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HUMAN RESOURCE SKILL MANAGEMENT IN COMPANY NETWORKS

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Abstract: *In this paper a model for human resource skill management is introduced. The idea is to support human resource management, knowledge management and production management with a detailed skill model. For that purpose a brief literature study was performed to position the model against these emerging management theories. Based on the findings in the study it was then possible to investigate how this type of models should be designed. In order to capture domain specific knowledge it is suggested to use an ontology based model architecture. The paper also discusses the first test of this concept. In this test an information model was implemented in the so called INNOMET advisory system, a system for human resource knowledge management.*
Key words: *human, knowledge, model*

1. INTRODUCTION

The manufacturing system can be seen as a series of interrelated activities and operations aimed at the engendering of products. However, from a holistic viewpoint it is necessary also to include human resources into the description of the manufacturing system. While many have tried to describe technological resources from a multi view perspective, few have tried to describe human resources that actually interact with the technological resources or at least the process. Hence, this paper will address human resource knowledge representation in order to try to fill this gap.

This paper is indirectly a result of the European INNOMET project ("development of the innovative database model for adding innovation capacity of labour force and entrepreneurs of the metal engineering, machinery and apparatus sector") aiming to develop an advisory system for human resource skill management within and between organizations. The undersigned person(s) have participated in the development of the underlying information model supporting such systems and also in a preceding survey identifying the need for human resource skill management within this field.

Based on the findings in this survey it was possible to identify the requirements on such models. Human resource models should serve two main purposes; first of all they should be able to answer all relevant questions concerning what type of knowledge and ability that is needed in order to fulfil a certain work assignment. Secondly they should define a common language to support the communication of requirements. The model suggested in this paper describes ability in terms of skill keywords. These keywords may then be used to describe what the person should be able to know and should be able to do. Furthermore these keywords may be used to define roles, or human resource profiles, and hence this model makes it possible to interact with other organizations such as educational institutions or companies concerning the need or adequacy of knowledge to be gained by a certain labour force category.

2. AIMS, PERSPECTIVES AND OBJECTIVES

The aim of this paper is to investigate how human resource skill models should be described in order to support human resource knowledge management. Due to the fact that this work has been performed within the frame of INNOMET the investigation is limited to companies active in the engineering industry sectors, although it is most likely that this work should have the same impact on other branches.

Throughout the paper the topics are looked upon from a scientific perspective and the need of small and medium size enterprises (SME) in particular. Hence the goal is to verify the model against their needs.

In order to reach the aim of the paper and to verify the perspective, the following objectives have been defined:

- To position human resource skill models against other business improvement philosophies and management theories.
- To investigate what type of information human resource skill models should include.
- To investigate how human resource skill models should be designed in order to capture domain specific knowledge.
- To propose an architecture for future systems dealing with human resource skills management.

3. THE MANUFACTURING SYSTEM FROM A HOLISTIC VIEWPOINT

3.1 Knowledge viewed as an asset

Globalisation, shorter life cycles and rapid changes in customer demands forces the companies to adapt their organisations to meet these new requirements. Virtual organisations, the extended enterprise and increasing focus on the companies' core products and value adding processes are just some examples on how companies today try to stay competitive.

For natural reasons this rapid shift in business conditions has a big impact on the companies' way of doing business. This includes efficient competence and knowledge management, which has become more or less a necessity in order to stay competitive. A leading question is therefore whether employee skills may capitalized? According to McAdam & McCreedy (1999) that have reviewed different types of knowledge management models, their answer is yes although most intellectual capital models targets explicit knowledge that can be verbalized.

3.2 Modelling of manufacturing systems

In most companies today the goal is to reduce lead time and costs. However, the complete development of products and accompanying resources is such a complex task that new business improvement philosophies are needed in order to reach this goal. One such philosophy is the digital plant which allows coherent development of new products by using standardized information models for communicating and storing information. This concept has proven to be very powerful especially when it comes to highly complex products, but still one of the main questions remain unanswered: how should we describe the constituents of the manufacturing system to allow a common understanding independent of what part of the system we want to describe, or what task lie in front of us? One step toward a common understanding is to extend the existing cluster of manufacturing standards in order to try to complete

this picture. Human resource models seem to have been forgotten in this context.

4. KNOWLEDGE MANAGEMENT

From knowledge management (KM) we learn that there are two types of knowledge, a distinction that is widely accepted: explicit and tacit knowledge (Nonaka & Takeuci, 1995). Explicit knowledge is structured and can be verbalized. Tacit knowledge, on the other hand, is inherent to people; in other words, it is the abilities they possess. It is therefore the structured explicit knowledge that is usually treated by knowledge management systems (KMS). KMS usually include four basic functions: securing, creating, retrieving/combining, and distributing knowledge (Liebowitz, 1998) similar to the functionality we find in most product management tools. Unfortunately the non-structured tacit knowledge is not that straight forward because it is much more difficult to record or transmit to others.

