11th International Colloquium of Logistics and Supply Chain Management **LOGISTIQUA 2018**
April, 26-27
FSTT & ENSAT, Tangier, Morocco

Axe de la communication : Processus logistique

Ontological model of competence management

Chahinaze FIKRI BENBRAHIM[1], ELBOUHDIDI Jaber[2], [3]Bakkali Hajira
[1]Engineering Research Team, Innovation and Management of Industrial Systems,
FSTT(AEU), Morocco, chahinaze.fikri@gmail.com
[2]Team SIGL, ENSA-Tetuan, jaber.f15@gmail.com,
[3]Laboratoire d'Informatique, Systèmes et Télécommunication de la FST de Tanger, hajiraone@gmail.com

Naoufel CHEIKHROUHOU [4], Naoufal SEFIANI[1], Kamal REKLAOUI[1]
[4]University of Applied Sciences Western Switzerland (HES-SO), Geneva, Switzerland.

naoufel.cheikhrouhou@hesge.ch, tsefiani@gmail.com, kamal.reklaoui@gmail.com

Résumé— Dans cet article, nous proposons une nouvelle approche concernant le modèle ontologique de la compétence basé sur la roue de Deming afin de faciliter la communication et la compréhension de l'information qui assure une bonne gestion des ressources au sein de l'entreprise. Nous choisissons l'ontologie car elle permet de définir et de gérer les compétences et les connaissances dans les entreprises en assurant une modélisation d'un ensemble de connaissances dans un domaine donné. Dans ce travail, nous développons un modèle qui décrit le processus du pilotage des compétences afin d'améliorer le traitement et le partage de l'information.

Mots clés— competence collective; competence individuelle; ontologie; référentiel de compétence

Abstract— In this paper, we propose a new approach concerning the ontological model of competence based on the Deming wheel in order to facilitate the communication and understanding of information that ensures proper competence management of resources within the company. Ontology constitutes a pertinent mean to define and to manage competencies and knowledge in companies thanks to its suitability to model knowledge. In this work, we develop a model that describes the management of competencies in order to improve processing and sharing of information.

Keywords— collective competence; individual competence; ontology; competence framework

I. INTRODUCTION

The business success generally depends on the efficiency of developing, manufacturing and distributing products, satisfying customers in terms of quality, cost and time. To achieve this goal, the company managers are responsible for maintaining the network of delivery of products and services, starting from the raw materials till the finished product reaches the customers through a set of procedures which include production, coordinated teamwork, and monitored productivity.

Competence Management is a key component of every business processe. Indeed, the ability to identify key competencies, to mobilize and recognize them and encourage their development has to be a primary concern of the enterprise.

For this reason, it is essential to develop methods and tools that allow effective competence management.

This paper proposes a new approach to develop an ontological model of the concept of competence which is based on the Deming Wheel. The goal is to establish a common vocabulary describing the domain of interest, share knowledge about the domain and connect with other domains.

Indeed, ontology is used as it is considered as a way to represent the domain knowledge into a human understandable and machine readable format. Introducing the ontology knowledge provides more relevant search results for the users in need for information.

This research is a good mean that enables managers to identify, deploy, and develop individual and collective competencies of the organization. The paper is structured as follow: Section II gives an overview of the literature on competence management in industrial engineering followed in Section III by the presentation of the ontology concept. In Section IV, The PDCA wheel for competence management is introduced. In Section V, an ontological model implementation of competence management is proposed. Finally, Section VI gives the conclusions and further avenues of research in this field.

II. COMPETENCE MANAGEMENT IN INDUSTRIAL ENGINEERING

Competence Management in Industrial Engineering aims to improve business performance by efficiently allocating and deploying competencies in its processes [1].
Competence management necessitates both formalization and assessment of the pertinence of competences (individual [2], [3], and collective [4], [5]).

The process of competence management can be divided into five stages: Acquisition, allocation, development, maintenance, and use [6].
The management of an enterprise competence system is a five-level structure that is introduced in [7] they are as follows: HR management; operational management; competency and competency characterization; policy of competency characterization and firm strategy.
Each level meets different management goals and horizons.
This structure introduces the process of "competency characterization": the construction, acquisition, consolidation, preservation, expansion, implementation and transfer of competencies.

In Industrial Engineering, [7] proposes a classification of the different competence management. This classification is structured in a systemic vision with three views: structural, functional, and evolution, which can be managed at three hierarchical levels of decision: strategic, tactical and operational.

- The strategic level deals with decisions on strategic management, which are strategy formulation, identification of strategic competencies, etc.
- The tactical level includes decisions on the design of the organization (job roles, team projects ...).
- The operational level focuses on the management actions in connection with the activities implementation.

