

e-Cat – VBE Members Profiling and Competency Management Tool

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Abstract

The e-Cat is a research prototype of a tool for maintenance of members' profiles and competencies in a Virtual Organisation Breeding Environment. The system combines peer-to-peer approach and centralized architecture. Distribution enables members to maintain their profiles locally and to work in the off-line mode when needed. Centralized components of the system ensure coherence in the common schema of competency and support common understanding. They also prevent anonymous users from advertising incorrect data via the catalogue and allow full control over members entering or leaving the community.

Keywords: Virtual organization breeding environment, virtual organization, competency management

1. Introduction

The clustering and integration of Small and Medium Enterprises (SME) is a natural evolution that reflects acceleration and increasing complexity of the business opportunities [1]. Most of the forms of virtual integration created for improving cooperation among independent entities [2] are covered by Collaborative Network Organizations (CNO). To work effectively, CNO needs to be supported with appropriate technologies that would provide effective partners searching, social knowledge management, negotiation support and other tasks. The existing support tools (based on web portals, emails, databases, etc.) work well, however, they work separately without any possibility to ensure consistent view of CNO.

In the area of CNO, terminology is not unified. Terminology used in this work is based on the research done by Camarinha-Matos and Afsarmanesh e.g. in [3]. Their research is oriented toward Virtual Organizations

(VO) and Virtual Organization Breeding Environments (VBE). VO introduces a temporary coalition of organisations, which utilizes pre-prepared and pre-negotiated general parts of the contract. VBE introduces a pool (alliance) of entities that is established in order to facilitate exploitation of possible and profitable collaborations by means of VOs creation and management. Operation of VBE and its institution is financed by membership fees. One of the missions of VBE is to facilitate sharing information of its members' profiles and competencies.

This work introduces e-Cat – a VBE members profiling and competency management system.

2. Theoretical Framework

This part briefly summarizes competency management terminology used in this work since the most important terms like *competency* and *profile* are

used in various publications with a slightly different meaning. We have also found useful to strictly differentiate between *competency class* and *competency instance*. For the purpose of e-Cat the following definition is used:

Competency is an ability to perform business processes, which is supported by necessary available resources, practices and activities, allowing the organization to offer products/services.

Competency class defines existence of the competency in the world, and tries to define it and distinguish it from other existing competencies. Competency class can also define means that can be used to measure the level and robustness of the competency. According to HR-XML [4] schema, the specifying attribute of competencies is called Competency Evidence (HR-XML is focused on human resources management but it is also easily applicable to other CNO domains). Competency Evidence approach is used to describe features of a competency class (e.g. capacity, resources and others).

Competency class does not relate to any particular subject (person or company) and its Competency Evidences are not bound to any particular values. If the class is not specific enough, it can be divided into subclasses – specializing classes. Thus, every competency class can have its generalizing and specializing class(es).

Taxonomy structure is used to organize larger sets of competency classes and to comprehend the relations among competencies. Different sets of competency classes may use different description systems for the same competency.

Competency instance always refers exactly to one competency class and to one subject (company, person, VBE, etc). If the competency class defines Competency Evidences, the competency instance can optionally assign values to them.

One competency class can be instantiated multiple times by different subjects. Instances usually vary in values of Competency Evidences. In the e-Cat system, each subject instantiates as many competency classes as many competencies they offer, and each subject can instantiate any of the competency classes only once.

In this work we also use **partner's profile**, which is based on two main blocks: (i) general information about the partner, and (ii) a set of instantiated competencies derived from the competency classes.

3. e-Cat Design

A VBE is a naturally distributed environment of independent SMEs having their own business goals and private knowledge that is not intended to be shared. Presented technology takes this constraint into account and therefore it is based on distributed elements organized in peer-to-peer network. On the other hand, the power of VBE is the support of its members in VO creation process by various centralized components provided by VBE supporting institutions. So the e-Cat system utilizes naturally centralized elements too. Such a solution enables effective cooperation in a distributed environment as well as support provided by VBE.

VBE members profiling and competency management tool should provide three main services:

- Management of VBE members' profiles
- Management of competency classes
- Management of access rights to the information provided within VBE.

In e-Cat, these services are provided by specialized components. According to the requirements of the system, e-Cat consists of distributed as well as centralized components. Distributed elements ensure maximal independence of VBE members and facilitate storing sensitive information on their local servers. Local copy of data allows each member to use the system, even if it is totally disconnected from the rest of the world. On the other hand, a “master copy” of published data is managed by each member so it is fully controlled by them. Centralized elements ensure common understanding of competencies in the whole VBE and maintaining identifying information about VBE members. They can also restrict the access to the community only to authorized members. All centrally maintained data should be supervised only by the responsible expert. Each authorized distributed element creates a local copy of the centrally maintained data, so even if central element is temporary inaccessible, the system works.

