

eCEM: AN ELECTRONIC COMPETENCE AND EXPERIENCE MARKETPLACE

Yelena Jussupova

University of Lausanne / HEC, Switzerland
yelena.jussupova@hec.unil.ch

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Electronic Competence and Experience Marketplace (eCEM) framework allows for and assists in intangible capital representation and transfer.

We propose a framework that includes eCEM Competence Score Card (CSC) and eCEM Dynamic Competence Score Card (Dynamic CSC). eCEM CSC is a tool which monitors business strategy objectives. eCEM Dynamic CSC is a form of enterprise memory that also allows carrying out feasibility studies ("what-if scenario" functionalities).

eCEM Competence and Enterprise Experience Navigator is a part of Dynamic CSC. This Competence and Enterprise Experience Navigator makes use of a conceptual case retrieval net algorithm. This conceptual case retrieval net algorithm is the author's original work and the subject of her doctoral thesis.

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Yelena JUSSUPOVA ,

University of Lausanne / HEC,
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Suggested track: Knowledge and Information technology (J)

1 Introduction

In this article we discuss a framework for Electronic Competence and Experience Marketplace (eCEM).

The term "Marketplace" in eCEM is due to the idea of Knowledge and Experience sharing. At the same time, this Knowledge and Experience sharing framework should implement a filter like functionalities. That is in order to provide a user with *core* or *strategic* knowledge and experience, as far as they bring value or provide a competitive advantage.

These considerations lead us to a conclusion that, a certain approach and an information management tool, which guides an enterprise in its *intellectual capital* acquisition and its pertinent exploitation, is needed.

In this work, we argue, that the enterprise gets the most out of its intellectual capital if and only if, this enterprise puts into practice the initiative of the *business competence management*.

Indeed, the competitive strategy requires the effective enterprise competence management within a company. "The real sources of advantage are to be found in management's ability to consolidate corporate wide technologies and production skills into competences that empower individual businesses to adapt quickly to changing opportunities" (Prahalad and Hamel, 1990).

We propose eCEM framework as a possible solution for coping with the challenge of intangible resource management.

Essentially, eCEM helps to design an intelligent virtual workplace for a manager.

This virtual workplace is founded on the identified enterprise intellectual capital. In our work, we assume that the enterprise intellectual capital is tightly connected with the enterprise competences.

At the same time, eCEM facilitates the identification of emerging enterprise competences and retention of core competences.

2 Towards a corporate memory of enterprise intangible assets

The idea of intangible asset assessment was brought by James C. Bonbright.

"The identification, valuation, and remaining useful life analysis of intangible assets was covered in *The Valuation of property*, by James C. Bonbright, first published in 1937" (Reilly and Schweih, 1998).

Many authors have contributed to the evolution of the theory of Intangible Asset appraisal. To name a few: Baruch Lev, Robert F. Reilly and Robert P. Schweins, Ikujiro Nonaka and Georg Von Krogh, and many others.

At the same time, the information age has introduced families of "intelligent" information systems: expert systems, neuron network based systems, genetic algorithm based system, data mining systems, etc.

A concept called "*corporate memory*", which is the subject of this article, has roots in the family of knowledge based information systems.

Notable the project called "COMMA: Corporate Memory Management through Agents". This work has been done by INRIA (Institut National De Recherche en Informatique et en Automatique) Sophia Antipolis research unit, in France.

2.1 Approaches for intangible asset evaluation

Let us discuss several approaches of the identification and valuation of intangible assets.

