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A MOBILE FRAMEWORK FOR COMPETENCE EVALUATION: INNOVATION ASSESSMENT USING MOBILE INFORMATION SYSTEMS

Marcos Ruano Mayoral, Ricardo Colomo Palacios, Juan Miguel Gómez, Ángel García Crespo

Department of Computer Science,
Universidad Carlos III de Madrid, Spain

E-mail: marcos.ruano@uc3.es (Marcos Ruano), ricardo.colomo@uc3.es (Ricardo Colomo), juanmiguel.gomez@uc3.es (Juan Gómez), angel.garcia@uc3m.es (Angel García)

Abstract

The environment surrounding organizations is characterized by an increasing necessity of competent personnel but with finite competence level. From the scope of the management of those human resources, one of the most crucial aspects is to be able to measure the competence level of each professional as quickly and precisely as possible. This paper introduces a tool, based on HR-XML standard, to feed competence evaluation with data or evidences that help to fit performance evaluations to the actual performance of the employees. Mobility capabilities in performance evaluation, particularly in the innovation field, involve an inventive contribution to current Competence Management Systems that, due to their lack of flexibility, hinder the full development of the capability to include evidences wherever they may take place, whether it is at work, at client's office or in a recruitment interview.

Introduction

During last few years, competential paradigm has become a standard for the modern Human Resources Management (HRM). The importance and the impact of this concept have headed industries to develop a set of solutions to help the introduction of Competence Management into organizations. The work developed in this paper describes a new competence management tool that is based on two main characteristics: mobility and cross-platform architecture. The presented model integrates the capabilities of a tool developed under open-source philosophy and based on the last XML standards with one of the most popular clients nowadays, the smart phone. In order to state in a clear way the state-of-the art, this introduction tackles first the definition of the competential paradigm. This first section offers the justification for the need of implementing a general purpose Competence Management System for the evaluation of innovation as a competence. Secondly a description of the Competence Management Systems is provided and lastly an analysis of the importance of mobile systems in today's Information Technologies environment is presented.

The Competential Paradigm

The competence approach to human resources management has a long history. The early Romans already practiced a sort of competence profiling in attempts to detail the attributes of a "good Roman soldier" (Draganidis & Mentzas, 2006, p.52). More recently, the concept of competence was used by early 20th century scientific management (Taylor, 1911), and has been used in the field of human resources management since the middle seventies, due to the works by McClelland (McClelland, 1973). In the context of this work, Competence is understood as the set of knowledge, skills and attitudes required in people to perform a specific task in an efficient way (Sagi-Vela Grande, 2004).

Competences' main characteristic is that they comprise a whole set of knowledge, procedures, attitudes and features that complement each other so that an individual must 'know', 'know how' and 'know how to be' to face professional situations in an efficient way. They can only be defined during an action, under job circumstances, and that is the reason why, for the competences development, the personal experience and the context that demands those competences are so crucial. Competences can be splitted into two groups, technical and general competences (Ansorena, 1996). Technical competences – including know-how, capability and aptitudes – are necessary to perform a specific job. On the other hand, general competences are not yet linked to a particular task or job position, being general behavioral characteristics or capabilities of the individual, but they do allow a cognizant job performance.

Over the last several decades, business books and trade press have flooded managers with workforce practices each demonstrated to produce benefits in at least some applications (Curtis et al., 2001). These practices include competence-modeling, 360º feedback reviews, knowledge management, competence based team-building, incentive based pay, mentoring, meeting management and empowered work among others. Many of them are based on competence definition and evaluation. People CMM (Curtis et al., 2001) bases also many of its practices in competence evaluation. Competence evaluations are used for promotion issues, assignment to specific positions, creating personal development plans, identifying relevant career options or evaluating the impact of workforce practice, among many others. Based on a survey of Competence Management systems, Draganidis & Mentzas (2006) point out that competences are capital in the following employee management applications: Workforce planning, Recruitment management, Learning management, Performance management, Career development and Succession planning.

Following the increasing importance of Competence Management, an ever-increasing number of commercial Information Systems include Competence Management modules. Draganidis & Mentzas (2006) outline that open standards (XML, web services, RDF), semantic technologies (ontologies and the semantic web) and portals with self-service technologies represent the most extensively researched areas for the development of those applications.