Consider figure 1 below. Although this figure gives us a simplified view of what manufacturing really is it gives us a hint what human resource skill model should encompass to support production management. This system consists of a number of processes that are executed by technological resources or humans. In order to interact with the technological resource, or at least the process, the employee must have the right skills and ability; that is, he or she must "know how" to perform a certain task (i.e. they must have both explicit and tacit knowledge). On the other hand, if we imagine that a new manufacturing system is going to be introduced we might have a knowledge base from earlier investments; i.e. explicit knowledge that the operator possess or have access to through knowledge repositories containing information about earlier systems.

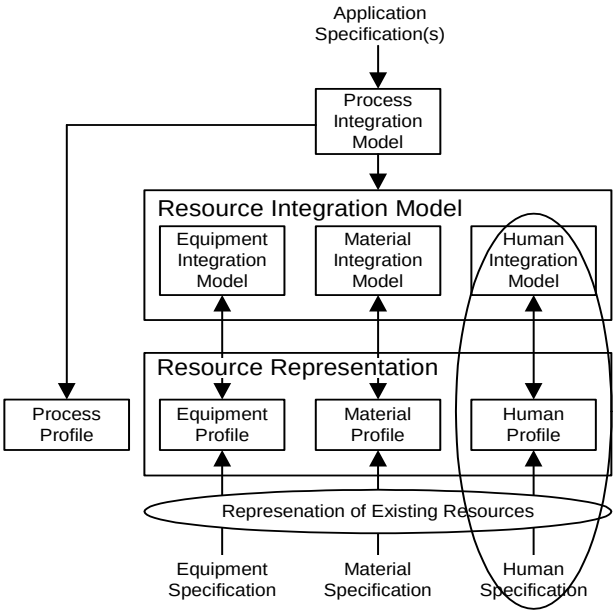

Fig. 1. Human resources as an integrated part of the manufacturing system model

Hence, from this perspective the human resource skill model should be able to capture and describe skills that support the creation and use of explicit knowledge (knowledge viewed as an asset) and tacit knowledge that is inherent to people like knowledge of manufacturing processes etc.

4.1 Knowledge management and its implications on human resource models

Before going into the principles for human resource skill management it is necessary to further investigate the connection between human resource management (HRM) and KM. Remembering that the main goal with KM is to help create learning organisations and management of explicit and tacit knowledge it important also to remember the impact made by HRM on KM practices (Yahya & Goh, 2002).

Yahya & Goh (2002) have explored the coupling between four areas of HRM (training, decision making, performance appraisal and compensation) with five areas of KM (knowledge acquisition, knowledge documentation, knowledge transfer, knowledge creation and knowledge application). They found (amongst others) that in terms of employee development and training the focus should be placed on achieving quality, creativity, leadership and problem solving skills (in that sequence) in order to achieve knowledge management and learning organisations.

Evidently, there is a strong connection between these two management theories and by promoting quality, creativity skills etc. the creation of explicit and tacit knowledge within organisations will be reinforced. Unfortunately our surveys indicate that SMEs seem to have forgotten this. While global enterprises often possess quite extensive long term competence plans the SMEs often rely on common sense. Hence, by promoting this type of HRM in SMEs they should reasonably be strengthened.

4.2. Knowledge representation

Knowledge may be represented in different forms. Explicit knowledge, for instance, may be represented in written form, in databases, in computer tools or be built into physical objects. Explicit knowledge may also represent the "know what" (knowledge) of a human being whereas tacit knowledge may represent a person's inherent knowledge, being a part of and building up a person's ability (competence).

Following the reasoning above it is possible to assume that the connection between explicit and tacit knowledge represents the person's ability to act (i.e. create new knowledge) or "know how". Although this assumption will be used throughout the rest of the paper it is not fully clear how these two are connected. For correctness the "know what" and the "know how" should be appended by "know why" where the later two include both tacit and explicit knowledge to some degree. In order to "*know how* to perform" a certain task one also needs to "know why" and in this context the later is considered to be a part of the "know how".

- *Know what* represents the explicit knowledge of a person.
- *Know how* represents a persons ability to act.

5. REQUIREMENTS ON HUMAN RESOURCE SKILL MODELS

5.1. Basic functionality of the system

Although the INNOMET advisory system for human resource knowledge management (Riives et al., 2002) itself is not in the scope of this paper it is necessary to reflect on the functionality of the system in order to better understand how and when the model will be used. The INNOMET system will basically help companies specifying their requirements so that educational providers and educational decision makers can access up-to-date information concerning their customers' need (it is not a system in the area of employee recruitment). From the system point of view the most important functionality is requirement synthesis and requirement extraction.

5.2. Model requirements

The human resource skill model should serve two main purposes. First of all the model should allow a common understanding of the skills that are to be described. That is, the model should leave no room for misinterpretations no matter how it is used or by whom. This implies semantics and a common vocabulary. Secondly the model should be able to

capture requirements. What skills are needed for a certain labour force category and a specific work assignment? By supporting requirement specification the model will support communication between companies and educational providers concerning the need or adequacy of human knowledge. It is of course possible to foresee a number of potential use-cases although in this particular case we have limited ourselves to describe employees (or groups of employees) and their skills.