A review of some research related to the key aspects of competencies management was presented in [8]. This review has been arranged according to the following themes:

- Appraisal and identification of key competencies.
- Integration of competencies in performance assessment.
- Allocation of competencies and team building.
- Development of IT support.
- Characterization of competencies and standards.

To summarize, competence management is integrated as a fundamental concept in order to achieve the required performance. Modelling can help understanding and identifying the most critical issues and a literature review of modelling languages is presented in [9], [10]. However, there is a short of researches dealing with the methodological for competence management. Hence, this study provides a contribution to the field by proposing a competence management approach based on ontology.

III. ONTOLOGY CONCEPT

As a discipline of philosophy ontology is the study of being as being (definition proposed by Aristotle), that is to say, the study of the properties, relationships and properties of everything. The word ontology has appeared in philosophical essays of Aristotle, where he used to describe the nature and organization to be [11].
According to [12], ontology has become increasingly important in computing and artificial intelligence (AI) (knowledge engineering). (AI) requires formal representations of real-world phenomena to reason about these phenomena. Artificial Intelligence (AI) practitioners currently use the word ontology to formally represent areas of knowledge. Amnesty International has coined the term 'official' ontology (or ontology of calculation).

Computing ontology is a formal description of a domain. It is usually described in a logical description language when individuals of a domain with all classes and their attributes and interrelationships between individuals, classes and attributes are defined. This allows automated reasoning engines to be built using the relationships between entities that can make "smart" choices in different situations in the field. Therefore, with the competence of ontologies formalized automated tools could be developed, which compare and contrast different competence descriptions semantically [13].

Ontology is "a formal, explicit specification of a shared conceptualization"[11].
It is a formal specification of a domain. It defines and specifies the categories of people that make up the area, the actual individuals and properties (relations) of people [13].
In [12] we found that Ontology is "a formal, explicit specification of a shared conceptualization of a field of interest. " Conceptualization depicts an abstract representation of a (real world) phenomenon which determined its relevant concepts, relationships, its axioms and constraints.

- Indicates the formal ontology must be readable and interpretable by the machines, as well formal excludes the use of the natural language.

- Explicit means (not implied) the type definition of concepts, relations, axioms and constraints connected with their use.

- Conceptualization describes an abstract representation of a (real world) phenomenon which determined its concepts, relationships, relevant axioms and constraints.

Gruber indicates that formal ontologies (formal ontology) must be designed and provides a first set of design criteria for ontologies developed for knowledge sharing [11]. These criteria are: clarity, coherence, extensibility, the minimal encoding bias, and minimal conceptual commitment [14].

- Clarity: “A common vocabulary should effectively communicate the intended meaning of the term. The definitions must be objective. Although the

motivation for defining a concept can arise from social situations or calculation requirements, the definition must be independent of social context or computation. All definitions should be documented with natural language".

- Coherence: "A common vocabulary should allow the inference that is coherent with the definitions. At least, the definition of axioms should be consistent and coherent. Coherence should also apply to concepts that are defined informally, such as those described in the documentation and examples of natural language. If a sentence that can be deduced from the axioms contradict a definition or an example given informally, the common language is incoherent".

- Extensibility: "A common language should be designed to anticipate the uses of shared vocabulary .It should provide a conceptual basis for a series of planned tasks, and representation must be designed such that it can extend and specialize vocabulary monotonically".

- Minimal encoding bias: "Conceptualization must be specified in knowledge without depending on a particular coding level symbol, as an XML schema. The results of a bias encoding at representations of choice are made only for the convenience notation or implementation ".

- Minimal conceptual commitment: "A common vocabulary should require a minimum number of concepts sufficient to support planned activities sharing knowledge".

In [11] we found that the benefits of ontologies as follows:

- Ontologies facilitate communication between partners in company.
- Ontologies facilitate knowledge sharing and reuse between the various interested parties in the particular field of knowledge.
- Ontologies enhance the interoperability between the different compoment systems.

IV. THE PDCA WHEEL FOR COMPETENCE MANAGEMENT

In 1950 the Deming Wheel appeared as the basis of the Shewhart cycle as referred to in [15]. Thereafter, the Deming wheel was translated into PDCA (Plan-Do-Check-Act) by the Japanese (Fig.1) [16]. It consists of a logical sequence of four repetitive phases for continuous improvement. The idea is to use the four phases until the expected level is reached.

Deming (1950) modified the Shewhart cycle in 1993 and called it the Shewhart cycle for learning and improvement, PDSA (Plan-Do-Study-Act) cycle. He described it as a flowchart for learning and improving a product or process. This modification was consolidated by researchers [17] to form the basis of the improvement model.

The Deming cycle, or PDSA cycle (fig.1):

- PLAN: plan ahead for change. Analyze and predict the results.
- DO: execute the plan, taking small steps in controlled circumstances.
- CHECK: study the results.
- ACT: take action to standardize or improve the process.