Human resources management is a crucial process for the proper daily operation of organizations. Particularly, a substantial number of companies related to technology and innovation are structured in a project-oriented way. One of the most relevant and unifying initiatives in these environments is the Project Management Body of Knowledge (PMBOK) published by the Project Management Institute (PMI). One of the knowledge areas comprised in PMBOK is Project Human Resource Management. Project This area includes the processes required to make the most effective use of people involved with the project (PMI Standards Committee, 2000). This PMI Knowledge Area includes topics as recruitment based on staffing skills, retention and performance evaluation. All these activities imply, or should imply, the use of a competence evaluation system.

Particularly, several authors consider "Innovation" as a dependent observation competence; what means that should be identified by the observation of a set of several competences (Robinson et alt 2007). According to their work, "Innovation" comprises two stages: the generation of ideas and the application of ideas. The generation of ideas may sometimes involve creativity, which itself is often considered to be highly related to the competency intelligence. The subsequent application of these ideas may involve competencies such as problem solving and technical ability. Therefore, it can be stated that the assessment of certain competences, and particularly 'Innovation", might comprise the observation of several competences that initially seem to be independent but whose verification may entail the presence of other sets of associated competences.

Competence Management Systems

Knowledge Management is a very close concept to Competence Management, and technical literature (Allee, 1997) tends to generate some confusion when analyzing Knowledge Management and Competence Management Systems. Competence Management Systems focus is on employee life cycle, covering competence requirement analysis (Lindgren & Stenmark, 2002) and other related HRM topics, such as personnel selection and compensation (Sagi-Vela Grande, 2004). Competence Management is a process that starts by defining the required organizational

competences, assigns them to employees, observes them through behavior, asses them according to organizations defined values and permanently, improve them (Levy-Leboyer, 1997). Figure 1 presents a dynamic vision of the processes involved in the Competence Management.
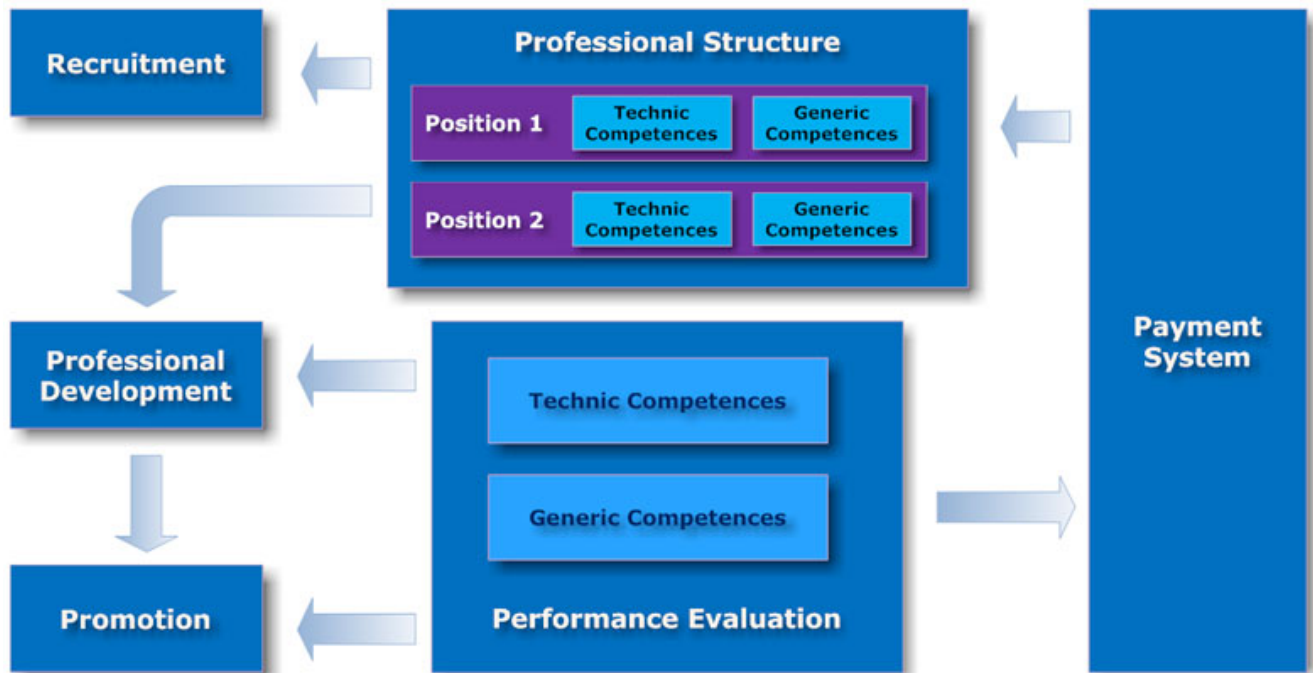

