

PERSONALIZED INCENTIVE PLANS THROUGH EMPLOYEE PROFILING

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Abstract: Total reward management (TRM) is a holistic practice that interprets the growing need in organizations for involvement and motivation of the workers. It is oriented towards pushing the use of Information Technology in supporting the improvement of both organization and people performances, by understanding employee needs and by designing customized incentives and rewards. Customization is very common in the area of e-commerce, where application of profiling and recommendation techniques makes it possible to deliver personalized recommendations for users that explicitly accept the site to store personal information such as preferences or demographic data. Our work is focused on the application of User Profiling techniques in the Total Reward Management context. In the Team Advisor project we experimented the analogies Customer/Employee, Product, Portfolio/Reward Library and Shop/Employer, in order to provide personalized reward recommendations to line managers. We found that the adoption of a collaborative software platform delivering a preliminary reward plan to the managers fosters collaboration and actively supports the delegation of decision-making.

1 INTRODUCTION

Competitiveness is a key issue for knowledge-intensive organisations in today's turbulent global marketplace. The most industrialised countries can no longer expect to compete only on efficiency. The labour cost gap is for the time being unbridgeable, at least until the market's natural economic forces increase the labour cost in developing countries such as India and China. It is a well-documented fact that to be competitive now depends more than ever on a company's capacity for innovation and on the level of its customer services, both of which attributes depend on the level of involvement and motivation of the workers. Total reward management (TRM) is a holistic practice that interprets these growing needs in organisations and offers a new action mode oriented towards pushing the use of Information Technology in supporting the improvement of people performances, by understanding employee needs and by designing customized incentives and rewards. In a recent study carried out by Watson Wyatt (Watson Wyatt Worldwide, 2000), interesting statistics emerged about the factors

that most commonly influence people's performance within a company. According to the study, there are three factors that stand out from the rest, namely, trust in senior leadership, chance to use skills on the job, and competitiveness of rewards. The Human Resource (HR) departments that historically looked after all the personnel development issues are now facing a new challenge: to reinterpret their role and become a more strategic component for the company, by contributing in the definition of incentive plans and professional development. To achieve this goal, they strongly need the participation of those who better know the single individuals, working side by side and coordinating their activities: the line managers. Geographical dislocation, complexity of roles and the escalating average size of the companies, force the HR departments to involve middle management in providing the right answers to the pressing demands of the employees. The line managers on the other hand do not possess the right background to cope with internal conflicts, to make objective evaluations and to act as compensation experts towards their staff. They need the right support and a good mix of up-to-date infor-

mation in order to apply their judgement in a timely and effective manner.

2 THE ROLE OF INFORMATION TECHNOLOGY IN TRM

IT support in this area could be very valuable if designed in a way that foster collaboration and facilitate the devolution of some HRM responsibilities to the line managers. Many authoritative management theories, like Drucker's (Drucker, 1955), Mintzberg's (Mintzberg, 1973), include responsibilities such as "hiring", "motivating" and "people development" as well as other more operational activities. As Mintzberg sums up; "He [the manager] defines the milieu in which they [his subordinates] work, motivates them, probes into their activity to keep them alert and takes responsibility for hiring, training and promoting them" (Mintzberg, 1973), p96).

The *Team Advisor* project addressed those issues by designing and implementing a platform for collaboration in the complex area of personnel development and reward planning. Its goal was to enable the line managers to be in charge of their own development plans by providing them with a personalized and contextualised set of information about their teams, together with some policy guidelines to follow in the implementation phase of those plans.

The use of profiling methodologies appeared very promising in this area. Personalization is very common in the area of ecommerce, where a user explicitly accepts the site to store information on her or himself such as her or his preferences in order to be provided of personalized recommendations. The more such a system knows about users the better it can serve them effectively. There are different styles, and even philosophies, regarding how to teach computers about user habits, interests, patterns and preferences. User modelling simply means ascertaining a few bits of information about each user, processing that information quickly, and providing the results to applications, all without intruding upon the user's consciousness. The final result is the construction of a user model or a user profile (Kobsa, 1993). The application of profiling methodologies was experimented then to create personalized incentive plans that could reflect the history and the habits of the single individuals as well as balancing the fulfilment of her or his needs with the company's global perspective.