The benefits of the PDCA cycle could be seen in:

- Daily routine management-for the individual and/or the team
- Problem-solving process
- Project management
- Continuous development
- Vendor development
- Human resources development
- New product development
- Process trials

Fig.1. Deming Wheel approach

V. PROPOSED APPROACH

Consider a company under study. The proposed competence management approach seeks to answers mainly the following question: How can a company manage its competencies in order to achieve the required performance? The proposed method is based on the principle of continuous improvement, illustrated by the Deming Wheel (Plan, Do, Check, Act).

A. Ontological model of competence management

In this research, we develop a structured approach and make it available to the enterprise for use and to serve as a reference model for efficient competencies management. Moreover, the enterprise can rely on this approach to cope with the changing environment and deal with the constant internal and external challenges.

In addition, the approach is scalable and flexible as it is based on the philosophy of the Deming Wheel [1], [18]. The Involvement of the movement of the Deming wheel needs to

find an engine capable of overcoming the challenges as well as achieving strategic objectives, which are broken down in terms of individual and collective competencies. For this reason, it is necessary to focus on the business action systems (processes and activities).
Yet, the approach focuses on the competency logic as a management device initiated by higher management, aiming towards the adaptation of the enterprise strategies by its environment.

The ontological model of competence management process implemented by protégé (Fig.2) and (Fig.3) makes it possible to define the terminology necessary for the description of the concepts of process of competence management.

The concepts adopted are: company, employee, strategy, competence framework, individual and the collective competence, assessment of competence, action plan, enhancement of competences, allocation, recruitment and development.

Step 1: The company has employees that need assessment of their individual and collective competencies in order to identify gaps at a qualitative and quantitative level. It is a good step to has a better understanding of the enterprise, its strengths and weaknesses.

Step 2: The assessment requires an action plan (Plan) to ensure the success of the company strategic plan which is: enhancement of competences, allocation and recruitment.

Step 3: The action plan is applied (Do) according to the results of the step1.

Step 4: The assessment (Check) is described by the strategy elaborated by the company and requires a competence framework.

Step 5: After the implementation of the action plan, the company realizes another assessment of employees competencies and an audit of the competence strategy and then, ensure the development of competence which permit to implement necessary action plans to address the identified gaps between the competencies needed and those available and also to improve the weaknesses of the competence management system (Act).

Fig.2. Graphic Model of the Ontology of comptence management ontology

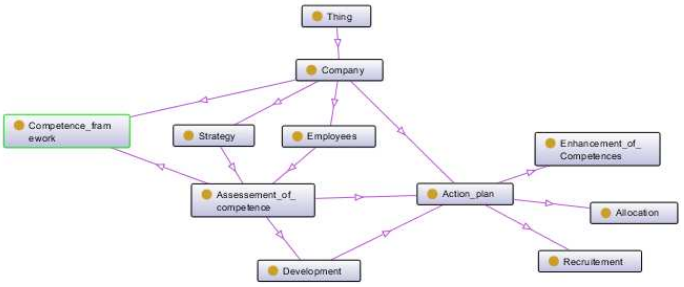
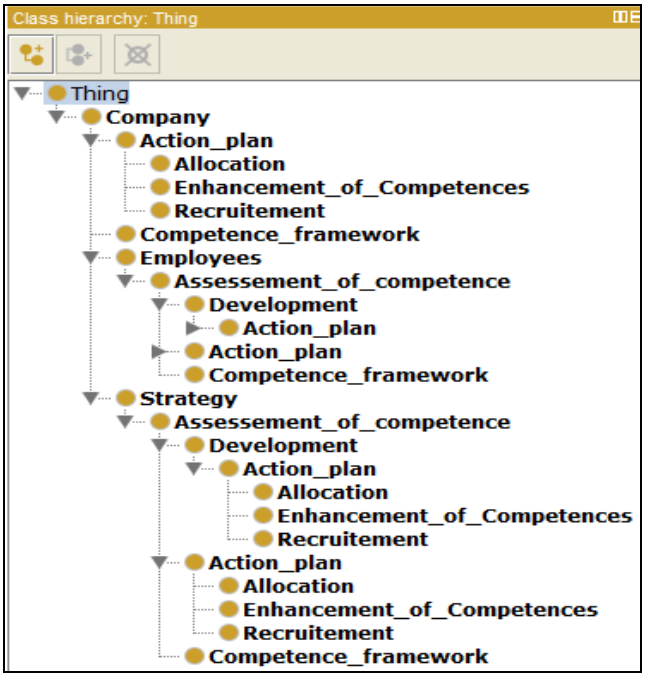
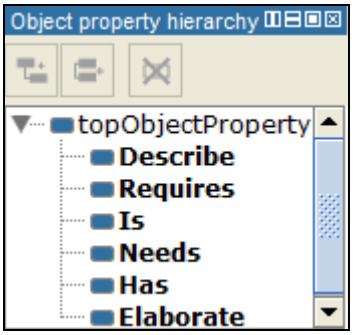
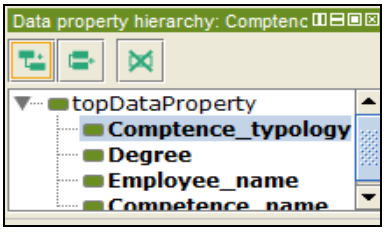