We begin with the Intangible asset theory and field studies by Baruch Lev. In his methodology B.Lev uses an economic concept of a "production function" to measure the value of intangible assets. The main idea is that the firm's economic performance is generated by the three major classes of inputs: *physical*, *financial*, and *knowledge assets*. There are some other important points that help to understand the nature of intangible assets (Gu F. and Lev B., 2001):

- One searches for measures of intangibles value in order to provide new information to managers and investors;
- A key ingredient in Lev's approach is the definition of an enterprise economic performance as an aggregate of *past* core earnings (earnings excluding unusual and extraordinary items), and *future* earnings, or growth potential;
- Intangible (intellectual) capital is driven by diverse factors: innovation (R&D), information systems, technology acquisition, advertising (brand support),

human capital, organizational processes, customer and supplier relations, to name some major ones. Those are some drivers of intangible capital, and in turn, corporate value;

- It can be expected that substantially improved valuations will be obtained by tailoring the intangibles measures to the specific circumstances of companies, subsidiaries, or stocks.

In his work Lev mentions, an Intangibles Scoreboard, which is a valuation tool for managers and investors concerned with intangible (intellectual) assets, and with the optimal resource allocation of intangible and physical assets.

Next example is the analytical tool developed by Karl Erik Sveiby (Sveiby , 1997). As it's stated on the web site www.sveibytoolkit.com [February, 10, 2004]: "Intangible Assets Monitor is a non-financial measurement system for intangible assets based on the concept of the knowledge organization".

Sveiby's Framework (Intangible Assets Monitor, www.sveiby.com on February, 10, 2004) has three branches in the "invisible" intangible part of the balance sheet:

1. *Individual competence* is people's capacity to act in various situations. It includes skill, education, experience, values and social skills.
2. *Internal structure* consists of a wide range of patents, concepts, models, and computer and administrative systems. These are created by the employees and are thus generally "owned" by the organisation, and adhere to it.
3. *External structure* consists of relationships with customers and suppliers, brand names, trademarks and reputation, or "image".

Obviously, the choice of the indicators for Sveiby's Framework relies on the company strategy.

The practical results of these two methods show that Intangible Asset measures provide valuable information for a manager, i.e. a company performance overview that differs from the view provided by traditional financial indicators.

2.2 Methods to build a Corporate Memory

Coming to the technical implementation of a platform for knowledge and experience sharing, let us look on one of the forerunner solution.

"CoMMA project (Corporate Memory Management through Agents) aims at developing an open, agent-based platform for the management of a corporate memory by using

the most advanced results on the technical, the content, and the user interaction level" (Perez et al ,2002).

The goal of this project is to design and implement a Corporate Memory management framework that facilitates the relevant knowledge retrieval in the corporate information base. The idea is to provide an intelligent search in the Corporate Document Base, where the documents have an XML (EXtensible Markup Language - a form of SGML that allows the user to customize tags to give functionality that is not available in HTML) format and are annotated by meta-information in RDF(Resource Description Framework - a metadata standard). COMMA's multi-agent system should be adaptive to a user and the Corporate Memory context. These functionalities will be provided by machine learning techniques.

3 eCEM: a platform to track the dynamics of enterprise intangible assets

We will now discuss a general approach called eCem (Electronic Competence and Experience Marketplace). Our survey of related works has led us to formulate four desiderata for an intellectual capital marketplace:

- Offer an environment for competences and experience sharing and learning;
- Provide references to enterprise Intangible Resources (IR) (references to the successful and failed IR management cases or to domain "knowledge keepers"; knowledge, competences, and experience references; etc.);
- Facilitate implementation of the enterprise key performance indicator system, as well as the access to the enterprise memory;
- Allow for the carrying out of feasibility studies ("what-if scenario" functionalities): required IR (e.g., the key competences that are fundamental for providing a new service or product) versus enterprise (on hand) IR (e.g., current level of enterprise know-how).