Figure 1. Competence Management Processes.

As a result of the widespread use of software in business circles, industry has produced several tools to support the different concurrent processes related to Competence Management within organizations. Human Resource Management Systems (HRMS) have been bundled since mid 1980s within ERP (Enterprise Resource Planning) suites. More precisely, some vendors of this particular software specialized towards HRMS to differentiate from their competitors.

Since 1990s the popularity of the competential paradigm has leaded to the irruption of new software tools focused on the competence management, assessment and development. The tools for supporting competence management can be classified into the four following families:

- Large ERP Suites. These are extremely complex applications that integrate in a modular way the whole set of processes within the organization. At the beginning, due to their high costs, their clients where limited to large companies; but the creation of new business models has encouraged some SME (Small to Medium Enterprises) to become part of the client portfolio of this kind of solutions. Some examples of

this kind of solutions are SAP, Oracle/Peoplesoft and Lawson.

- SME ERP Suites. They are similar to previous, but software is tailored to SME organizations. Microsoft Navision and Axapta are relevant players in this category.
- Standalone HCMS (Human Capital Management Solutions). Large and SME driven solutions from vendors exclusively dedicated to Payroll & HCMS, not providing support for other corporate business processes (such as Supply Chain Management, CRM, Financials,...), but including fully support for Competence & Performance Management. Kronos, Meta4 and Ultimate Software play significant roles in this type of solutions.
- Competence Management Solutions. Automate Competence Management processes, in combination with Performance Management, and eventually providing support for some other related Competence Management process, in a non-comprehensive, integrated way. Snowdrop, Mindsolve and Geo Learning are relevant players in this category. The importance of mobility in this kind of business applications has meant the creation of modules to allow

access via WAP or Internet browsers. Nevertheless, the effective integration with productivity tools such as Microsoft Outlook to take advantage of their full capabilities and possibilities has not been accomplished.

This fact is the motivation of this paper, to introduce a model to allow the assessment of competences in the field of organizations whose resources perform their duties by means of mobile technologies.

This circumstance allows that the data acquisition, based on competence evidences, can be carried out not only during the usual annual competence interview, but during the whole time that the employees are performing their work activities. Due to this possibility, the reliability and precision of the evaluations and their usability will increase drastically. Additionally, the necessity of a mechanism for the collection of competential information for the assessment of innovation entails the implementation of a general purpose competence management system with mobile capabilities. On the other hand, taking into account existing standards in industry and aiming to the development of a solution that could be extended to a set of heterogeneous and interconnected set of companies, mechanisms for the exchange of competential information among diverse environments and systems should be provided. The best tool for this purpose is the HR-XML standard.

The HR-XML Consortium is an independent, nonprofit organization dedicated to the development and promotion of a standard suite of XML specifications to enable e-business and the automation of human resources-related data exchanges. By developing and publishing open, freely available data exchange standards based on XML, the HR-XML Consortium provides the means for any
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company to interact with other companies without having to establish, engineer, and implement many separate interchange mechanisms (HR-XML Consortium, 2004).

SIDES is one of the recommendations published by the HR-XML Consortium. SIDES stands for Staffing Industry Data Exchange Standards and it is a suite of data exchange standards that offers new efficiencies and cost savings for staffing customers, staffing suppliers, and other stakeholders in the staffing supply chain (Bartkus et alt 2007).

