



OntoHR - ONtology Based Competency Matching Between the Vocational Education and the Workplace

Final Report

Public Part

Project information

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Executive Summary

According to the Bologna qualification structure different levels of education must prepare a student for particular organizational needs and prerequisites. Students finishing their studies at various levels of vocational education have to go through the organization's Prior Learning Assessment, in which previous experience and qualifications are evaluated against entry requirements (skills and competencies) for the job role. Broad educational qualifications are too crude for purposes of personnel selection. We therefore created more specific qualification to job matching, with the overriding purpose of tackling the conversion of vocational education qualifications into job related competencies. To facilitate this, an ontology supported selection and training system has been built in line with relevant HRM and Knowledge Management (KM) theories, employing existing educational technology such as Content Management Systems and adaptive testing. This eLearning interface is able to

- Map qualifications in vocational education to current and valid job roles
- Test and evaluate students on the basis of valid, labour market driven competencies
- Identify missing competencies and provide learning content needed to acquire them
- Address the weaknesses of particular VET curricula, and thereby provide ad-hoc support

The OntoHR consortium is consist of the following members:

- [Corvinno Technology Transfer Center, Budapest, Hungary](#) (Coordinator)
- [HRM-OB group, Amsterdam Business School, University of Amsterdam, The Netherlands](#)
- [Dida Network Srl, Rome, Italy](#)
- [Qompas BV, Leiden, The Netherlands](#)

There were no changes to the partnership during the lifetime of the project. Furthermore, no difficulties have been encountered with relation to the management of the partnership. All documents connected to project management are accessible on the OntoHR Intranet website.

During the lifetime of the project the following activities have been carried out

- State of the art analysis of theoretical background and current ontology based educational, selection and recruitment processes;
- A job-role (Information System Analyst) has been selected for piloting and has been analysed both in the Netherlands and Italy;
- Competency profile of this job-role has been set up (72 technical competences)
- Job-role and VET ontologies have been created
- O-net Ability Profiler for General Mental Ability tests has been integrated, translated
- The OntoHR selection and training system has been set up (+200 knowledge elements, testbank)
- A mapping algorithm matches Job and VET competencies (Workplace-Education matching)
- Pilots have been organized in Italy and the Netherlands, with further pilots foreseen in Germany and the UK.

The consortium also put an emphasis on communicating and involving important stakeholders from all sectors interested in the outputs of OntoHR. In this respect the following activities have been carried out:

- Establishment the www.ontohr.eu, which is the main channel of communication, all project materials are available on this website. Confidential content is password protected.
- Strong presence of social networking sites (Linkedn, Facebook, Slideshare, etc...)
- Three OntoHR Workshops and two exploitation meetings have already been organised, in order to influence the project by organisation, which are active on the ICT VET education and employment (also in the private sector).

- OntoHR consortium has also been present on several academic conferences and industry job-fairs.

Quality is a key concern of the project. The quality of the project outputs is guaranteed by the cooperation amongst the partners and the established quality control as a two-tiered process: internal quality control by the Board of Management and external quality control by the project's external evaluator: Cork Institute of Technologies, Ireland.

OntoHR products and the system are available on the official project website: www.ontohr.eu.

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1. Project Objectives

According to the Bologna qualification structure different levels of education must prepare a student for particular organizational needs and prerequisites. Students finishing their studies at various levels of vocational education have to go through the organization's Prior Learning Assessment, in which previous experience and qualifications are evaluated against entry requirements (skills and competencies) for the job role. The field of personnel selection has its roots in the notion that a candidates' future job performance in a particular position may be predicted at the time of selection on the basis of relatively enduring and stable characteristics of that candidate.

Inferences that are made in personnel selection research can be classified into three approaches towards establishing the validity of predictor measures, namely 1) the content-related approach; 2) the criterion-related approach; and 3) the construct-related approach. Rather than attempting to assess the job performance domain in its entirety, either a predictor or a criterion measure is used to sample the performance domain. Broad educational qualifications are too crude for purposes of personnel selection. We therefore want create more specific qualification to job matching, with the overriding purpose of tackling the conversion of vocational education qualifications into job related competencies.

The partnership is working together on an eLearning environment, which will be used to test skills, competencies and knowledge of vocational education students. Based on this test we give an evaluation as to whether the selected individual meets the criteria of a given job profile of an existing company. The underlying HRM model with its 'predictor measure', 'criterion measure' and 'underlying psychological construct domains' also demonstrate an inferential mixture, which supports the validity of the predictor as a decision making tool pertaining to qualification–job role matches. These measures can be defined in terms of knowledge and competencies, which form the foundation of the educational ontology.

Our framework encompasses a Domain Ontology, a VET Ontology, a mapping engine, and an adaptive testing engine. The Domain Ontology comprises a global map of the organizational needs and competencies needed to carry out valued activities within a particular field (in this case Information Technology). Based on this ontology specific job roles will be identified. Subsequently, a detailed description of the essential skills and other competency elements, that are required for being selected for a certain position, are framed in terms of student/applicant VET qualifications.

