Knowledge Management and e-Human Resource Management

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Abstract

Although Knowledge Management (KM) is typically defined to be the holistic combination of measures for managing *people, processes, and technology,* the explicit integration of Human Resource Management into KM initiatives is seldom examined. In this paper we present the concept of e-HRM as an integral KM part, we describe several use cases for technological e-HRM support, and we sketch the integration of these use cases into a holistic e-HRM approach.

1   Introduction & Overview

In the course of prevailing trends like globalisation, customer orientation and specialization, most of the companies place emphasis on recruitment, sustainment and evolution of qualified employees.

The companies are aware of the fact that human resources have changed more and more from a cost factor to a success factor[1]. Companies that have realized the message out of the data of vital statistics know that a declining population will be the main problem in the next ten to twenty years.

On the other hand we can see a diminishing importance of the HR-departments in the companies due to the dislocation of core tasks of HR back to the employees (e.g.the maintenance of standing data). Lots of chore can be delegated with modern information technology to the employees themselves.

Electronic Human Resource Management (eHRM) is a web-based tool to automate and support HR processes. The implementation of eHRM is an opportunity to delegate the data entry to the employees. eHRM facilitates the usage of HR marketplaces (e-Recruitment) and offers more self-service to the employees. eHRM is a collection of many different technologies. At first the growing attention of companies on the factor knowledge is mainly driven by the evolution of information technology. Information systems – like eHRM-solutions – that network information enable companies to get a consistent concept for their knowledge management

In this sense Knowledge Management is always a collection of different techniques. A variety of these techniques is used in companies to acquire knowledge, to organize knowledge and to make knowledge transparent.

One of these mentioned techniques is Knowledge Discovery in Databases (KDD) respective Data Mining[2] as a step of the KDD-process. This paper demonstrates the possibilities of Data Mining in the domain of Human Resource Management.

In this article it is shown how far this process in companies has evolved and how it can be supported with intelligent data analysis (Data Mining). Further it is discussed how eHRM and intelligent data analysis in special can disburden the employees in the HR-department. Thus the HR-department can concentrate more on the qualitative tasks in personnel planning like coaching and consulting.

The structure of the paper is as follows: in chapter two the corporate environment will be presented where the ideas are to be integrated. In chapter three we give a description of the connection between knowledge management and human resource management. Chapter four presents the three use cases which are: skill-extraction, recruitment decision support and strategic personnel evolution. In the last subchapter of chapter four the three use cases are shown in an integrated – holistic – approach. Chapter five presents relations to other work in that domain while chapter six gives an impression which steps will be done next.

2   Corporate Environment

To get an idea where the content for this paper originates from, we give a short description of the eHRM-solution at DaimlerChrysler AG Plant Wörth, Germany.

Since nearly one year DaimlerChrysler AG, Plant Wörth, decided to replace the old host-based HR-systems with a web-based solution. The software product that is used is PeopleSoft from PeopleSoft GmbH Germany[3]. The new System (internally called ePeople) is a centralized web-based application that supports HR in the fields of HR-administration, candidate management, HR-development and payment.

Apart from the payment-functionality the software is designed to offer one central contact point for HR-tasks in contrast to the heterogeneous host-based environment before.

In equal measure ePeople comes with changes for the employees and for the executives. One of the main tasks of the HR-department: the consulting is at the

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[1] cp. Greife, Langemeier (1997), S. 521ff

[2] cp. Berry, Linoff (1997)
[3] cp. http://www.peoplesoft.de/corp/de/products/line/hrms

same time one of the most time-consuming tasks. To reduce the time-exposure at this point more responsibility is given to each person. Many questions like "How can I change my banking account number?" or "I need a copy of my last payroll!" can be handled by the employee directly. As a result more freedom for each employee is achieved.

