procurement and contract situations of a complex project. (for Level B certification);

- He/She has successfully managed the procurement and contract situations of a project with limited complexity (for Level C certification);
- He/She has the knowledge required concerning the management of project procurement and contracts and can apply it (for Level D certification).

We can also consider the contextual and behavioural elements of competence as being in relationship with the commercial activities in projects.

4. Modelling project management competencies using an ontological approach

Ontology is a shared formal specification of a domain (Gruber 1992). It defines and specifies the different domain concepts and the properties (relationships) of the concepts (Maedche, Motik and Stojanovic, 2003). The benefit of developing ontology is that it is machine-processable and can be directly used to make applications more aware of the domain semantics (Schmidt 2005), (Schmidt 2004). Different software applications can use ontology to perform different tasks, including those involving reasoning based on the different relationships between concepts.

The ontology-based competency modelling approach (Sicilia 2006), (Draganidis, Chamopoulou and Mentzas, 2006), (Ley 2006) (Lindgren, Stenmark and Ljungberg, 2003) improves the definition of the desirable competence profile which assures the performance demonstrated by employees on concrete situations at work. Ontology gives a better definition of the types of relations and hierarchies among competencies. It extends the measure scales to be used by the competence assessment process (Schmidt 2004).

A number of data schemas were defined to describe competences. The competency format specified by the HrXML consortium (HrXML 2003) is very well known and has an important relevance for practical applications. In the HrXML standard, the competencies are defined through XML code.

The IMS consortium (IMS 2003) also provides a specification for competencies called "Reusable Definition of Competency or Educational Objective (RDCEO)". RDCEO and HrXML provide similar capabilities.

Ontology provides an extended set of modelling elements for defining in competency schemas different kinds of competency, different relationships, several measurement scales. Ontology description languages can be used to represent both the concepts but also the instances (i.e., the concrete taxonomies) In addition, the diverse concepts that surround the notion of competency can be modelled through logical, precise definitions, ready to be used in intelligent applications (Schmidt 2005)

The competence ontology named *PMCatalog* was developed by the authors in the framework of the project CONTO, financed by Romanian through the grant 91-037/2007. The ontology was developed using Protégé editor (Protégé 2008). *PM Catalog* ontology has one metaclass, *MyMetaClass* and 15 classes, as shown in figure no. 3.