To facilitate this, an ontology supported selection and training system will be built in line with relevant HRM and Knowledge Management (KM) theories, employing existing educational technology such as Content Management Systems and adaptive testing. This eLearning interface will be able to

- Map qualifications in vocational education to current and valid job roles
- Test and evaluate students on the basis of valid, labour market driven competencies
- Identify missing competencies and provide learning content needed to acquire them
- Address the weaknesses of particular VET curricula, and thereby provide ad-hoc support

2. Project Approach

Introduction

This chapter reports on the findings of a review of the academic and practitioner literatures that have direct bearing on competencies and therewith the ONTO-HR Project. Below, we start with a discussion of some of the key difficulties in defining the competency concept.

Key issues in defining the competency concept

In thinking about competencies, it is tempting to simply define the concept as an individual's ability to do something desirable successfully. Yet, as soon as we define the object of the competency, it quickly becomes apparent that we can vary the specificity with which we define an individual's ability to do something desirable successfully. For instance, in the context of driving a car with manual transmission, the ability to change gears could be construed as a competency under the above definition. Yet, the ability to drive the car from point A to point B, which includes changing gears, amongst many other 'lower level' competencies, could also be considered a competency. Thus, from a measurement perspective, for example when we want to ascertain a person's driving ability for licensing purposes, we are confronted with the choice to either assess "overall driving ability" or to assess driving ability on a larger set of lower level competencies. Although conceptually there is nothing wrong with such multilevel constructs, and approaches are being developed to validate them (Chen, Mathieu, & Bliese, 2004), from a measurement perspective such constructs pose a thorny choice, as we will outline below.

The Bandwidth Fidelity Dilemma

Originally stemming from the field of communication (Shannon & Weaver, 1949), the application of the Bandwidth-Fidelity dilemma to the field of Industrial and Organizational Psychology is typically attributed to Cronbach and Gleser (1965). In essence the bandwidth fidelity tradeoff comes down to the idea that in assessing multilevel constructs, the number of lower level constructs (i.e., measurement specificity or bandwidth) is negatively related to the precision with which each of these constructs can be assessed (i.e. fidelity). Or stated differently, since test length is finite, we can either measure a single global competency with many items, or assess a larger number of specific competencies with relatively fewer items per competency. Within the field of industrial and organizational psychology and personnel selection in particular, the debate has mainly centered on the adequate and accurate assessment of personality and job performance (Ashton, 1998; Hogan & Roberts, 1996; Ones & Viswesvaran, 1996; Schneider, Hough, & Dunnette, 1996), although Tett Guterman, Bleier and Murphy (2000) discuss the dilemma as it pertained to the development and validation of their 53 competency hyperdimensional taxonomy of managerial competence.

In summarizing their discussion on the topic, Tett et al., (2000) contend that increased specificity will result in a more refined person-situation fit, a more complete understanding of causes, effects and measurement, and greater construct specificity than what the generalist performance models have to offer. Tett et al., (2000) specifically argue that: a) Predictive accuracy may be improved with the use of more specific and articulate performance measures; b) Complexity with respect to content must be matched between the criterion and predictor spaces; c) Specific measures, even if they are relatively short, are not by definition less reliable; and finally, d) Distinct measures of specific relevant constructs are likely to be more efficient because less time is spent measuring superfluous content.

It is readily apparent that the aforementioned advantages of specificity also apply to the ONTO-HR project. Specifically, since it is our overriding objective to match vocational educational qualifications to job related competencies, it is our contention that whether or not

someone has acquired a VET diploma as a main ingredient of the hiring decision constitutes too broad an approach to yield the degree of insight that is necessary to i) optimally predict job performance for selection purposes; ii) to provide remedial training in case of below standard performance; iii) provide feedback to educational institutions regarding specific deficiencies of graduates as compared to graduates of other educational institutions, and iv) to gain a thorough understanding of the theory based relationship between VET outcomes and workplace requirements.

Having established that for the purposes of the current project competencies should be defined in specific terms, the next question becomes how specific? In answering this question several interrelated issues come into play. First, working with too large a set of competencies quickly becomes unwieldy for educators, HR employees, and job applicants alike, which might in turn impact the face validity of these measures. Since one of the main purposes of the ONTO-HR project is to demonstrate the practical feasibility of ontology based selection and assessment, our would-be clientele should not be alienated by myriad competencies. Second, the competencies need to be measured at a level of specificity that is both theoretically and practically appropriate. The competency to hit the “enter” button on a computer keyboard, although crucial to the performance of certain jobs, is likely to be useless since it is framed too specifically to be theoretically meaningful (i.e. a person who is able to hit the “enter” button, is almost certainly also be able to hit the other buttons on the keyboard), and it is likely to be invariant across job applicants (i.e., all applicants will likely have the knowledge to hit the “Enter” button on a computer keyboard). Third, are the aforementioned measurement issues. Particularly in proctored personnel selection tests, there is a limit on test length. The number of competencies that can feasibly be assessed is further reduced by a factor that equals the (average) number of items per competency construct. That is, if maximum test length is X items and the (average) number of items per construct is Y than the maximum number of constructs that can be assessed is X/Y. This being the case, the ONTO-HR project sets out to maximize both fidelity and bandwidth by employing an adaptive testing approach (cf. McBride, 1976).