3 MARKET ANALYSIS

Our analysis of the actual context of Human Resource Management (HRM) applications has shown that most of organisations that already use software solutions for employee administration are now searching for applications which can strengthen their HRM systems with decision support functionalities that can simplify their management processes. We did a market research that involved the following software solutions: Authoria Advisor¹, Disc Profiler², Incentive Suite³, Etweb Enterprise⁴, Onesis IAS 19⁵, H1 HRMS⁶, IDP-IDipendenti⁷, Minosse⁸.

The market segmentation was analyzed focusing on those products that appeared to be more competitive in terms of profiling technologies and rewards management system, which are essential requisites to create customized reward recommendations (Spitzer, 1996; Busacca, 1998). The obtained results are shown in a segmentation matrix (Figure 1) based on the two variables "variety of rewards offer" (rewards library on axes Y) and "focus on profiling techniques" (profiling technology on axes X).

None of the assessed information systems presented a good mix of both required features. Thus they are mainly positioned in the lower part of the matrix, manifesting an insufficient level of detail in the rewards range definition. The analyzed softwares have in fact been developed essentially for supporting personnel administration, with low attention to more complex processes, such as customized reward planning and assignment. On the other hand, the upper right part of the matrix represents the ideal placement of the envisioned software application, since it requires not only a high-level quality in profiling technologies and in reward library definition, but also a strong interconnection between the two aspects. More accurately, this application has been designed for merging contents from profiling system and elements of reward library and create suggestions for customized incentives: the purpose is to create a kind

¹Authoria Inc., <http://www.authoria.com/AdvisorSeries.204.aspx>

²Axiom Software Ltd., <http://www.axiomsoftware.com/discprofile.asp>

³Nexcentec Software Inc., <http://www.nexcentec.com>

⁴ExecuTRACK Software AG, <http://www.executrack.com/en/solutions.html>

⁵Onesis S.p.A, <http://www.onesis.it>

⁶EBC Consulting Srl, <http://www.ebcconsulting.com/cgi-bin/private/hrms\area.cgi>

⁷TPC&Join s.r.l., <http://www.idipendenti.it/demo/demo.asp>

⁸Mizar Informatica s.r.l., <http://www.mizar.it/prodotti/index.php\#minosse>

of "virtual manager" supporting enterprise compensation and reward policies.

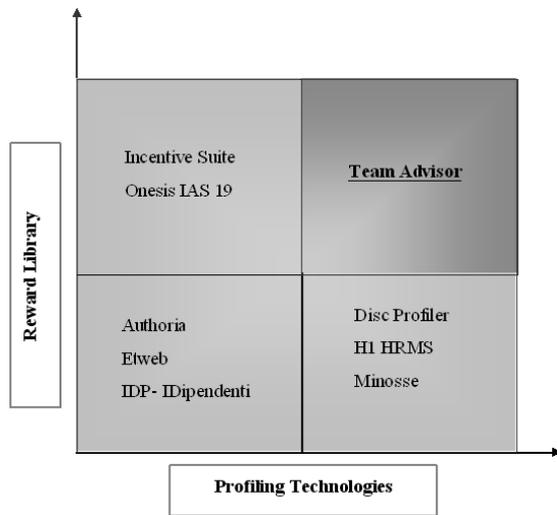


Figure 1: Segmentation Matrix.

4 THE TEAM ADVISOR SYSTEM

Within the Team Advisor project, our work was focused on the application of the User Profiling techniques in the Total Reward Management context, where we experimented the following analogies with respect to the on-line market: Customer/Employee, Product Portfolio/Reward Library and Shop/Employer.

In this context, a user profile is meant as the set of information collected about a user, in order to take into account her or his needs, wishes, and interests in granting those benefits that are part of the organisation's incentive programmes, thus a set of recommendations reflecting those preferences. Rather than addressing the recommendations to the customer, as it generally happens in the standard e-commerce applications, the Team Advisor project experimented a new form of advice addressed to the line manager, suggesting the best reward policy for a specific staff member, depending on a profile built upon both demographic data and behavioural preferences collected through a commercial Human Resources Management portal, without asking to the employee to compile a periodical questionnaire to provide her or his preferences for potential rewards. As well as in the e-commerce area, the privacy problem is also to be considered in the TRM context: many users are distrustful to give private data because they wish to have their privacy guaranteed and they may also be afraid

of being controlled. One possibility is to handle personal data for the customer so that she can control/edit her own user model. In addition, the company must guarantee not to give personal data to a third party and in addition should provide suitable technical means for users to rectify user model items (Kobsa, 2001). Actually, the core issues are trust and transparency, because the user wants the companies to respect their privacy by clearly declaring when they are collecting the personal data, offering opt-in to data collection programs rather than opt-out only choices. In fact, the EU Privacy Directive (European Parliament and Council of the European Union, 1995) gives users the right to have access to "the knowledge of the logic involved in any automatic processing of data concerning the user". Taking into the right consideration privacy issues, the suggested metaphor allowed for a new HRM paradigm in which the line manager acts as a partner of the HR department. Provided with a personalized recommendation system, he could evaluate individual needs and expectations and try to find the right balance between them and the organisation's rewarding strategy received by the HR department.