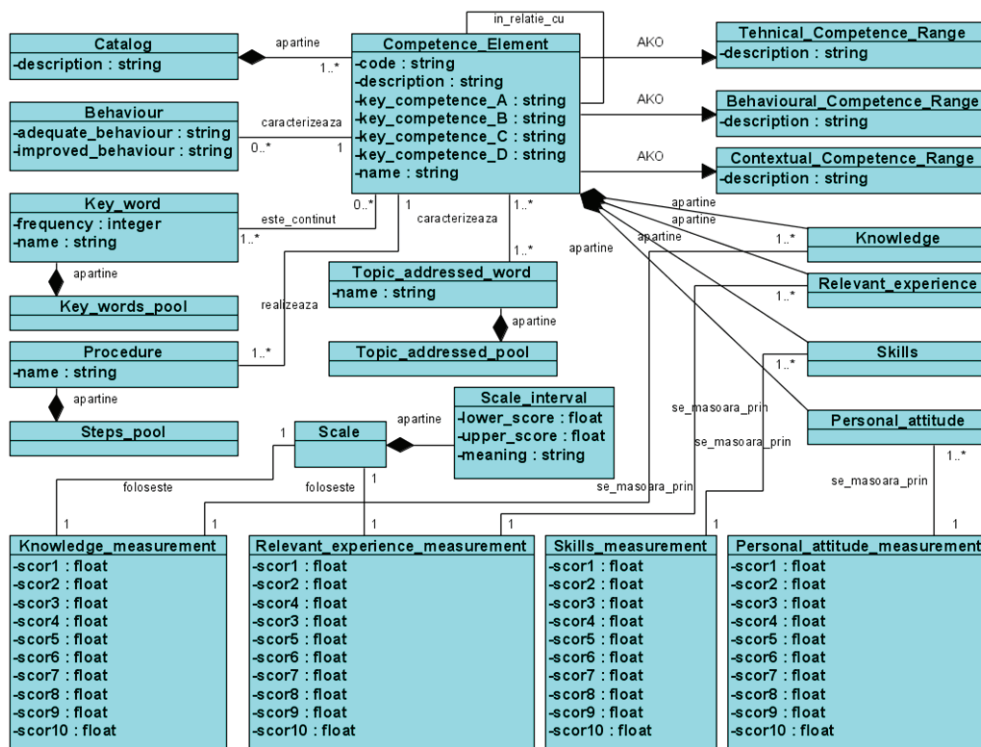
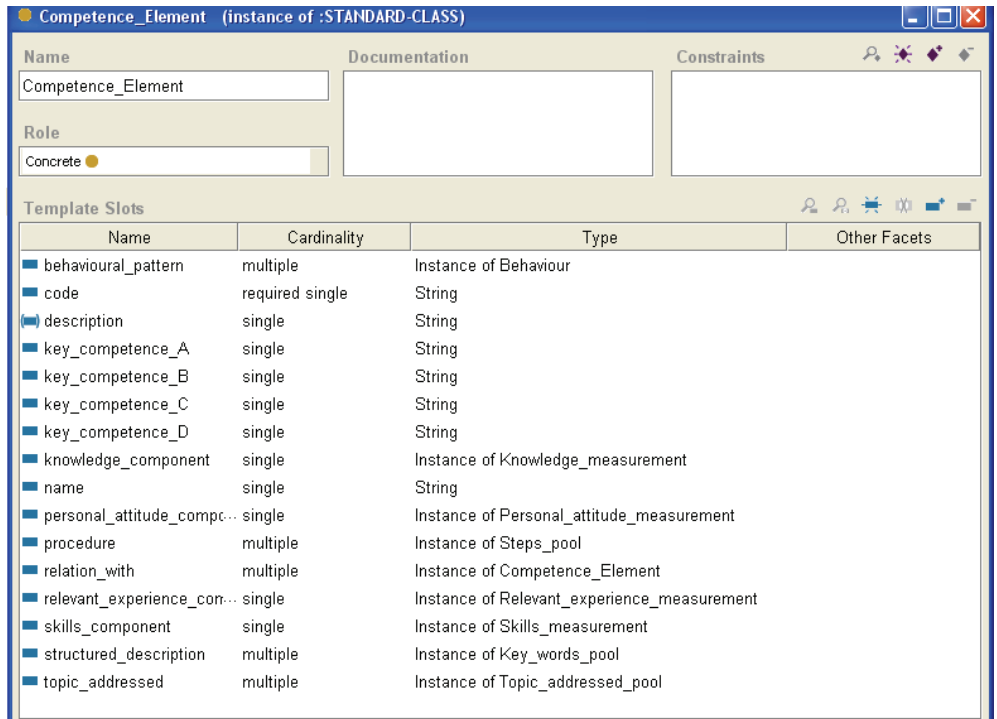
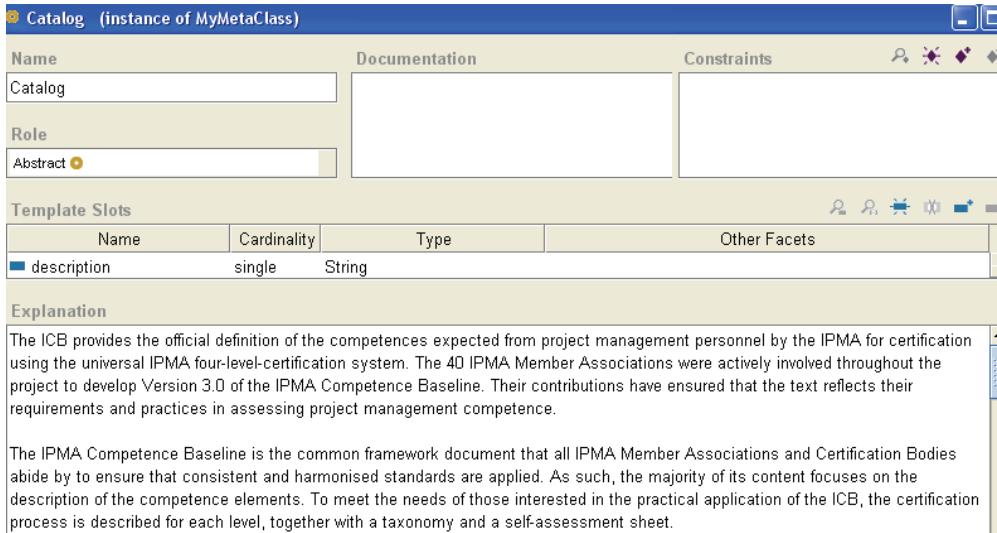