One of the multiple parts of SIDES is a competence schema designed to fulfill the following requirements (Allen, 2004):

- The competence schema is simple and sufficiently flexible and generalized so that it is useful within a variety of business contexts.
- The schema provides structure to enable competences to be easily compared, ranked, and evaluated.
- The schema is capable of referencing competence taxonomies from which competence descriptions were taken or used.
- The competence schema is relatively simple and compact so that it does not add to the complexity of the process-specific schemas within which it is used.

For the purpose of our work, the competence schema allows the integration with other Human Resources Management Systems but, to achieve the full capacity of competence analysis that this framework seeks, it is necessary to build an extension of the competence schema to store some extra information about each competence evidence. The selected extension method is wrapping. Figure 2 shows the XML Schema of the HumanResource data type incorporating the definition of the same type provided by HR-XML
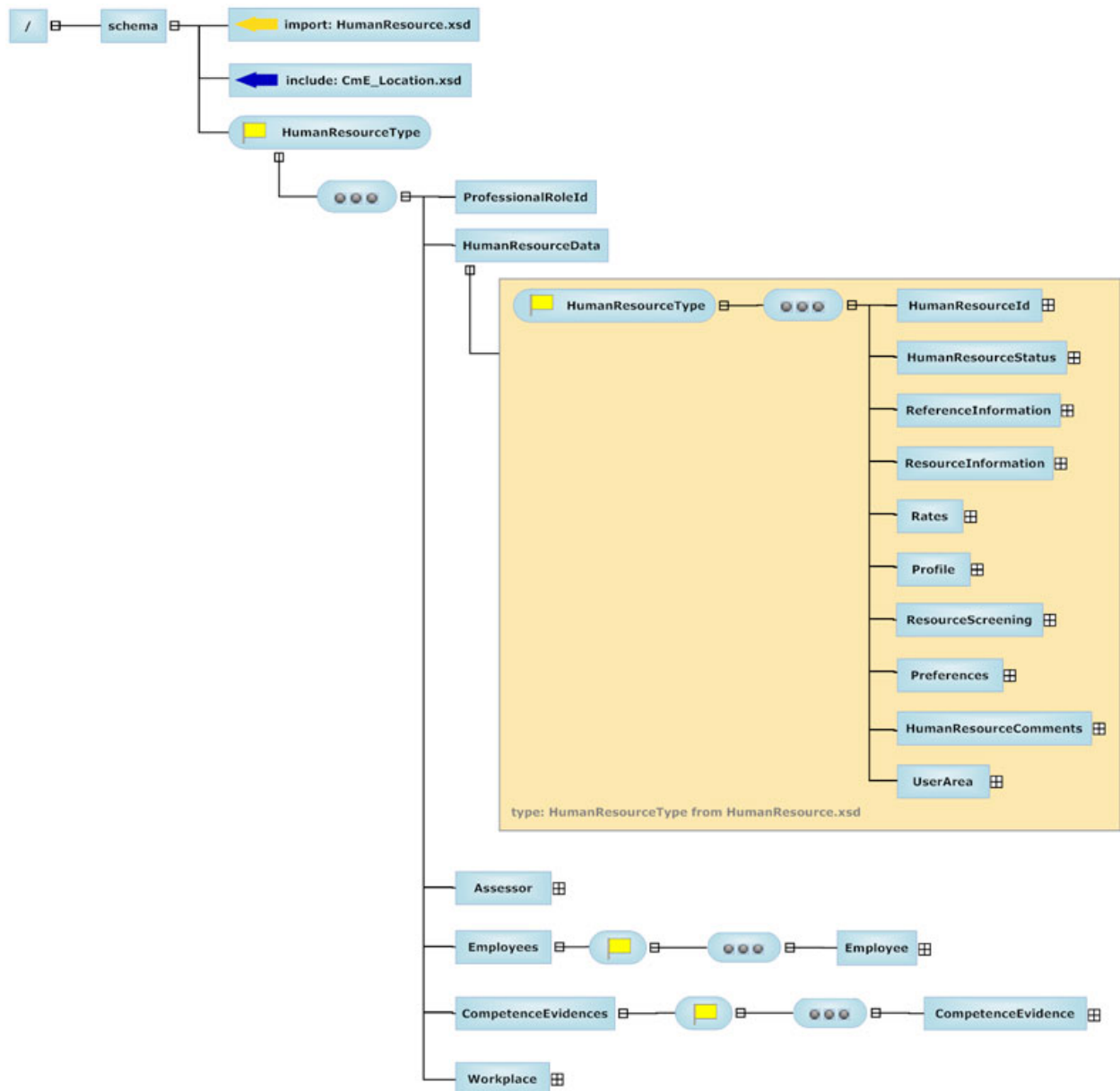
Figure 2. XML Schema