The philosophy of ePeople is to cover the whole life-cycle of an employee beginning with the candidature and ending with the withdrawal (see Figure 1).
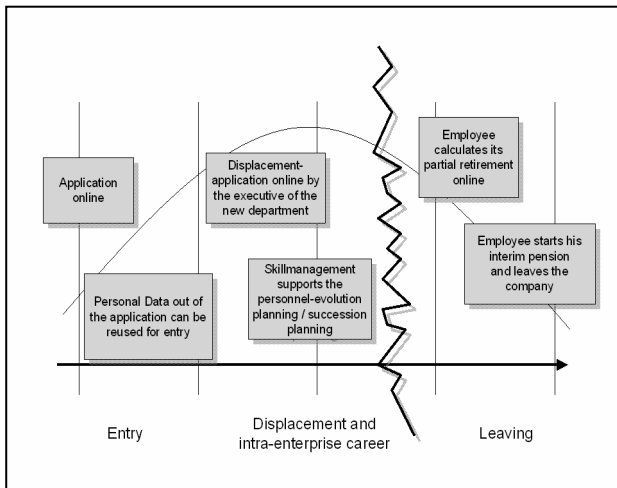

Figure 1: Employee Life-Cycle in ePeople

Figure 1 shows starting with the entry-process – that is ideally done online by the applicant – how the data out of the electronic application is taken over. In the ongoing process it is exemplarily shown a dislocation-application and the skill management. Each of these steps are directly processed by the ePeople-system itself – there is no need to delegate data or work to other systems. The life-cycle of an employee ends up with its (partial) pension when he leaves the company.

The benefit for DaimlerChrysler AG is due to the strong emphasis of the self-service concept of ePeople. The self-service of ePeople offers the user full access to his personal standing data. The employee can print attestations or can see personal information. The self-service is generally splitted into a section for executives and a section for employees. Executives can – in their manager-self-service – use functionalities like initiating a workflow or interact with a personnel consultant from the HR-department. Furthermore they can get easily reports out of the system.

A central module of ePeople is the functionality around the skill management. Skill management is viewed out of the perspective of the employee or applicant who can document his skills (makes his skills transparent) and out of the perspective of the executive who can use the system to get an overview of the skills of his employees. This means for the employee an enhanced visibility of his skills in the company. Out of the executive-view can result an overview of the structure of skills e.g. in a department and out of this concrete recommendations on training-measures can be made by such executives. The second useful aspect for executives is the possibilities to get an overview over the pool of unsolicited applications. In a plant with approximately 10.000 employees the everyday-work of the aproximantely 300 HR-workers is stamped by ad-

ministrative activities. Employees who change a department – who need an attestation – who have a question concerning their payroll – who want to ask something about their taxes – who have changed their adress – who have been ill – who want to go into early retirement – who want to work part-time. All these needs of the employees are expressed in a lot of questions that have to be answered. If only a half percent of the employees has such a question per week – more than 50 request per week have to be handled. Lots of the questions mean an investigation in files and produce extraordinary work.

3 Knowledge Management and e-Human Resources Management

The growing attention of companies on the factor knowledge is mainly driven by the evolution of information technology. Information systems like ePeople at DaimlerChrysler that network information enable companies to get a consistent concept for their knowledge management.

In this sense Knowledge Management is always a collection of different techniques. A variety of these techniques is used in companies to acquire knowledge, to organize knowledge and to make knowledge transparent.

One of these mentioned techniques is Knowledge Discovery in Databases (KDD) respective Data Mining as a step of the KDD-process.

Firstly the concept e-Human Resources Management (eHRM) shall be discussed. Further the impact of Data Mining in the context of eHRM is shown as a collection of use cases that describe the possibilities to enhance the eHRM-processes.

eHRM offers the opportunity to automate administrative HR-work and to optimize value creating HR-activities. Three levels of development can be distinguished:

1. web-presence HR,
2. web-enabled HR, and
3. web-energized HR.

The first level means that parts of the eHRM-solution are present. Web-enabled means that all parts of the eHRM-solution are present and can be accessed online. The third level describes the eHRM-solution that is fully implemented, can be accessed online and is used intensively by the employees.

The desired level and the pace of implementation for HR-solutions are specific for each company. At DaimlerChrysler AG, Plant Wörth the eHRM-solution is on level two at the moment and is to reach level three where it is intensively used by the HR-workers and the employees.

As a weak definition eHRM shall be known in the following as an integrated optimization of HR-processes consequently using web-based technology for all facets of HR-work. Amongst other facets e-Learning in the field of continuing education, employee-self-service (ESS) in the field of HR-administration and the utilization of the intra- and extranet in the field of recruitment belong to the main fields of eHRM that are supported by the eHRM-system at DaimlerChrysler AG.

The main benefits of eHRM are an increase of quality and pace, because the existing administrative processes were slow and inefficient conditional upon mainly paper-based processes, e.g. the tendance of standing data and the payroll.

The direct access of the network-enabled employee avoids double-entries for example at the tendance of standing data, travel expense accounting and applications for leave. With e-recruitment the company gets an additional possibility besides the normal application by paper to recruit people over the web in an online-application process.