5 EMPLOYEE PROFILING

In the Team Advisor project, the Employee Profiling system creates detailed profiles of the co-workers. The Employee Profiling system is built upon a Personalization Engine (PE) (Semeraro et al., 2003; Licchelli, 2005) that takes advantage from information stored in a commercial Human Capital Management application. The PE component is a Java application deployed in Apache Tomcat. The Human Capital Management application, provided by a global software player in the area of Human Resources Management Systems, is a web application written in Visual Basic for the Microsoft COM+ architecture. The integration of the two systems was carried out by a C# module run in a Microsoft .NET environment, and was based on RDF/XML-driven interoperability. The whole integration architecture schema is shown in Figure 2.

Before starting with the profile creation process, a preliminary work is needed to establish a formal description of the features necessary to accomplish the given task. Starting from these features it is possible to define the representation language of the entire learning system. In parallel it is necessary to define a number of classes that characterize the corresponding kind of reward to be associated to the various configurations of features. Then, it is possible to create the employee profiles in two steps: during the first one a number of sample classification are provided to the Personalization Engine in order to create a set of

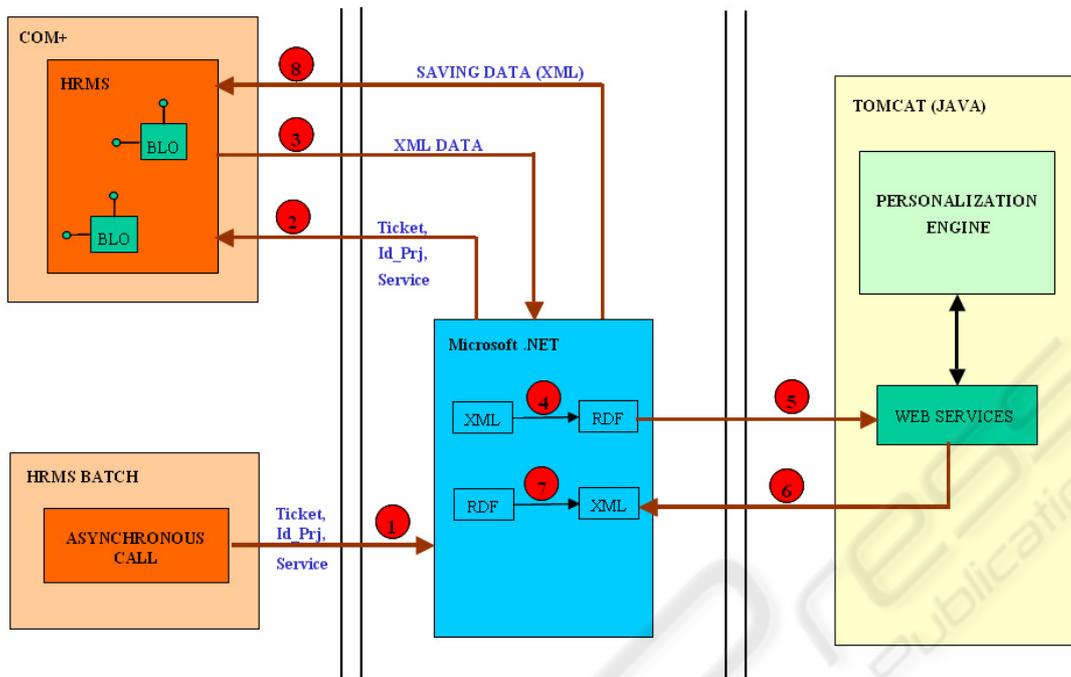


Figure 2: Employee Profiling System.

classification rules. In the second phase, those rules are applied, employee by employee, to the whole set of identifying features. The application then generates a set of recommendations composed of a list of rewards the system deemed appropriate for each individual, together with a ranking useful to prioritize the decisions.