We took the above prerequisites as constraints on our approach to creating eCem.

eCEM has three main modules:

1. Enterprise knowledge and competence representation module (BusCo Ontology);
2. Enterprise strategy representation module (Competence Score Card). This module is a type of Score Card that has an alert system. An alert is activated if the system encounters a lack in required resources (knowledge, experience, etc.);

3. Enterprise knowledge and competence retrieval module:

- Dynamic CSC. This is an extension of the Competence Score Card (CSC). First of all, Dynamic CSC is the tool for computer simulations. For instance, when Dynamic CSC detects an insecure (abnormal or unstable) situation (e.g.; intellectual capital erosion, "fading out" phenomena of one of the information distribution channels) :
 - i. Dynamic CSC analyzes the CSC's alert messages (i.e., it detects the type of problem);
 - ii. then, Dynamic CSC consults the enterprise memory (in our case, the *enterprise memory* is an encyclopaedia of enterprise project descriptions, key "knowledge keepers", successful stories, failures, etc.);
 - iii. finally, Dynamic CSC suggests a list of related references which aim to solve the new case.
- Competence and Enterprise Experience Navigator (CEE Navigator). This inference engine processes and retrieves specific CSC information. In fact, the CEE Navigator provides valuable information that is afterwards used to design the "cause and effect" table of indicator mutual influences. This table of mutual influences is a representation of the rule set that describes the domain of interest. In eCEM we adopt the following formalism as a rule structure:

Rule :

" *Perspective1.indicator2.measure1 -> Perspective2.indicator3* "

Is valid with confidence of x%.

3.1 Competence Score Card

Our assumption is that the enterprise intellectual capital implicitly reflects the enterprise competencies. The purpose of the presented system is to assist in enterprise intangible capital evaluation. eCem's Competence Score Card (CSC), therefore, reports on enterprise competencies. eCem's Competence Score Card, on the other hand, is a key performance indicator (KPI) system. One can consider this Competence Score Card as an enterprise strategy representation (image, "photo") in the domain of knowledge and competence management (Figure 1).

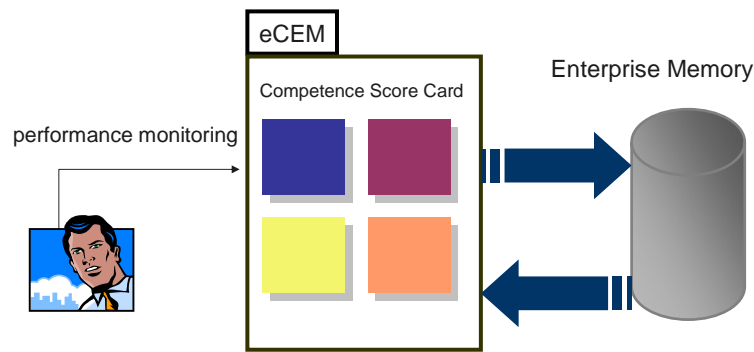


Fig. 1. eCEM's Competence Score Card

Literature surveys, references on intellectual capital research (Bontis et al. 1999; Hall, 1993; Von Krogh et al. 2000), experience and our reflections lead us to propose the following four axes for the Competence Score Card:

1. Know-how;
2. Alliance/Cooperation management;
3. Competence management;
4. Resource management.

The "Know How" axis allows for the monitoring of the internal processes that are *key business processes*. The goal is to focus on the processes that add value to the main products or services, differentiating the company from its competitors. We propose the following indicators for "Know How" perspective:

- Activity efficiency;
- Cost vs. Effectiveness;
- Technology innovation.

The "Alliance /Cooperation management" axis performs a cross-evaluation within an alliance and provides a representation of the *business partners' feedback*. The enterprise will then be able to monitor the performance of the processes that are shared with business partners: success, failure, stagnation. Obviously enough, cooperation problems influence business processes. The indicators for "Alliance /Cooperation management" axis will be:

- Profitability;
- Partner's feedback;

- Market growth progress;
- Alliance bandwidth.

Previous studies have shown the importance of the notion "COMPETENCE". "Competence is an ability (power to do something) to sustain the coordinated deployment of assets in a way that helps a firm to achieve its goals" (Sanchez, 1996). Here are a few examples of core competencies cited in (Prahalad and Hamel, 1990; Sanchez et al, 1996):

1. Flexibility, that is, the ability to configure and reconfigure a bundle of resources according to the demands of a particular project;
2. Constant renewal of the diversity of products and services.