It is common for large companies to install eHRM. Not only can the processing time be shortened but also manpower can be saved. So far eHRM reaches the prime objective of cost effectiveness.

Besides the positive aspects of eHRM there are different negative impacts. The traditional social task of the HR-department suffers under the increasing areal distance that eHRM causes with its virtual online-processes. The partial loss of face-to-face communication is rated negative by the employees. Finally the HR-worker is affected by the changes in the HR-processes. The ongoing automation of formerly time-consuming tasks leads to long-term staff cuts in the HR-department. Thus the HR-worker is a central component of the implementation of eHRM because he is the key-factor to realize the newly installed processes. With a demotivated HR-worker due to the anxiety to loose his own job an implementation of eHRM is futile. A main task must therefore be the re-orientation of the HR-workers to a new scope of duties, especially in the area of strategic Human Resource Management that is recruitment, personnel evolution and continuing education.

In the following chapter three the concrete suggestions are presented that can enhance the hitherto described HR-processes in form of use cases.

4 Enhancements for eHRM with Knowledge Discovery in Databases (Data Mining)

In this chapter a collection of use cases shall be presented. It is not the intention of this chapter to give a detailed solution for each of the problems, since each of the following subsections could be a single topic itself. Rather we give an overview of the possibilities and arrange the individual use cases in an overall process. This overall process wants to show the interaction of the different methods as a holistic approach.

4.1 Skill-Extraction

To make implicit knowledge more transparent DaimlerChrysler AG, Plant Wörth uses Skill management[4] in his HR-solution to document the knowledge of each single employee.

Skill management supports companies to recognize existing skills of their employees, and to use these skills systematically. The knowledge about the skills of the employees can, for example, be used to extend the skills of the employees with training measures, or it can be useful to recruit new employees.

DaimlerChrysler AG, Plant Wörth uses the Skill management approach at the very first possible interface to the possible new employee. If a candidate applies online at DaimlerChrysler AG, he is asked to fill a "competency tree" with his / her current skills. By this means, a candidate gives a skill-profile to the company that can be used to recruit very precise according to the current needs of the company. Each given skill can be rated with a category like "expert" or "basic knowledge".

The "competency tree" is structured in main categories out of which the candidate can choose his / her

Figure 2: Competency Tree in ePeople

skills. The tree offers about 500 single skills that can be choosed. The tree originates from the input the diverse departments in the company gave when the tree was firstly set up. The speed how the tree expands is rather slow at the moment but it is to expect that the requests to maintain the tree will grow according to an increasing usage of the skill management. The tree-structure is not very well defined at the moment. The terms in the tree of one main category are often duplicates of terms in other main categories. This problem originates from the method to find the terms, because there was no interaction between the departments that defined the terms. Further the terms are often used in that sense in the one category while they are used in another sense in the second category. The relation between terms and categories is expressed by the is-a-relation (e.g. Java is-a Programming Language is-a IT-knowledge). The main task and one of the first steps has to be to set up a *consistent* competency tree without the sketched problems.

Furthermore the candidate has the possibility to attach a free-text description to his application. Most of the candidates use this option to attach CVs or work experience.

The main problem is the fixed structure of the competency tree. The tree is maintained manually out of the feedback from the operating departments. Thus the risk is high that the tree is getting outdated relatively fast because no one is really maintaining the tree from a central point of view. The idea to maintain the tree semi-automatically originates out of this fact.

The way to do this is the assumption that the candidates write down those skills in the attachments they couldn't find in the fixed competency tree in ePeople during the online-application process.

This is the point where Text Mining starts to work. Text Mining is a technology that enables the user to

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[4] cp. Faix, Buchwald, Wetzler, R. (1991), p. 11ff

extract and analyze information out of documents[5]. Text in documents is mostly written in natural language. The challenge for Text Mining is to make the information represented by the natural language explicit, to make it understandable for machines.

In the case of maintaining the competency tree with Text Mining the idea is to extract with this technique keywords out of the attached documents[6] and to use these results as a suggestion to enter them into the fix structure of the competency tree.