5.1 Personalization Engine

The PE component is the part of the system that uses supervised learning techniques to automatically discover users' preferences. It interacts with the WEKA library (Witten and Frank, 2000) in order to induce rule sets for classification. Both the input and the output of the PE component is composed of RDF models. These models contain:

- the input to the learning process (the set of positive and negative examples, as well as the definition of the learning problem, i.e. the features together with their possible values, and the name and type of classification to be learned), the main class for this being pe:InstanceBag;
- the results of the learning process (a set of classification rules), represented by the pe:Classifier class;
- the input to the classification phase, in which the learned rules are used to categorize previously un-

seen instances, which consists of a pe:Classifier instance and one or more pe:InstanceBag instance, together with the related output, which is instance of pe:ClassificationResult.

The main functionalities are then:

Phase name	Input	Output
Rule building	pe:InstanceBag instance	pe:Classifier instance
Classification	pe:InstanceBag (unlabelled) pe:Classifier	pe:ClassificationResult

5.2 User Profile Generation Process

In the context of TRM, the problem of learning employee's preferences can be cast to the problem of inducing general concepts from examples labelled as members (or non-members) of the concepts themselves. Given a finite set of categories of rewards $C = \{c_1, c_2, \dots, c_n\}$, the task consists in learning the target concept T_i "employees interested in the category c_i ". In the training phase, each individual set of features represents a positive example regarding the categories the employee is interested in and a negative example regarding those she or he dislikes. To this goal we chose an operational description of the target concept T_i , using a collection of rules that match

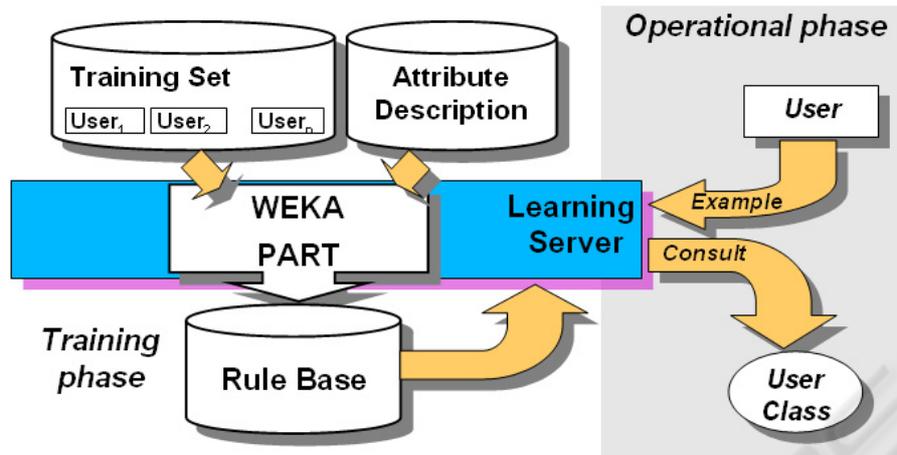


Figure 3: Personalization Engine learning process.

against the features describing a user in order to decide if she or he is a member of T_i . The subset of the instances chosen to train the learning system has then to be labelled by a domain expert, that classifies each instance as member or non-member of each category. Stated that, in the context of TRM, the domain expert belongs to the HR department, in order to facilitate the definition of the training sets we introduced a pre-classification process interesting population samples instead of single individuals. The expert was then asked to classify groups of employees sharing the same subset of characteristics, and to decide whether they belong to a certain category or not.

There are 4 rules extracted for class **Company Car**:

```

if Seniority <= 7.0
  and Job Class = Employee-CONS then
    Class: yes
else if Seniority > 7.0 then
  Class: Estate
else if Job Class = White Collar-SALES then
  Class: no
Otherwise Class: Saloon
    
```

Figure 4: An example of classification rules for the reward category "Company Car".

This approach allowed the generation of training sets without the direct knowledge of the candidates, thus taking advantage of a natural clustering habit of the expert user. The training instances were processed by the Personalization Engine, which induced a classification rule set for each reward category by taking into account the whole set of features at a higher

Profile for User: Thomas Rice	
AGE	41
GENDER	Male
MARITAL STATUS	Married
JOB CLASS	Blue Collar-DEV
SENIORITY	5
NUMBER CHILDREN	0
.....
Rewards for Employee Thomas Rice:	
<ul style="list-style-type: none"> ▪ Company Car = city car (0.863) ▪ Notebook = no (0.667) ▪ Flexitime = yes (0.897) ▪ Sound-Video Tools = no (0.568) 	
.....	