The addition of the described data implies a guarantee for the adaptation of the characteristics of the modern Competence Management to the information systems that support it, including improved analysis and mobility capabilities.

The importance of mobility

In recent years two unrelated trends have stood at the forefront of technology. First are the great improvements in the accessibility of information which, driven by the Internet revolution, have made it possible to access huge amounts of information using a traditional PC and a simple browser. Second are the advancements in computer technologies which reach beyond the traditional desktop environment to areas such as mobile, or even wearable, computing. (Carmeli & Cohen, 2001) Mobile

computing has the potential to radically transform the way people interact with computers. It is motivated by the observation that computing and networking technologies are becoming increasingly powerful and affordable (Grimm, 2004). Another crucial tendency that is present in enterprise systems is the importance of system and even application integration. In most enterprise projects, the majority of effort surrounds integration. Integration is mainly about extending systems and most often it is really about extending business processes. Mobile solutions extend business processes to be available to the workforce and other participants in business functions. It means that the employees can access and even manipulate core business information just when they need it the most – immediately (Forsberg & Sjostrom, 2002).

One of the major forces in the marketplace, the changing environment in which businesses must do business, is speed. Everything happens faster in a sphere where information is exchanged digitally and people who need the information are connected to it. Mobile technologies contribute significantly to the speed of business in many ways. Corporate back office as well as any connected mobile worker can be made available at the point of mission critical activity, leading to freely exchanged interaction (Forsberg & Sjostrom, 2002).

Mobile Framework

General Description

The designed solution is intended to, among other functionalities, support the process of documenting competence evidences wherever they may take place: meetings at clients' office, different acts and events... In a brief description, it is a tool that allows the incorporation of new features such as, personal productivity and mobility, to the performance evaluation based on competences.

Having this purpose in mind, the solution has been created as an open source tool which will aggregate the set of functionalities available in the Competence Management solutions, adapting them to the HR-XML standard and extending this standard to include those functionalities related to mobility. The main functionalities provided by the framework are:

- Definition of the structure of the company: divisions, departments, positions...
- Description of the different positions according to competencies.
- Planning of meetings related to performance assessment.
- Effective assessment of the performance of the employees using either 360o Feedback, or competence interview, or Assessment Center.
- Collection of competence evidences outside evaluation periods.
- Reporting.

Architecture

In order to provide these functionalities, the designed architecture is based on web and it is integrated with new mobility solutions via Wi-Fi, Bluetooth or GPRS. The main objective is to support the decisions related to professional development of the workers by means of data obtained and collected with the minimum delay as possible.

The architecture of our system is based on a set of smart clients, a server and a competence database as is explained next in this section. Following Figure shows a graphical representation of the suggested architecture.
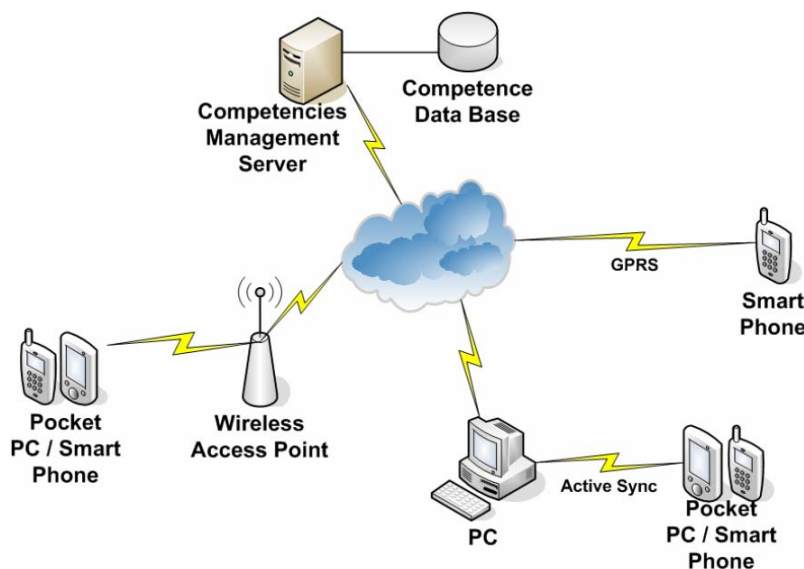