Figure no. 3: Class Diagram

Four classes of *PMCatalog*, respectively: *Catalog*, *Technical Competence Range*, *Behavioural Competence Range* and *Contextual Competence Range* are abstract classes, and the other 11 are concrete classes. The class *Catalog*, presented in figure no. 4 has three abstract sub-classes, named: *Technical Competence Range*, *Behavioural Competence Range* and *Contextual Competence Range*. Each of these subclasses has a concrete sub-class, named *Competence Element*. The *Competence Element* class, presented in the figure no. 5, has 46 instances, corresponding to the 46 elements of competence of the International Competence Baseline. This class has the following 16 attributes:

- *code*, *description*, *key_competence_element_A*, *key_competence_element_B*, *key_competence_element_C*, *key_competence_element_D* and *name* (as string attributes)
- *behavioural_pattern*, *knowledge_component*, *personal_attitude_component*, *procedure*, *relation_with*, *relevant_experience_component*, *skills_component*, *structured_description* and *topic_addressed* (as instance attributes)



Behaviour class, presented in the figure no. 6, includes the set of behavioural patterns related to the behavioural elements of competence. The class attributes are the following:

- adequate_behaviour;
- improved_behaviour.

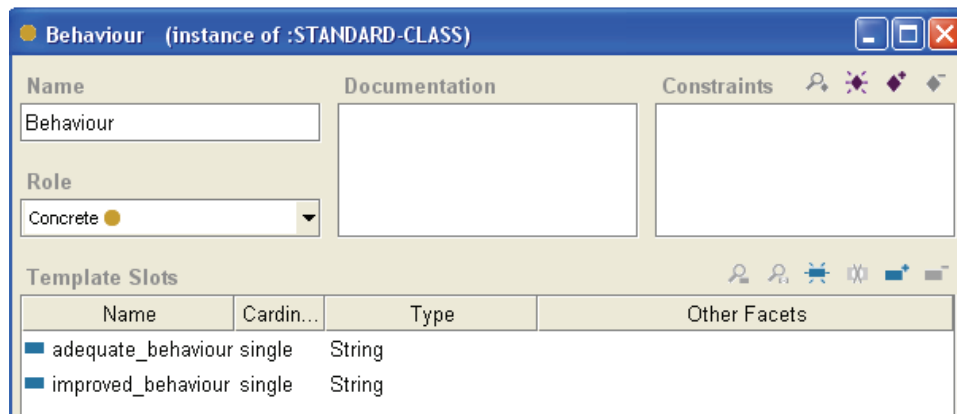


Figure no. 6: Behaviour class

For each competence element, the knowledge and the experience are assessed, using a scale where values from 0 (no competence) through 10 (absolute maximum) are used. Knowledge does not mean just correctly reproducing facts, but also understanding relationships, knowing how to apply project management in practical situations and interpreting methods. The individual has the required level of knowledge that is normally provided by answering questions. The project manager doesn't gain much experience from doing the same type of project for many years. He should apply the knowledge in real and different situations (e.g. projects of different sizes, different kinds of projects, different organizations, branches of the organization and/or cultures).

The assessment of the project management competence elements requires a mix of methods (Bodea and Dascalu 2009a), (Bodea and Dascalu 2009b). Project management knowledge and experience can be assessed from training portfolio, written exam, the 360-degree feedback or the workshop, the project report, the references and the interview itself. The effectiveness of the assessment can benefit from the so called STAR-method (Situation, Task, Activity and Result).