Fig.3. Class Hierarchy, Object properties and Class Datatype Properties of comptence management ontology







VI. CONCLUSION

Currently, the competence takes a particular dimension and the focus on human capital becomes an absolute necessity. Thus, the interest of the organization shifts from the job to the individual. Also, the concept of competence management is introduced as an alternative to the management of jobs and qualifications. In this paper, an approach to the ontological model of competence management process which is based on the Deming wheel is proposed. Potentially, we plan the improvement and enrichment of the proposal ontological model of competence management.

References

[1] N. Sefiani, C. Fikri Benbrahim, A. Boumane, K. Reklaoui, 'Towards a Competence Management Approach Based on Continuous Improvement', World Academy of Science, Engineering and Technology, International Journal of Medical, Health, Biomedical, Bioengineering and Pharmaceutical *Engineering*, vol.9, 2015, pp.704-712. scholar.waset.org/1999.9/10002743

[2] C.Fikri Benbrahim, N.Sefiani and K. Reklaoui, 'Modélisation et évaluation de la compétence individuelle, Stratégie Management Logistics (SMALOGresearch), ISSN: 2509-0186, 2017, pp.1 -21.

[3] G.Pépiot , N. Cheikhrouhou, J-M .Furbringer and R. Glardon A fuzzy approach for the evaluation of competences, International Journal of Production Economics, vol.112, pp.336-353, 2008.

[4] C.F. Benbrahim, N.Sefiani, A.Meddaoui, and K. Reklaoui, 'Assessment of human resource competence and performance indicator', Int. J. Process Management and Benchmarking, vol. 7, 2017, pp.20–37.

[5] G.Pépiot, Modélisation des entreprises sur la base des compétences. Ph.D. Thesis, école Polytechnique Fédérale de Lausanne, 2005.

[6] K.L. Stenlund and S.A Hörte, "Competence Accounting: Methods for Measuring and Valuing Key Competencies", in: European Operations Management Association VI International Annual Conference. Managing Operations Networks: Venice, Italy, 7–8 June, 1999.

[7] Dulmet, M. , Bonjour, E."Vers un méta-modèle de pilotage du système de compétences de l'entreprise", the 5th international conference of industrial Engineering, Québec, 26-29 october, 2003.

[8] Belkadi F., "Contribution au pilotage des compétences dans les activités de conception: De la modélisation des situations à la caractérisation des compétences", Thesis, franche comte university, 2006.

[9] G. Pépiot, N. Cheikhrouhou, J-M Furbringer and R. Glardon, "UECML: Unified Enterprise Competence Modelling Language", Computers in Industry, vol.58, 2007, pp.130-142.

[10] N. Cheikhrouhou, A. Choudhary, A.H. Al-Tawil, "Modelling Competence-based Virtual Organizations using the Unified Enterprise Competence Modelling Language", International Journal of Production Research, vol.50, 2012, pp.5239-5258.

[11] A.Ali, M. Mansooreh and R. Luis," Ontologies For Supply Chain Management", IIE Annual Conference, pp. 1-6, 2003.

[12] S.Andreas and L. Joerg, "Supply Chain Management Ontology From An Ontology Engineering Perspective ," Computers In Industry, Elsevier, vol.65, 2014, pp.913–923.

[13] K. O. Lundqvist, K. D Baker and S. A Williams," An Ontological Approach To Competency Management", Proceedings of iLearn, Paris, pp. 1-4, 2007.

[14] M. Nikolai and C. Djenana, System Assurance: Beyond Detecting Vulnerabilities, The Mk/Omg Press, 1st Edition, 2010, Chapter 9.

[15] M. Ronald, N.Clifford, N., "Evolution Du Cycle Pdca", 2012.

[16] H. Emir, H., P. Jeim and J. Cano, "A Systemic Maturity Model World Academy Of Science", Engineering And Technology International Journal Of Social, Education, Economics And Management Engineering, Vol.8, 2014.

[17] G.Langley, K. Nolan, T. Nolan, C. Norman and L. Provost, "The Improvement Guide". Jossey-Bass, San Francisco, pp. 1-10, 1996.

[18] Deming, W.E., Elementary Principles Of The Statistical Control Of Quality, Juse, 1950.