Figure 5: Employee Profile.

level of detail than the expert user can afford (Figure 3). Each rule is composed of an antecedent, or precondition, and a consequent, or conclusion. The antecedent is a series of tests, like the tests at nodes in decision trees, while the consequent gives the category that applies to instances covered by that rule (Figure 4). The learning algorithm adopted in the profile generation process is based on PART (Frank and Witten, 1998), a rule-based learner that produces rules from pruned partial decision trees, built using C4.5's heuristics (Quinlan, 1993). The main advantage of this method is its simplicity: it produces good rule sets without any need for global optimizations.

The actual employee profile generation process is performed by applying this set of rules to the employee data. For each reward category, the system is

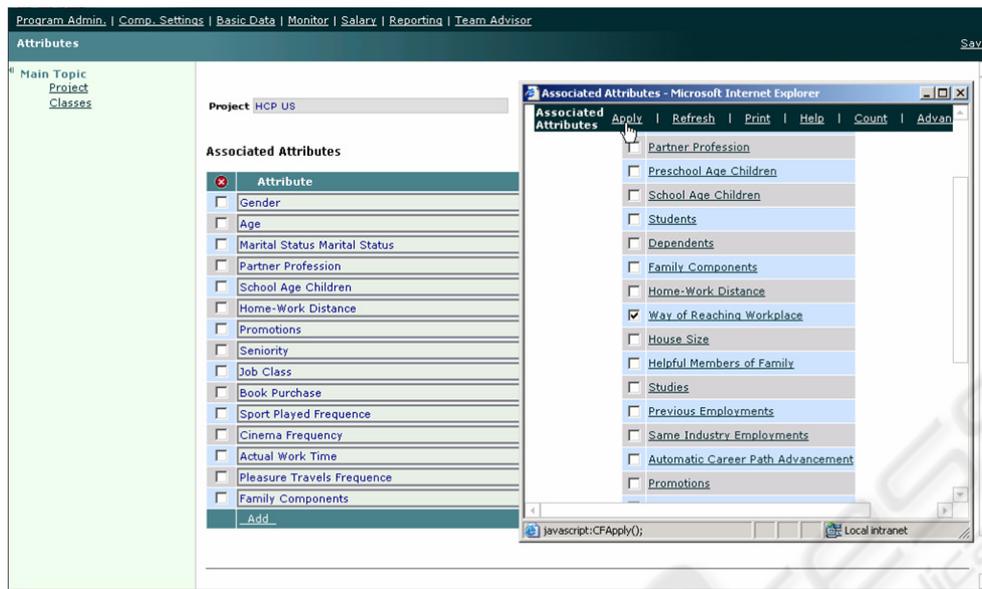


Figure 6: A list of the most representative data.

able to predict whether the employee is interested in it or not, specifying the hypothetical satisfaction level for each. An employee profile (Figure 5), as intended within the Team Advisor project, is then composed by two main frames: the frame of employee data, and the frame of the rewards "learned" by the system.

6 MANAGER ADVISOR

TeamAdvisor has been designed to provide personalized reward recommendations (Kerr, 1995) through the analysis of user profiles stored in a support database. This allows for a rationalization of the process of incentives planning, with consistent time savings in the implementation of decisions. However, we had to cope with the problem of identifying who is the best candidate to examine the recommendations provided and to exploit them. This requires on the one hand some degree of familiarity with compensation and rewarding practices, and on the other hand a good acquaintance with the employee they are addressed to (Wanless, 2003). An innovative solution could be to integrate the traditional competencies of the HR department by delegating to the line managers some of their activities. Legge (Legge, 1995) underlines that HRM is "vested in line management as business managers responsible for coordinating and directing all resources in the business unit in pursuit of bottom-line profits". Therefore evaluation process, employee development, performance management and rewards assignment can be considered the best areas for an

effective intervention of the line on HRM. In order to simplify organizational structure and to humanize personnel administration procedures, they seem to be the most appropriate figures to accomplish these changes (Renwick, 2003). Moreover, they are supposed to know personally the staff they manage, also thanks to informal conversations in the workspace, so that they can add a personal value in examining recommendations and in choosing which reward to assign. Two factors play against a partial devolution of HR strategic management to the line manager (Whittaker and Marchington, 2003):

- They generally have a heavy load of work responsibilities, which should not be increased with tasks they have no great competence about.
- Because of their dimensions, many large-sized enterprises make it very difficult to build human relations that go beyond formal employer-employee relationships.