The main assessment components are:

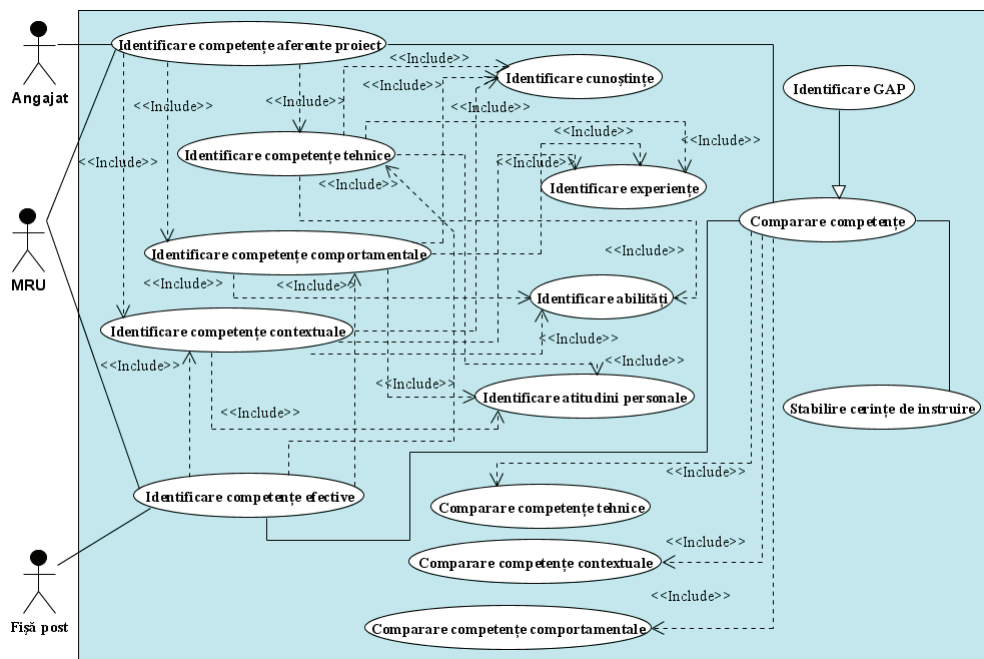
- *Written exam*: Several types of questions (multiple choice questions, direct text questions, open essays, intellectual tasks) with reference to the ICB, to be answered by the individual in a limited period of time.

- *Report*: Covering the subjects that describe the management of a real project, programme or portfolio (depending on the IPMA Level), with reference to the ICB, on an appropriate number of pages.
- *Workshop*: Problem solving as part of a small team on an example project, observed by one or several assessors, revealing the actions of the individuals in different roles, especially the role of the (sub-) project manager.
- *Interview*: Answers to specific, representative questions prepared on the basis of the candidate's report (can be extended to the self-assessment, written exam questions, workshop results, replies from referees) with reference to the ICB.

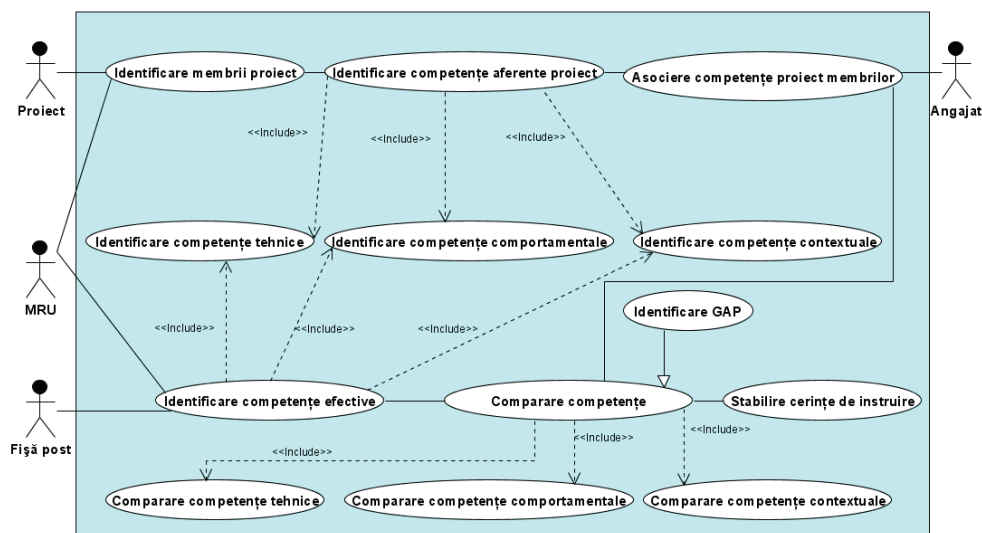
5. The main use cases of the ontology for commercial activities