The e-Cat consists of following subsystems (each part is discussed in detail later):

- **Distributed Profile Catalogue**, which keeps, manages and distributes profiles of VBE members. Because of the distribution the members can maintain their profiles individually. Each member of VBE has a read-write access to its profile and a read-only access to other members' profiles.

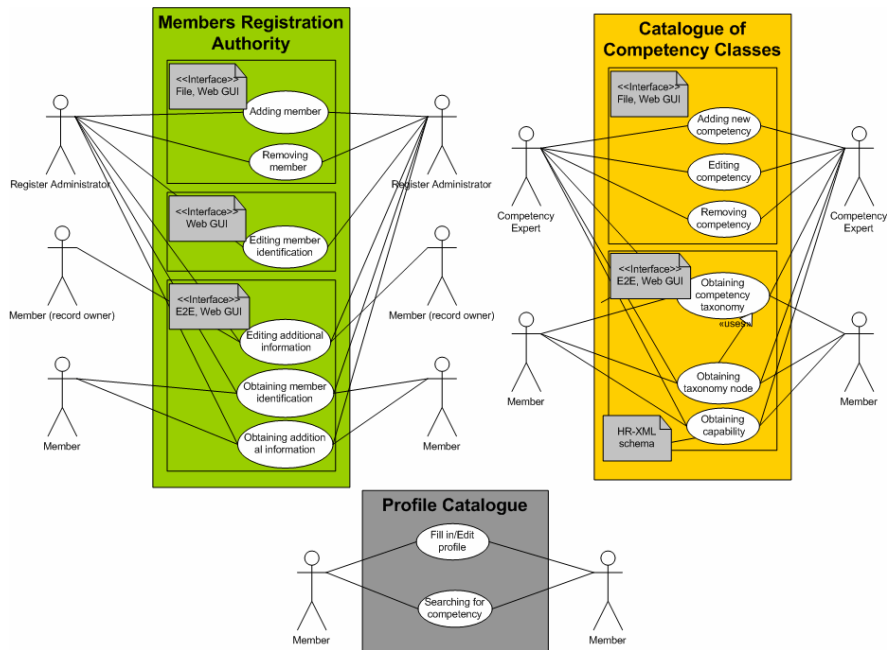


Fig. 1. Use cases of main components of e-Cat system

- **Catalogue of Competency Classes**, which defines the competencies available in the VBE and their exact description, taxonomy and attributes. It ensures coherence in the common schema of competency.
- **Members Registration Authority**, which allows full control over members entering community, and maintains data for identification of partners.

Members Registration Authority and Catalogue of Competency Classes are intended to be deployed on VBE management servers maintained by VBE support institutions. The Profile Catalogue can be distributed and in such case it is deployed on each member's server. Users can share servers (does not matter, where the physical equipment is located) to install their parts of Profile Catalogue. The VBE management server can also contain specialized part of Profile Catalogue with web interface to summarize data from all members and represent the profile of VBE as a whole.

As an extreme case, the distributed part of the catalogue may be omitted and the whole system can be deployed on one server.

The Fig. 1 presents the use cases of e-Cat system. The Fig. 3b presents the e-Cat architecture.

3.1. Members Registration Authority

The Members Registration Authority enables members to join the community. It also maintains the basic information about them. This part is designed to be centralized to allow the VBE management to control the members entering the community. The authority also maintains the contact and identification information, which is used to authorize each VBE member. Therefore it prevents anonymous users from advertising data via the catalogue and anybody from pretending to act as an existing VBE member.

Each member's record contains information to be used by a human user and by the e-Cat system. The record is divided into two parts: (i) Exact identification of a member. Identification consists of the name of the company, the postal address and the e-Cat contact information. It can be edited only by the VBE management. (ii) Additional contact information (phone and FAX numbers, addresses of web-sites and e-mails) that can be edited by each user.

3.2. Catalogue of Competency Classes

This catalogue contains competency classes and the relations among them. It is hierarchically organized in tree-like structures to enable defining generalizations and specializations of individual competencies. The

catalogue defines the schema that is used by all VBE members. It is centralized in order to ensure existence of one common schema in VBE and to support common understanding of this schema. This also facilitates management of commonly understandable member's profiles within the whole VBE community.

The catalogue is edited by a “competency expert” of the VBE, who is responsible for clear definition of classes. The competency expert can create, edit and remove any competency class and also search and navigate through the database of competency classes. VBE members can download whole database of classes, search and navigate through it, and instantiate competency classes in their profiles.

The competency expert is also responsible for contacting the members who have instantiated a class before modification. Competency expert has to ask them to actualize the competency instance because only the competencies and their details defined in the actual version of the catalogue can be searched. This may cause a profiles consistency problem. The valid version of competency class is the actual one presented in the catalogue.