The answer to these objections can be found in the philosophy of the proposed IT solution: the adoption of a collaborative software platform delivering a preliminary reward plan to the managers, makes the devolution process a real thing, and actively supports decision-making. Line managers can then add their personal judgement coming from personal acquaintance storing from the information provided by system as a result of the analysis of objective data stored in the company database. To substantiate these reflections with a use case, we created a demo data set representing a US firm working in the banking/financial industry, and did a full run of the Team Advisor sys-

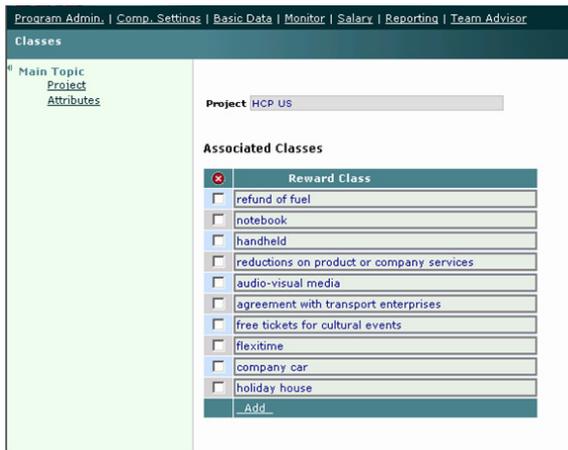


Figure 7: Selected rewards into the organizational incentive plan.

tem within the company reward assignment process. An HR domain expert sets up the employee profile generation process in two phases. First, she selects a list of the most representative data about identity, professional path and socio-demographical background of the employees. Anagraphical and socio-demographical data closely pertain to human dimension of the employee and are the same for every company. They can be collected and updated through periodical on line surveys. On the contrary, data about job conditions, although generally available in all companies' databases, are context-sensitive, and may be more or less relevant according to the external environment and to the company policy. In figure 6 it is shown, for a demonstrative purpose, a partial list of the attributes enclosed in the employee-profile. This can be properly customised according to the needs of each company.

Second, she selects the rewards listed into the organizational incentive plan, shown in Figure 7, to build the Team Advisor Reward Library. For each item a domain is also specified, made up either of yes/no labels or of multivalued labels (i.e. saloon, estate, city car, as possible values for the item "company car"). The reward library provided in the example is created following a recent study by OD&M (OD&M Consulting, 2005), and is given as a basic customizable set. A user profile generation process is then started, and it eventually produces the employee profiles as described above (see Section 5.2).

Take now a manager of our sample enterprise, Fred Sidel from the Atlanta Branch, receiving recommendations about potential rewards to be assigned to his team, through a dedicated section of his digital dashboard. The system provides him with a detailed view of the recommendations for each of his thirteen co-workers, as shown in Figure 8.

For each recommendation one single label is specified, that is the domain value for which the recommender has computed the highest popularity rating; the goal of recommendations is to inform the line manager about the preferred rewards and their adherence with the related employee profile. It's up to the manager then to decide whether to use such information, including the reward recommendation into the incentive plan for each employee, or ignoring it and adopting an autonomous evaluation method.

7 CONCLUSION AND FUTURE WORKS

The work carried out in the Team Advisor project suggested that the application of profiling and recommendation techniques in the context of the incentive planning processes it is not only possible but also effective in providing support to the decision-making. We observed how the recommendations could act as a valuable starting point for the managers who need support in an activity they are not used to perform, by providing a means for unleashing unexpressed and undiscovered connections among the various elements that govern the reward assignment process. In addition, the recommendation system allows for the distribution of the knowledge of the HR domain expert by providing timely and accurate information about the preferences of the employees, not forgetting the overall company perspective. In this context, the judgment of the managers can be applied to refine the suggestions and to convert them into an effective development plan.

Starting from the results achieved in the prototypical phase, the Team Advisor working group is committed to perform both a technical and an organizational evaluation of a commercial version of the software developed. For what concerns the technical validation we are interested in checking how the system is able to replicate the knowledge of the domain expert and thus to provide coherent recommendations. On the organizational level it is instead important to verify how the provided recommendations can contribute to streamline the compensation and rewarding process of the organisations. To this goal, we're going to submit an ad-hoc survey to real users of the system, chosen among the managers implementing personalized incentive plans. This survey will aim at evaluating the overall satisfaction as well as the acceptance level of the recommendations as for their usefulness, clarity and completeness.