The maintenance can be done manually by a domain expert or it is supposable to do this by an algorithm that does intelligent guesses where the newly found keyword is to be entered in the competency tree.
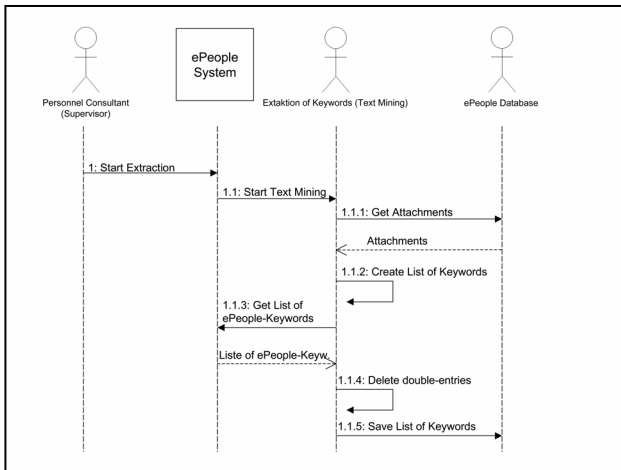

Figure 3: Sequence Diagram: Extraction of Skills out of natural-language attachments

With this method the competency tree could be held actual and new "trends" in education would be entered in the competency tree quasi as feedback out of the attached documents of the candidates.

As a closing remark to each of the proposed use cases the use case is presented as a sequence diagram (see Figure 3) on a high level of abstraction to convey the understanding of the case.

4.2 Recruitment decision support

Well-founded employee assessment has gained increasing interest as the basis of efficient employee selection. It is generally accepted that the personality profiling of the candidates (with so called skill-profiles) is of particular interest here. The present section shows how maching learning can be used for automatically inducing a classificator for recruiting decisions.

As a first step the classificator has to be trained to recognize if a candidate is suitable or not. The point that should be learned by the classificator is: is it a candidate that can be employed or not? For this task companies own already most of the required data in their HR-information systems. The training-phase conditions the classificator. For the training of the classificator a training data set is needed. In this case we need a set of data about candidates that have been accepted and declined in the past. This set of information (well-transformed in a readable input for the classificator) is used to train the classificator. As a next step a test data
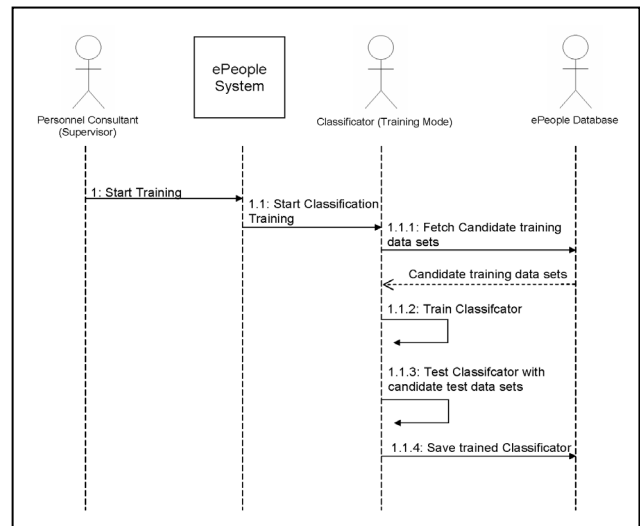
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[5] cp. Carstensen et al. (2001)
[6] cp. Novotny et al. (2001), S. 13f

Figure 4: Sequence Diagram Classificator (Training Phase)

set is needed to test the function of the trained classificator. For this task data that wasn't used for the training step can be used to examine if the classificator works correct – which means: can give good recommendation to emplay a candidate or not. Out of the test some conclusions can be noticed: if the performance of the classificator is too weak, it could be a solution to intensify the training phase. A too small training data set can complicate the recognition of generally accepted patterns in the real data.

If the testing brought satisfying results the classificator can be used to classify new candidates on a decision support-basis. For this step the relevant criteria of the candidates have to be collected – which is very easy in an online application process of an eHRM-system – and feeded to the neural net. The classificator "calculates" a value of suitability of the candidate.