That is why, "Competence management" axis gives a summary of the *enterprise core competencies*. In the following part (see 3.2) we discuss hypotheses and a procedure of a dynamic "inference" of enterprise core competences. The "Competence management" axis should draw the management's attention to:

- Capability
- Availability, which may be gauged by:
 - competence rarity and its added value brought into the business process;
 - degree of complexity to "copy" an enterprise competence (non imitability)
 - degree of complexity to "substitute" an enterprise competence (non substitutability).
- Reliability
- Cost

The "Resource management" axis is an illustration of the enterprise information resources: data, data bases, yellow pages, intranets, news groups, etc. The goal is to evaluate the risk of losing some of these information resources or information distribution channels. The CSC's additional value, probably, is an option (in fact, an indicator) that helps a manager to *evaluate the ratio "cost of information distribution channels vs. contribution to the enterprise profits or benefits"*. The "Resource management" perspective should emphasize the aspects of value and contribution of

these information resources or information distribution channels to the business process:

- Capacity
- Availability
- Functionality
- Cost

In summary, the main functionalities provided by the Competence Score Card are:

1. Representation of the enterprise competence current state (Competence monitoring and Competence balance);
2. Representation of the enterprise strategy for competence development and retention.

3.2 From the Competence score card to an Electronic Competence and Experience Marketplace

The eCEM Dynamic Competence Score Card (DCSC) is a management eKit, which helps detect a gap between the actual and expected (sought or planned) levels of enterprise competences. Dynamic CSC is a form of representation (a structure) of corporate memory. In the case of eCEM framework, this corporate memory is the Case base of the enterprise's intangible asset assessments. In other words, Dynamic Competence Score Card is the case base of the enterprise Competence Score Cards (Figure 2).

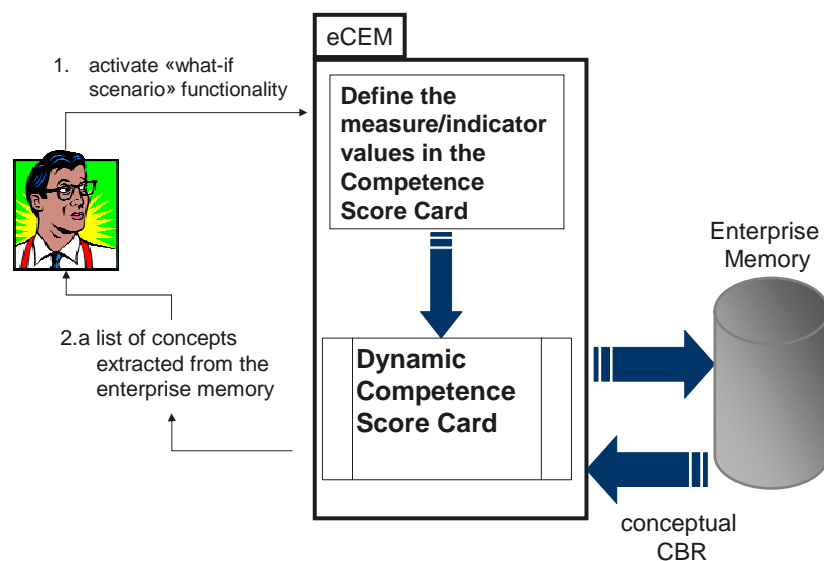


Fig. 2. eCEM's Dynamic Competence Score Card

DCSC's Case base has three elements:

1. a present-day or actual CSC (a *problem* definition);
2. a sought or model CSC (a *result* of simulation, an imitation of a potential situation or representation in experimental testing);
3. a proposed strategy: possible *solution* in the form of
 - i. a list of actions to adopt;
 - ii. general recommendations;
 - iii. references to best practices & pitfalls;
 - iv. key persons, e.g. "knowledge keepers" to contact, etc.