Figure 3. Architecture of the solution.

Smart clients comprise both Smart Phones and Pocket PCs. By means of this kind of clients, the competence evaluator can capture a competence evidence in a Task or in a Calendar Entry in Pocket Outlook. Pocket Outlook was chosen because it is present in every Smart Phone and Pocket PC, and it is a worldwide used PIM (Personal Information Manager) with proven capabilities. The integration between Pocket Outlook and the developed tool is achieved via a Pocket Outlook add-in in the Tools menu. When selecting a Task containing information about a competency evaluation the add-in extracts the necessary data and introduces it into the framework.

The communication between the smart clients and the competence server is carried out making use of the full connection capabilities of these devices, namely:
• Wireless LAN connection through a wireless access point.
• GPRS connection through a mobile telephony network.
• Synchronization with a personal computer or laptop using ActiveSync software.

If there is any wireless connection, the application can be accessed using a web browser in the smart client. In the case that no connection is available, the captured data can be stored in the device until it is synchronized or a connection can be used.

The competence database stores the information related to the competence evaluations that have been performed, the competence evidences captured and other relevant competence information. The purpose of the Competence Server is first to receive the data regarding to the competence evidences coming from the smart clients and then store it in the competence database. The server can also be used to generate competence reports including:

• Personal reports about one individual, that allows the study of the competential evolution of an individual.
• Department reports including competency information about a work team as a whole.
• Role reports and comparisons.
• Evidence reporting that includes a detailed analysis of the competence evidences stored in the server.
• Geography of competence reports to analyze the distribution of competences among the different places in which the people hold their jobs. This kind of reports is useful to detect differences on the competential performance of the workers depending on where they are developing their duty.

The competence server has been developed under Open Source paradigm at University environment. By way of example, Figure 4 shows some of the elements of the mobile application.

Figure 4. Mobile application screenshots.

Discussion

Mobile Business Systems will colonize companies as Business Systems did in past decades. In the industrial and services sphere where we live, it is more and more important the human capital. The management of this kind of resources is based on the correct assessment of the performance of the knowledge workers. The proposal exposed in this paper combines the most outstanding and modern ideas of the fields on which it is based: human capital management through competencies management feeded on the systematic collection of competency evidences. This brings us the possibility of performing this collection anywhere in a discreet and integrated way and the capacity of sharing that knowledge with the appropriate stakeholders in the company.

The proposed future work is the development of different practical applications. Firstly, it would be desirable the adaptation of the developed client to make it compatible with the biggest number of mobile devices in the market as possible. Secondly, the development of particular solutions for different kinds of workers, applying and suggesting performance measurement templates based on the technical literature. And thirdly, it is proposed the adaptation of the solution to specific innovation environments and not restricted to certain professional profiles, but to homogeneous business environments.

References

Allee, V. (1997). *The knowledge evolution: expanding organizational intelligence*. Butterworth-Heinemann, Boston.

Allen, C. (2004). Competencies (Measurable Characteristics). Retrieved from the Web 7/31/2007 http://ns.hr-xml.org/2 3/HR-XML-2 3/CPO/Competencies.html .

Allee, V. (1997). *The knowledge evolution: expanding organizational intelligence*. Butterworth-Heinemann, Boston.

Ansorena, A. (1996*). 15 Pasos para la Selección de Personal con Éxito*. Paidós, Barcelona.

Bartkus, K., Dolan, K., Bubsey, G., Ryan, T., & Johnson, B. (2006). Staffing Industry Data Exchange Standards (SIDES). Retrieved from the Web 7/31/2007 http://ns.hr-xml.org/2 4/HR-XML-2 4/SIDES/SIDES.html .