The following three main use cases are considered for commercial-related jobs:

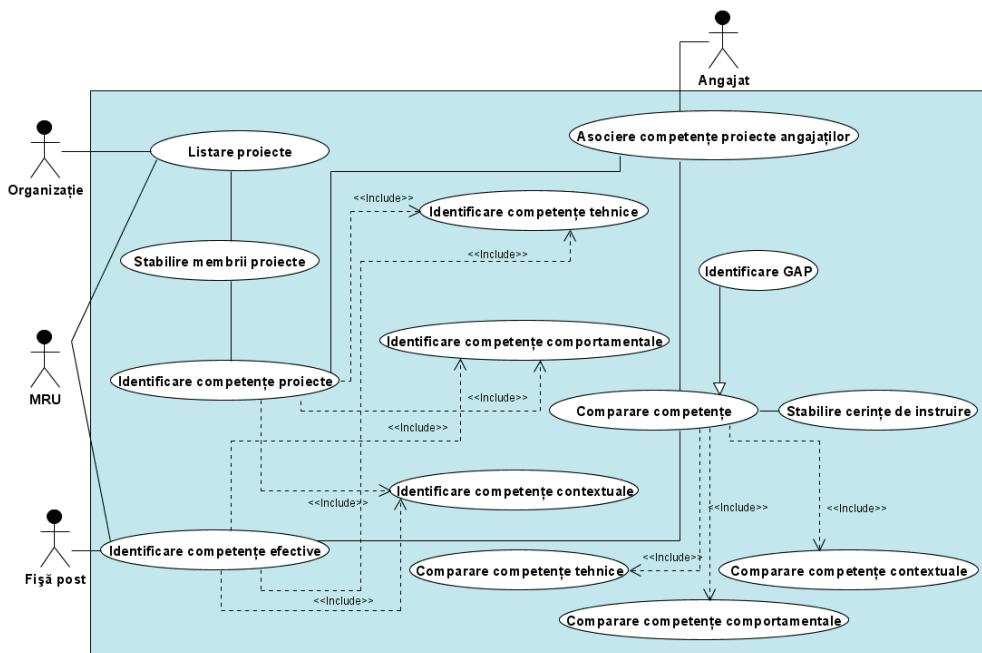
- competency gap analysis at individual level (figure no. 7a)
- competency gap analysis at project level, for all project team members (figure no. 7b)
- competency gap analysis at organizational level, for all commercial-related jobs in the organization (figure no. 7c)



a)



b)



c)

Figure no. 7: Use Cases for the commercial activities

The competency gap analysis represents the process of comparing the requirements profile with the current competency profile, yielding missing competencies. The result is the degree of how well a person fits to requirements. After that, the identification of suitable learning requirements can be made (Bodea 2009).

Conclusions

The ontology-based competency modelling approach improves the definition of the desirable competence profile which assures the performance demonstrated by employees on concrete situations at work. Ontology gives a better definition of the types of relations and hierarchies among competencies. It extends the measure scales to be used by the competence assessment process. Ontology provides an extended set of modelling elements for defining in competency schemas different kinds of competency, different relationships, several measurement scales. Ontology description languages can be used to represent both the concepts but also the instances (i.e., the concrete taxonomies). In addition, the diverse concepts that surround the notion of competency can be modelled through logical, precise definitions, ready to be used in intelligent applications.

The paper presents the competence ontology, named *PMCatalog* which is intended to be used for the competency gap analysis at individual, project and organizational level for commercial-related jobs in the organizations delivering complex projects such as sustainable development projects. The future work will be done in order to integrate the *PMCatalog* into an ERP system and to develop the inferential part of the ontology.

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