6. AN ARCHITECTURE FOR HUMAN RESOURCE SKILL MODELS

In order to capture the requirements mentioned above one solution is to use ontologies. By using an ontology based approach it is possible to capture domain specific skills (i.e. according to labour force category and potentially also specific work assignments) in a coherent way.

Ontologies usually consist of four fundamental and basic building blocks: taxonomies, specifications, axioms and dictionaries. In this case the taxonomy could represent a framework for decomposition of skills (i.e. for employees in the engineering industry), while the specification of a certain skill helps avoiding misunderstandings. The dictionary could then be used to support a multi language system and translation of skills into foreign languages.

Consider figure 2 below. In this case requirement synthesis is simplified due to the use of a generic Meta taxonomy from which all professions are derived. This breakdown itself makes it possible to interpret the requirements because it is easy to follow how the skills are grouped. On the other hand, if there are any uncertainties concerning the interpretation of a specific skill it is possible to investigate how a skill is defined in the corresponding specification (which in its turn may be document based or model based).

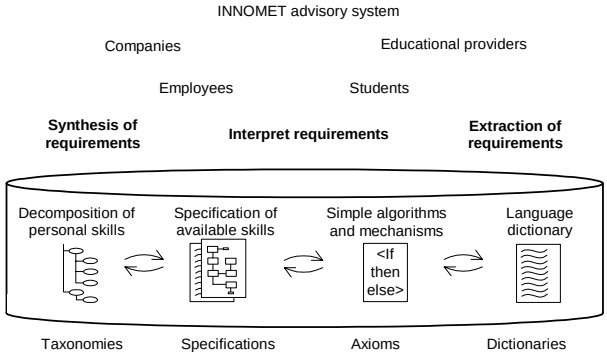

Fig. 2. Using ontologies to describe human resource skills

Although it is not always necessary to include axioms into the representation this modelling methodology leaves us with an interesting opportunity to see human resource skills management as an integrated part of expert systems. With a methodological breakdown of skills according to the generic meta taxonomy and perhaps also axioms it would be possible to build an expert system based on simple logics and heuristics such as if-then clauses.

Finally the dictionary may be a good guide to help overcome language conflicts when people from different background come together.

7. DEVELOPMENT OF A HUMAN RESOURCE SKILL MODEL

This architecture was tested in the so called INNOMET advisory system for which an information model was developed. The INNOMET system basically helps companies specify their requirements so that educational providers and educational decision makers can access up to date information concerning their customers' need (it is not a system in the area of employee recruitment); what kind of skills do the companies want the students to possess? The system also comprises parts for educational institutions and certification authorities.

The first step was to test the concept on the companies. For that purpose a paper based inquiry was developed which contained a number of questions with predefined skills for different types of personnel categories within the engineering and manufacturing branch. For each skill the companies managers were asked whether this was an important skill or not (needful level) and what level they estimated that their employees had achieved (actual level). On both needful level and actual level they had a six level graded scale (0-5) to choose from. The result from this survey indicated that the company managers were a bit confused; they didn't know how to interpret the meaning of a certain skill, and they didn't think that the pre-defined skills reflected their personnel categories.

The next step was to develop the information model that should reflect the content of this first survey without these disadvantages. For that purpose so called skill keywords were developed. These keywords may be used to describe a certain personnel category (labour force category) or even an individual (work assignment).

The communication with educational providers is then facilitated thanks to a similar construction for describing courses and study programmes since they can choose from the same skills when designing and describing their courses.

Skill	Know what	Know how
	Explicit knowledge, actual level	Ability to act, know why, needful level
Quality	0-5	0-5
Creativity	0-5	0-5
Leadership	0-5	0-5

Table 1. Examples of skills and how they are treated in the human resource skill model presented in this paper

Table 1 above shows how skills are defined in the model. For each skill there is an attribute for needful level and actual level. These keywords reflect what the person should be able to know (know what) and should be able to do (know how, know why). Furthermore these keywords may be used to define roles, or human resource profiles, and hence this model makes it possible to interact with other organizations such as educational institutions or companies concerning the need or adequacy of knowledge for a certain labour force category.

8. CONCLUSIONS AND FUTURE WORK

This paper has discussed human resource skill models in the context of skill management, although some necessary parts of human resource management systems have been addressed as well.

The results of this application are promising and the application has been very well received amongst the members of the project as well as the participating companies. From modelling point of view it is necessary to further investigate how ontologies could be used in a wider perspective not only in the field of skills management but also in the field of knowledge management.

Although the model itself does not constrain what skills are allowed the survey indicated that many companies are unwilling to answer how they appreciate personal skills like creativity and team working skills. This is very unfortunate, especially with reference to chapter 4.1 which indicates that these types of skills are very important in order to support a learning organisation.

Future research could focus on technological resources and how they should be described using the same approach.

Generic taxonomies for different machine categories could simplify machine purchase and requirement specification as well as increase customer supplier integration.

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