The initial set of competency classes and taxonomy is supposed to exist in the beginning of VBE operation phase. During the VBE creation phase, Catalogue of Competency Classes includes this pre-defined catalogue. Data can be consequently modified during operation phase of VBE without any limitations. The initial set of competency classes is given by VBE members, or adopted from any reputable source.

3.3. Profile Catalogue

The main task of profiles management system is to keep, manage and distribute profiles of VBE members. This system is designed as distributed to allow the members to maintain their profiles individually – this is a very important feature because of the requirements for information privacy.

Each component of Competency Profile represents one VBE member and manages a master copy of its profile. It also communicates with Members Registration Authority in order to keep social knowledge (identification and communication details of other VBE members) up to date and with Catalogue of Competency Classes to keep the actual competency database. Whenever the local profile is updated, it is distributed to all known VBE members. If some information (member database, competency database, profile of some member) is expected to be out of date,

the particular partner is queried for the data.

When working with its own profile, the VBE member can add (instantiate), edit and remove a competency in its profile using an existing competency class. This operation may contain several steps, depending on competency description model used. When working with profiles of other VBE members, a VBE member can search and navigate through the other members' profiles. Each member can make local backup copy of remotely stored data and thus outlast a period of their inaccessibility. In the case of competency class modification, the member is informed by a competency expert. Member is responsible for updating the profile as soon as possible. It can happen that some other partner performs a search between the competency modification and the profile updating. In this case, consistency is not assured and searching mechanism may provide incorrect results.

Distribution is a native feature of Profile Catalogue but sometimes it is not applied: (i) Components of Profile Catalogue are mainly deployed on servers of VBE members; one or more agents can also be installed on one server, maintained e.g. by VBE management. When necessary, multiple components of Profile Catalogue can be installed on one server, sharing the same user interface. (ii) Some members want to use the e-Cat for searching for partners but they are not able or they do not want to maintain the master copy of their profile. In such case an external expert hired by the member or provided by the VBE management maintains their profiles.

4. Technology Used

The e-Cat system is a distributed system that uses multi-agent technology as the ICT. Multi-agent technology is not only a distributed technology that could support this research prototype; it was chosen because of existing suitable components and easy implementation of the whole system.

Multi-agent part of the system is implemented using JADE multi-agent platform [5, 6]. Each component of the e-Cat system (Catalogue of Competency Classes, Members Registration Authority and Profile Catalogue) consists of agents specialized to perform various services (Web GUI, communication with other e-Cat components, etc.). For communication among agents within one e-Cat component, JADE native intra-platform messaging technology is used. For communication among e-Cat components (centralized

The screenshot shows a web browser window titled 'Register - Micolla' with the URL 'http://ecat.cerion.com/register/Control?factor=members-000'. The page header includes the 'e-Cat' logo and 'Member Registration Authority'. The main content area is titled 'Edit entry of partner: Dirk Gently' and 'Partner Nr. 0002'. On the left, there is a 'Member Register' sidebar with options like 'Distribute Update', 'Add New Member', and 'Logout', along with a list of members including 'Dirk Gently'. The main form contains the following fields:

- Name: Dirk Gently
- Address: Marvinstrasse 42
- City: Bremen
- ZIP: 28359
- Country: Germany
- State: [empty]
- Phone: +49-421-100-1111, +49-421-100-1121, +49-421-100-1125 (with 'Add' buttons)
- Fax: +49-421-100-1122 (with 'Add' button)
- EMail: genty@dirk-gently.de, info@dirk-gently.de (with 'Add' buttons)
- Web: http://www.dirk-gently.de (with 'Add' button)
- General description of the organization: [empty]
- Annual turnover: [empty]
- Established in: [empty]
- E2E name: dirk-gently-Agent@ECat
- E2E address: [empty] (with 'Add' button)

At the bottom of the form are 'Save' and 'Delete' buttons, and a 'Remove selected' button.

Fig. 2. Expert's interface of Members Registration Authority to create and update profile of VBE member

servers and distributed parts of Profile Catalogue), HTTP protocol based inter-platform messaging is used. This interaction is performed using standard FIPA protocols [7]. XML format is used as the Message Content Language.

For all user interfaces the web-based thin clients are employed. This technology allows the end users to use the system without installing any special software on their computers.

The e-Cat is based on E2E technology that was developed for projects ExPlanTech [8] and ExtraPlanT [9] as a core technology for supporting extra enterprise cooperation. The server side applications of the web interfaces are based on EEAgents also developed within the ExtraPlanT. To implement the server side of the application, Apache Jakarta Tomcat Servlet Container [10] has been used. The application combines Servlet and JSP (JavaServer Pages) [11] technology.