As a restriction we should note that a classificator approach should not be used as a standalone solution, because of the error-rate a classification approach always has. A classification can be a good helper if they
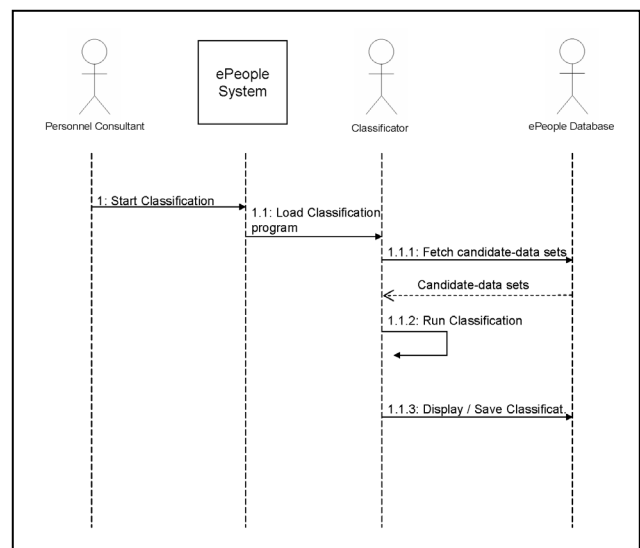

Figure 5: Sequence Diagram Classificator (Operation Phase)

are integrated into an existing HR-solution, as it is described below in the overall eHRM-process chapter. As

both diagrams (see Figure 4 and Figure 5) show: the effort and the involved resources are relatively humble. The steps to get a result in a productive system are limited and straightforward. One of the controverse discussed approaches in literature to do this is to use neural nets[7]. The main point of critisism is that neural nets cannot explain why they come up with a certain decision. But the question is: is it important for an HR-worker to see how the decision was made? Isn't it more important – however the decision came up in the neural net – that it is a help and decision support for the HR-worker besides his own opinion if to emply a candidate or not? The argument that HR workers will not use such a net because the cannot comprehend the suggestion can be extended to any other (symbolic) approaches. With that argument in mind – it doesn't matter which approach you take – a symbolic or subsymbolic approach. What matters is the result. If the HR worker notices that the quality of recommendation is good enough to support his work – he will use the system even if he cannot understand completely the underlying technical details.

4.3 Strategic Personnel evolution

The problem the most companies have is not so much the number of staff, but rather the correct mix of staff. Planning engages the company into taking actions now in anticipation of the future. Workforce planning aims to have the right people in the right place at the right time – all the time.

Where HR-management and strategic planning were once thought to be mutually exclusive, it is now clear that the "knowledge management" requires a more disciplined focus on the people factor.

An effective HR planning system will require HR managers who are in every sense business managers and who have a knowledge of the overall operations of the company. Importantly, they must be able to integrate the various HR functions so as to be consistent with the company's strategic plans.

In this context a clustering-approach is proposed that can help to identify the recruitment or education needs.

As we already know employees can document their skills directly in the ePeople-system. Therefore the first major step to do a strategic planning is already done: the gathering of all actual present skills of the employees.

The idea is now to do a clustering on the skill-profiles in an organizational unit (e.g. development department) to get an impression which groups of similarly skilled people are present in that department.

With this information a company can decide if the structure of "knowledge" is the one the company wants it to be. On the other hand such an analysis can be a valuable hint, that the structure of "knowledge" (skills) has to be adapted. Measurements could be recruiting new employees or to train the existing employees to close the gap between target-skill-profiles and actual-skill-profiles.

The main benefit is to identify employees or groups of employees whose capabilities are not likely to meet future needs so they can be retrained, redeployed or separated.
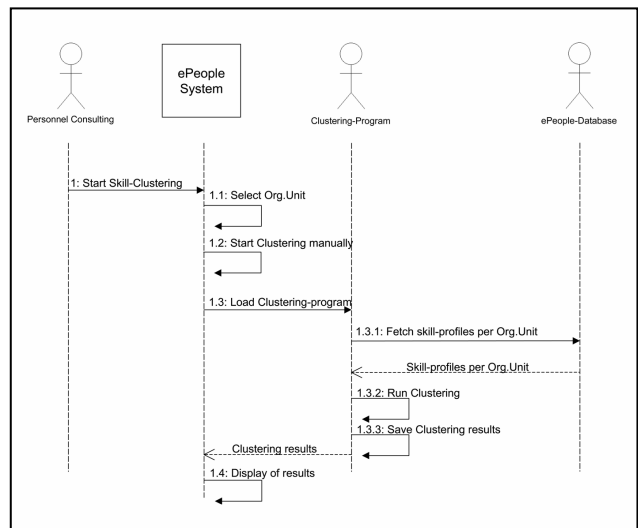
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[7] cp. Lackes, Mack (1998)

Figure 6: Clustering on Skill-profiles

The staff utilization can be improved through assigning employees to the highest value work they can perform and identifying development opportunities.