For what concerns possible future software developments, the group is aiming at embedding new functionalities capable of collecting live user feedbacks on the recommendations, and use them in order to re-

The screenshot shows a web application interface with a navigation menu at the top: My Data | My Development | Team Management | Team Development | Team Planner | Recruitment | Reporting | My worklist. The main content area is titled 'Team Management > Basic Data: William Lurs' and includes 'Delete' and 'Save' buttons. Below the title, there is a box containing employee details:

Full Name William Lurs
E-Mail hlurs@acme.com
Company HCP US
Location Atlanta
Job Credit Analyst
Organizational Unit Atlanta Branch
Main Position Branch Manager Assistant

Below the details is a table titled 'Recommended Rewards':

Reward Name	Label	Ratings
audio-visual media	no	1
holiday house	no	1
notebook	yes	0.75
free tickets for cultural events	no	1
company car	saloon	0.666
flexitime	no	0.9
handheld	no	1
agreement with transport enterprises	yes	0.823
reductions on product or company services	no	0.75
refund of fuel	yes	1

Figure 8: Recommendations for an employee.

fine the process of profile generation. This will enable the system to become a dynamic engine of employee profiling, thus supporting the organisations in refining and sharing the knowledge about its human capital.

REFERENCES

- Busacca, A. G. (1998). Il customer profiling. In *Costruire Fedeltà*. Il Sole 24ore.
- Drucker, P. F. (1955). "management science" and the manager. *Management Science*, 1(2):115–126.
- European Parliament and Council of the European Union (1995). Directive 95/46/ec of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data. In *Official Journal of the European Communities*, page 31.
- Frank, E. and Witten, I. (1998). Generating accurate rule sets without global optimization. In *Proceedings of the 15th International Conference on Machine Learning*, pages 144–151. Morgan Kaufmann.
- Kerr, S. (1995). An academy classic: On the folly of rewarding A, while hoping for B. *Academy of Management Executive*, 9(1):7–14.
- Kobsa, A. (2001). Tailoring privacy to users' needs. In *Proceedings of the 8th International Conference on User Modelling*. LNAI 2109, pages 303–313. Springer.
- Legge, K. (1995). *Human Resource Management: Rhetorics and Realities*. Macmillan, Hampshire.
- Licchelli, O. (2005). *Personalization in Digital Libraries for Education*. Computer Science in the Graduate Division of the University of Bari, Italy.
- Mintzberg, H. (1973). *The Nature of Managerial Work*. Prentice-Hall, London.
- OD&M Consulting (2005). Rapporto benefits 2005. in collaborazione con Lavoro & Carriere - ed. Il Sole 24 Ore.
- Quinlan, J. R. (1993). *C4.5: Programs for Machine Learning*. Morgan Kaufmann.
- Renwick, D. (2003). Line manager involvement in HRM: an inside view. *Employee Relations*, 25(3):262–280.
- Semeraro, G., Abbattista, F., Degemmis, M., Licchelli, O., Lops, P., and Zambetta, F. (2003). Agents, personalisation and intelligent applications. In Corchuelo, R., Cortés, A. R., and Wrembel, R., editors, *Technologies Supporting Business Solutions, Part IV: Data Analysis and Knowledge Discovery, Chapter 7*, pages 141–160. Nova Sciences Publishers.
- Spitzer, D. R. (1996). Power rewards: Rewards that really motivate. *Management Review*, 85(5):45–50.
- Wanless, C. (2003). Devolution of HR activity to the line: does the reality lag behind the rethoric? <http://business.king.ac.uk/research/hrm/wanless.pdf>.
- Watson Wyatt Worldwide (2000). WorkUSA 2000 - Employee Commitment and the Bottom Line. <http://www.watsonwyatt.com/research/resrender.asp?id=W-304&page=1>.
- Whittaker, S. and Marchington, M. (2003). Devolving HR responsibilities to the line. Threat, Opportunity or Partnership? *Employee Relations*, 25(3):245–261.
- Witten, I. H. and Frank, E. (2000). *Data Mining: Practical Machine Learning Tools and Techniques with Java Implementations*. Morgan Kaufmann Publishers, San Francisco.