5. Scenarios

5.1. Joining the e-Cat community and creating a new profile

New member of VBE installs Profile Catalogue Component of e-Cat on a server. Following configuration includes adding addresses of Members Registration Authority and Catalogue of Competency Classes, which are provided to the company during the

process of joining the VBE.

Then an expert of the Members Registration Authority creates a new record in the register including basic member's contact information, and the name and the address of the new e-Cat member. After this procedure the other members are notified that a new partner has joined the community. The expert's interface of Members Registration Authority for creating, updating and viewing profiles of VBE members is presented on the Fig. 2.

If the new member decides to offer some services to other VBE members, the competency class for such services must be found in Catalogue of Competency Classes. If the proper class does not exist in the catalogue, it can be added in cooperation with catalogue expert management, or the generalizing competency is used.

Selected competency classes are instantiated in the profile and the user may assign values to their competency evidences in order to quantify and qualify them. When they are set, the profile is automatically distributed to all known VBE members.

5.2. Looking for provider of competency

The search engine of e-Cat offers various attributes for finding potential partners. Local copy of profiles of other members is searched for the competency. If the local copy of profiles is lost or outdated, partners are asked for data dynamically (if obsolescence of data is not recognized and thus update is not done, only an intersection of former and actual versions is utilized). If the search result is unsatisfactory, user can decide to use taxonomy to find generalizing or specializing competency and search profiles for them. Sequence diagram of data exchanges showing one member (represented by E2E agent responsible for negotiation within e-Cat system) searching for a competency is presented on Fig. 3b.

6. Conclusion

The e-Cat system is a research prototype of VBE partners profiling and competency management tool. It combines peer-to-peer approach with centralized architecture.

The e-Cat consists of three main parts. The first one is the Members Registration Authority, which is the gate to the VBE community. It maintains static information about all the VBE members. The second

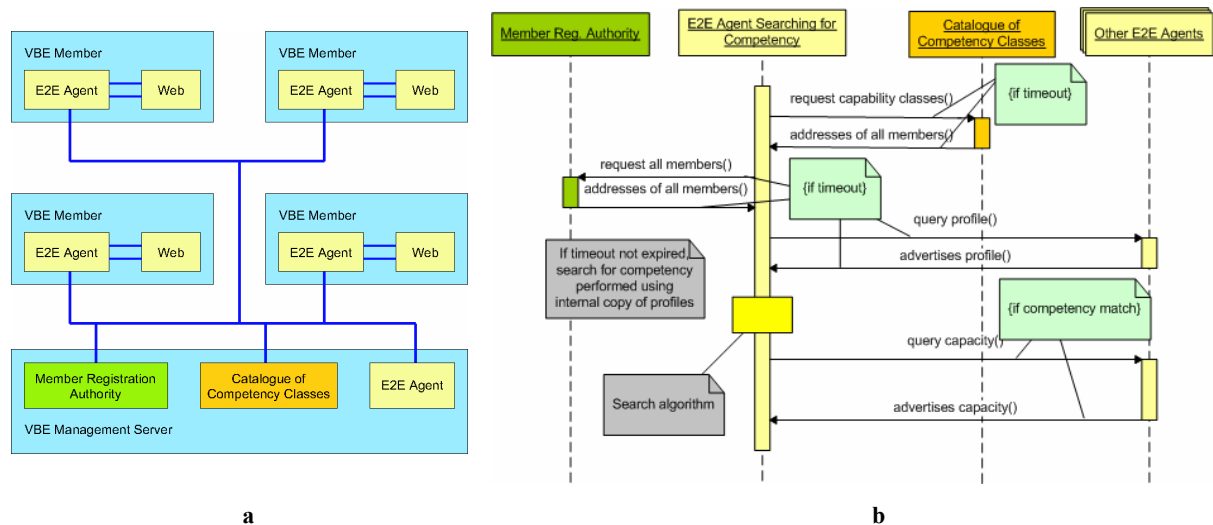


Fig. 3. a) e-Cat architecture diagram; b) Sequence diagram of high-level data exchange performed, when one member (represented by E2E agent) searches for a given competency

one is the Catalogue of Competency Classes, which ensures common understanding of competencies in the whole VBE. The third part is the Profiles Catalogue, the task of which is the maintenance of profiles of the individual VBE members. This component is distributed in order to enable VBE members to maintain their profiles locally and to work in the off-line mode when needed.

The e-Cat is developed as a members profiling and competency management tool for one VBE only. If the Catalogue of Competency Classes is shared among multiple VBES then the instances of competency classes are ensured to be correctly visible and understandable across the VBES sharing this catalogue. The Members Registration Authority is always unique for each VBE.

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