The initiatives of the HR department are consistent with and complimentary to business plans.

As an extended benefit the company can develop career paths to meet future skill requirements as well as providing improved career options to the employees.

Clustering skill-profiles requires an adequate and up-to-date skills vocabulary. It is always a problem to motivate the employees to maintain their skills to get an up-to-date data set. However at DaimlerChrysler the solution was very simple: the executives had a vital interest to control that their employees maintained their skills because the maintenance of the skill-profiles is one of the target definitions that the executives made for their variable payment. By this way the evolution of the profiles can be controlled and they can be kept up-to-date without great efforts. By that the data quality is comparably high.

4.4 Holistic View

Most of the proposed use cases first make sense if they are combined with the processes that exist in the daily HR-work. For the daily HR-work the cases have to be integrated seamlessly into the existing system environment to get a user acceptance as high as possible.
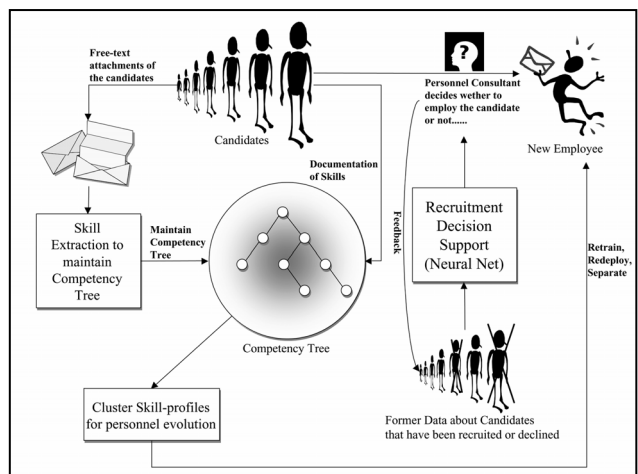

Figure 7: Holistic approach

The figure shows a proposal of how to integrate the previously drafted use cases.

A central component of the holistic approach (see Figure 7) is the competency tree. At the moment ePeople organizes the competency tree as a simple tree data structure in its database. Because of the central role of the competency tree and its multiple use by the different algorithms, it is proposed to design the competency tree as an ontology for a more flexible use in future.

With that step to convert the competency tree in an ontology all advantages of ontologies become visible. With an ontology we get a common understanding about the structure of the saved information. In addition we get interoperability, machine-readable data and as a result the reuse of domain knowledge that is saved in the competency tree.

This representation form opens the door to more complex approaches that weren't possible before due to the representation in a database. For example a more sophisticated search routine for skills is in planning that can handle synonyms to enhance search results.

Around the competency tree as a central element the figure shows how the proposed use cases integrate in the system environment. At the head of the figure the candidates are shown that apply online at the company. They document their skills in an online-process in the competency tree. From this point on their skill-profile can be used for evaluation. The attachments of the candidates are used to maintain the content of the competency tree via skill-extraction.

To support the recruitment process the knowledge about formerly recruited and rejected candidates is used as input for the neural net in the recruitment decision support-use case. The personnel consultant can use the recommendation as an additional decision criterion whether to employ the candidate or not.

Besides the recruitment process the saved skill-profiles of the employees can be used to do the clustering on these profiles. As already illustrated in section 3.3 the results of the clustering can be used to retrain or redeploy employees.

5   Related Work

At certain steps there exists related work which deals with similar tasks. According to the use case: skill-extraction out of candidate attachments (which are mostly curriculum vitaes (CVs)), there exists a project called CommonCV[8] at the University of Nantes (France) that deals with the problematics of e-recruitment. This project tries to identify and formally represent the competencies underlying a curriculum vitae. The objectives of the project are the definition of a competency model and the definition of a process dedicated to the management (i.e. identification, formal representation and exploitation) of the competencies underlying a CV.

At the University of Dortmund, the problem of recruitment decision-support by Neural Networks is investigated[9].

6   Status Quo and Future Work

To realize and test the ideas described in the holistic approach a test environment is built up at the moment. The test system is a fully functional "mirror" of the productive ePeople-system with the restriction of anonymized personal data.

A diploma thesis is planned for the third quarter of 2003 that deals with the problem to transfer the competency tree into an ontology. After this, we will implement the use cases to demonstrate the feasibility of the proposed holistic approach.

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[8] cp. Trichet, Leclère (2003)
[9] cp. Lackes, Mack (1998)