In eCEM's Dynamic Competence Score Card, we had a hard time applying traditional Information Retrieval techniques to the task of enterprise knowledge and enterprise competence retrieval. Traditional Information Retrieval techniques execute a keyword search but "domain specific knowledge can hardly be integrated into such approaches" (Lenz, 1999). Thus, the main possible drawback is that retrieved references could be out of the domain's context.

Therefore, as an information technology paradigm to handle the task of management of this Case Base (Dynamic CSC), we apply Case-Based Reasoning.

Case-Based Reasoning (CBR) is a problem solving paradigm that solves a new problem by remembering a previous similar situation and by reusing information and knowledge of that situation (Aamodt & Plaza, 1994).

In fact, the Dynamic CSC is based on a new approach to information retrieval and concept discovery: *Conceptual Case Retrieval Nets* (CCRN).

In the following chapter we will discuss an inference scheme and a retrieval procedure of the enterprise's intellectual capital core.

4 eCEM implementation

In this part we will present an algorithm that is a backbone of the Dynamic Competence Score Card. We will also discuss the eCEM prototype design.

4.1 Conceptual Case Retrieval Nets

Conceptual Case Retrieval Nets is a Conceptual Case Retrieval algorithm, which is specifically adapted to the process of discovering business patterns and the handling of business rules. *Conceptual Case Retrieval Nets* (CCRN) is a method that classifies

objects on the basis of domain concepts and attribute relationships. Our work has been inspired by earlier research in Conceptual clustering (Michalski et Stepp, 1984) and Case Based Reasoning (Lenz, 1999).

We have modified the traditional Case Retrieval Net algorithm. Our version of Conceptual Case Retrieval algorithm includes two coherent steps:

1. *Rule / Concept mining;*
2. *Case Retrieval.*

We should point out the fact that we have adopted a twofold view. On the one hand, Dynamic Competence Score Card is the logical model of the corporate memory. On the other hand, Conceptual CRN is the physical model (or computer representation) of the corporate memory.

The CCRN algorithm proceeds as follows:

Step 1. Rule / Concept mining

At this stage, the system "discovers" the concepts or rules "hidden" in the case base of Competence Score Cards.

Firstly, CCRN examines this case base in order to find domain concepts: domain axioms, exceptions, "cause and effect" rules and attribute inter-relations, etc.

We propose to adapt the approach of support/confidence measures.

Secondly, CCRN measures the relevance of an attribute (e.g., *Perspective1.indicator2.measure4*) with respect to a found concept/rule.

One of the conventional approaches for Attribute relevance Analysis is calculating entropy and information gain.

Step 2. Case Retrieval

At this stage, the algorithm builds Case Retrieval Nets (CRN). We use this CRN as an instrument to implement the information retrieval module for the enterprise memory.

CRN is a "specific memory model for case retrieval: Instead of building a tree from the case base, a properly structured net might be constructed" (Lenz, 1999). The CRN approach is based on concepts coming from neural networks and associative memory models disciplines. In the CRN, contrary to a neural network, all the nodes and arcs have precise meanings. These "meanings", that form an attribute weight system, illustrate the realities of the corresponding application domain.

Hence, "Given this kind of net, one can apply a spreading activation process in order to retrieve cases being similar to a posed query "(Lenz, 1999).

Going over the main points:

1. Conceptual CRN is a set of Case Retrieval Nets (CRN);
2. Each CRN corresponds to a set of domain concepts (rules, axioms, exceptions, etc);
3. The objective is to define activation and similarity propagation rules in each version of Case Retrieval Nets (CRN).

In eCEM prototype:

1. Conceptual CRN provides with (or uncovers) domain concepts (rules, axioms, exceptions, etc). These concepts "are mined" from the given state of the enterprise memory. In other words, at this stage, *similarity and relevance weights are verified* by background (domain specific) knowledge.
2. The next step is to carry out initial CRN activation, similarity propagation and relevance propagation. At this point, the system retrieves "solution"/"solutions" to the come-forward situation (e.g., values in actual Competence Score Card).