Carmeli, B. & Cohen, B. (2001). PiNet: Wireless Connectivity for Organizational Information Access Using Lightweight Handheld Devices*. IEEE Personal Communications*, 8(4), 18–23.

Curtis, B., Hefley, W. E., & Miller, S. A. (2001). *People Capability Maturity Model* (P-CMM R) Version 2.0. Technical report, Software Engineering Institute, Pittsburgh. Doc. Ref.: CMU/SEI-2001-MM-01.

Draganidis, F. & Mentzas, G. (2006). Competency based management: a review of systems and approaches. *Information Management & Computer Security*, 14(1), 51 – 64.

Forsberg, C. & Sjostrom, A. (2002). *Pocket PC development in the enterprise: mobile solutions with Visual Basic and .NET*. Harlow: Addison-Wesley, Great Britain.

Grimm, R. (2004). System Support for Pervasive Applications. *ACM Transactions on Computer Systems*, 22(4), 421–486.

HR-XML Consortium (2004). About HR-XML. Retrieved from the Web 7/31/2007 http://www.hr-xml.org .

Levy-Leboyer, C. (1997). *Gestión de las competencias: cómo analizarlas, cómo evaluarlas, cómo desarrollarlas*. Gestión 2000, Barcelona.

Lindgren, R. & Stenmark, D. (2002). Designing Competence Systems: Towards Interest-Activated Technology. *Scandinavian Journal of Information Systems*, 14, 19–35.

McClelland, D. C. (1973). Testing for Competence rather than for 'intelligence'. *American Psychologist*, 28, 1– 14.

PMI Standards Committee (2000). *A Guide to the Project Management Book of Knowledge*. Project Management Institute, Philadelphia.

Robinson, M.A., Sparrow, P.R., Clegg, C. & Birdi, K. (2007). Forecasting future competency requirements: a three-phase methodology *Personnel Review*, 36(1), 65-90

Sagi-Vela Grande, L. (2004). *Gestión por Competencias. El Reto Compartido del Crecimiento Personal y de la Organización*. ESIC Editorial, Madrid.

Taylor, F. W. (1911). *The Principles of Scientific Management*. Harper & Brothers, New York.

About authors

Marcos Ruano is a Research Assistant of the Computer Science Department at Universidad Carlos III de Madrid. He holds a BSc in Computer Systems from Universidad de Valladolid and a MSc in Computer Science from Universidad Carlos III de Madrid. He has been involved in several research projects as information management engineer and software consultant.

Ricardo Colomo has been a Faculty Member of the Computer Science Department at Universidad Carlos III de Madrid since 2002. His research interests include Software Process Improvement, Software Project Management and Information Systems. He received his PhD in Computer Science from the Universidad Politécnica of Madrid (2005). He also holds a MBA from the Instituto de Empresa (2002). He has been working as software engineer, project manager and software engineering consultant in several companies including Spanish IT leader INDRA.

Juan Miguel Gomez is a Visiting Professor at the Computer Science Department of the Universidad Carlos III de Madrid. He holds a PhD in Computer Science from the Digital Enterprise Research Institute (DERI) at the National University of Ireland, Galway and received his MSc in Telecommunications Engineering from the Universidad Politécnica de Madrid (UPM). He was involved in several EU FP V and VI research projects and was a member of the Semantic Web Services Initiative (SWSI). His research interests include semantic web, semantic web services, business process modelling, b2b integration and, recently, bioinformatics.

Angel García-Crespo is the Head of the SofLab Group at the Computer Science Department in the Universidad Carlos III de Madrid and the Head of the Institute for promotion of Innovation Pedro Juan de Lastanosa. He holds a PhD in Industrial Engineering from the Universidad Politécnica de Madrid (Award from the Instituto J.A. Artigas to the best thesis) and received an Executive MBA from the Instituto de Empresa. Professor García-Crespo has led and actively contributed to large European Projects of the FP V and VI, and also in many business cooperations. He is the author of more than a hundred publications in conferences, journals and books, both Spanish and international.