4.2 Case Studies (MyChocolat.com and an NGO)

Let us discuss first an application scenario of eCEM prototype (Figure 3).

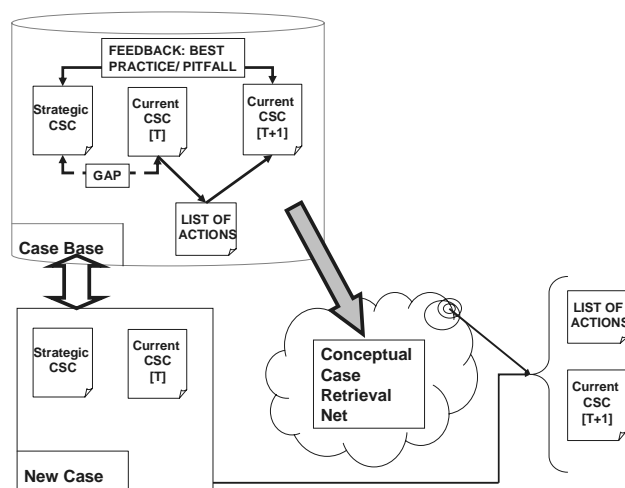


Fig. 3. eCEM prototype

The first step is to set up a system of enterprise Key Performance Indicators (KPI). This implies:

1. Going over strategic goals. A manager decides which (branch of business, activity) brings additional value to a business process and must be monitored.

2. Going over indicators and measures: checking if the information sources are able to provide the system with relevant data. Here a knowledge administrator should cooperate with enterprise management, thus the system of intellectual capital monitoring will be consistent with the enterprise's strategic goals. At this stage, a CSC design group (managers and a knowledge administrator) will sketch a "cause and effect" indicator table, in order to:

- assign importance to each indicator , and
- specify confidence level for each rule that describes influences/linkages between competence Score Card indicators (such a rule we call an "indicator mutual influence").

3. This CSC design group will discuss and propose hypotheses and assumptions about possible initiatives and actions that aim to leverage, correct and improve enterprise performance.

The second step is to adopt the eCEM "shell" for this enterprise. This means:

1. The Knowledge administrator will key in enterprise KPIs and cause-and-effect influence table.

2. The Knowledge administrator will put into service a Case base of enterprise Competence Score Cards containing:

- an actual CSC (a *problem* definition);
- a model CSC (a *result* of simulation or representation in experimental testing);
- a proposed strategy: a possible *solution* in the form of a list of actions to adopt, general recommendations, references to best practices & pitfalls, key persons (e.g. "knowledge keepers" to contact), etc.

Finally, the Enterprise knowledge and competence retrieval module (Dynamic CSC with Competence and Enterprise Experience Navigator as an inference engine) can be launched and used by enterprise management.

Following Dynamic CSC simulation functionalities,

- Dynamic CSC may detect an odd situation (e.g., negative feedback of business partner) when analyzing the CSC's alert messages.
- Dynamic CSC consults the enterprise memory (an enterprise encyclopaedia of enterprise project descriptions, key "knowledge" keepers, successful stories, failures, etc.);
- Eventually, Dynamic CSC suggests a list of related references, which aims to guide in solving the new case.

At the same time, in the background, the Competence and Enterprise Experience Navigator adjusts the "cause-and-effect" table of indicator mutual influences. In fact, as time passes, the enterprise accumulates different versions of CSC. This leads to the need for "cause-and-effect" table updates. Our assumption is that "cause-and-effect" table renewal can be caused by fluctuation of the business environment (e.g., market opportunities), modification of laws and variation in other external constraints (or probably even internal constraints: e.g., new business strategy or new operational process)

In fact, this "cause-and-effect" table of indicator mutual influences is a rule set that describes the enterprise. We use the following formalism to represent the "cause and effect" table structure (Table1):

Table 1. eCEM concept representation

Concept	confidence
<i>Perspective1.indicator2.measure1-> Perspective2.indicator3</i>	x%
<i>Perspective2.indicator3.measure1 -> Perspective4.indicator2</i>	y%
...	...

As far as maintenance is concerned, the CSC design group will overview the eCEM application results, carry out the system *reliability* study by:

1. going over new strategic goals;
2. going over corrected indicators and measures: checking the relevance of indicators and theirs values;
3. checking the coherence of "cause and effect" indicator relationships; and

4. proposing new initiatives that should influence enterprise performance.

We have already held series of interviews with two companies: a chocolate shop and a non profit organization.

In the first case study we examine an application of the eCEM approach to a competence management in artisan chocolate production and sale (Durig, 2003). The enterprise "Durig Chocolatier" is based in Lausanne. The products are sold through the retail outlet, but can also be ordered by phone, fax or email, and then sent by mail to the customer. This company plans to put an e-Shop into service (marketing on-line, purchase online, customer's feedback online, etc.). Internet sales and online order procurement will, definitely, bring several benefits and drawbacks for this traditional chocolate shop.

The subject of our case study is to identify the set of changes caused by launching this "Virtual Shop" (MyChocolate.com Shop), i.e.:

- we will consider and design new CSC indicators or, simply, adjust the values of CSC indicators;
- we will perform Dynamic CSC monitoring: to assure that the "cause and effect" table (the table that "stores" the indicator mutual influences) has been processed appropriately.

Our second case study we carry out with a non profit organization. The enterprise life cycle is composed of a set of humanitarian projects. *Company Z* is one of the players in development assistance. In the meantime, this organisation supplies water pumps in Africa counties.

Company Z's performance indicators, certainly, are measures of impacts of development projects or programs. These indicators enable managers to monitor project effort progress, validate project results and, finally, take corrective action to improve project outcomes.

Consistent with Company Z's strategic goals and key performance indicators, eCEM's Competence Score Card focuses on:

1. feedback of project partners and participants (outcomes),
2. sustainable growth of humanitarian project contributors (debit/credit performance),
3. impact of project activities on institutional development (internal process) , and

4. potential for growth and obtaining new projects.

In this part, we have presented "MyChocolate.com" Dynamic Competence Score Card and "Water Pumps" Dynamic Competence Score Card that are based on the eCEM approach.

5 Conclusions and Perspectives

We have presented an implementation model of the Electronic Competence and Experience Marketplace (eCEM). eCEM is a framework to design a corporate memory based on the Conceptual Case Retrieval net technique. Therefore, our research work is twofold: on the one hand we have proposed a schema for Competence management Score Card, on the other hand we have implemented an algorithm for business patterns and business rules retrieval.

Next step in our research is the design and implementation of enterprise portals based on eCEM approach. These enterprise portals will be accessible by employees and managers, what implies two security levels:

1. employees have access to the representation of enterprise general performance indicators;
2. managers have access to the Competence Score Card and Dynamic Competence Score Card.

Evaluation of eCEM based enterprise portals will be done with a help offered by two entities:

- private chocolate business;
- non profit organization.

In the first case, the company is based in Lausanne and functions as a traditional company with clients, suppliers and a shop. We use eCEM to analyze the consequences produced by transaction from a local business to the Internet product distribution.

In the second case, the organization carries out projects in the domain of water supply and water pumps installation for developing countries. This time, the eCEM framework provides simulation and analysis functionalities that help to evaluate the advantages and drawbacks of diversification and enlargement NGO activities, for example:

- employing more volunteers;

- becoming active in agriculture or food programs.

Finally, case studies will help us to evaluate important criteria of the eCEM framework application, such as: scope, precision, transformability, extensibility, consistency.

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