Having discussed some of the defining characteristics of competencies, we will now examine how competencies may be compared and contrasted with a number of related terms that are also highly relevant to the ONTO-HR project. These are job performance, cognitive ability, personality, and knowledge and will be discussed below. In order to frame and further clarify the main issues in this discussion, we will first present Binning and Barrett’s (1989) framework for validating selection context predictors¹.

The field of personnel selection has its roots in the notion that a candidates’ future job performance in a particular position may be predicted at the time of selection on the basis of relatively enduring and stable characteristics of that candidate. In their seminal article, Binning and Barrett (1989) shed light on the inferences that are made in personnel selection research (see Figure 1.) by providing three approaches to establishing the validity of a predictor measures, namely 1) the content- related approach; 2) the criterion-related approach; and 3) the construct-related approach. Rather than attempting to assess the job performance domain in its entirety, either a predictor or a criterion measure is used to sample the performance domain. Binning and Barrett have named the first approach, where a predictor measure such as the work sample test that is common to the assessment center directly taps into the performance domain, the content-related approach to establishing validity. This approach is represented by inference 9 (see Figure 1).

¹ The discussion of this framework previously appeared in the authors’ 2007 unpublished doctoral dissertation entitled “Crossing Borders with Personnel Selection: From Expatriates to Multicultural Teams”.

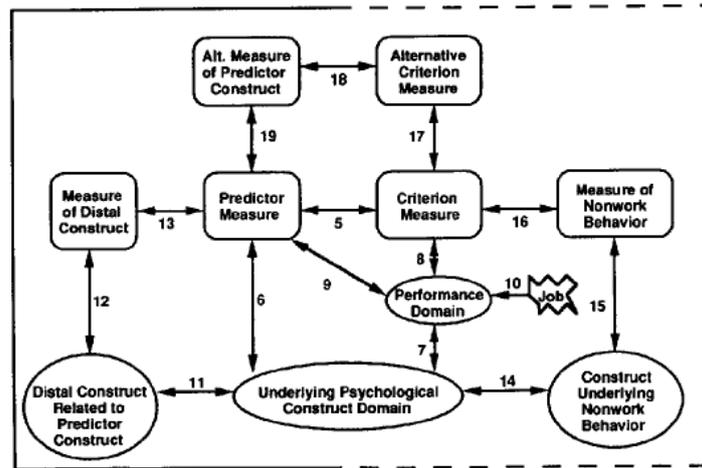


Figure 1 Binning and Barrett's (1989) elaborated model for personnel decision research.

They have labelled the second approach, where a predictor measure (such as a conscientiousness measure) is used to predict a criterion that samples the performance domain, the criterion-related approach to establishing validity. Within the criterion-related approach, the researcher needs to provide support for two inferences (namely 5 and 8) rather than just inference 9. Thus the researcher needs not only to demonstrate predictive validity of the predictor measure onto the criterion measure (inference 5), but also needs to demonstrate that the criterion measure adequately samples the job performance domain (inference 8). The criterion-related approach to validation is empirical in nature in that it hinges upon the demonstration of an empirical relationship between some predictor and a measure that has been designed to adequately and accurately sample the performance domain.

The third and final approach to establishing validity is called the construct-related approach. The construct-related approach involves the identification of psychological construct domains that overlap with the performance domain (inference 7), and then developing predictors that tap into this domain (inference 6). As can be derived from Figure 3, this is an alternative and a more theoretical approach to providing support for inference 9 than either the content-related or the criterion-related approaches. Although the content-related approach is exclusively concerned with providing support for inference 9, it is important to note that in this case the complete performance domain is not assessed in full, but that rather it is sampled by the predictor measure. According to Binning and Barrett (1989, p. 483) the danger of solely relying on a criterion-related approach to validating predictor measures is that "at its worst it represents an atheoretical and circuitous, if not an entirely misleading route to predictor development (e.g., 'dust-bowl empiricism')". Therefore, Binning and Barrett recommend that the criterion-related approach be used as an empirical research strategy for confirming the quality of either the content-or construct-related approaches.

Job knowledge. It was stated that competence is more likely than personality to be firmly rooted in knowledge. With this we mean that the ability to do something desirable successfully, particularly within the educational and organizational contexts on which the ONTO-HR project is focused is likely to be highly contingent upon knowledge. Recently in the field of education Vas, Kovacs & Kismihok (2009) have all but equated knowledge and competency. Within their educational ontology, Vas et al. (2009, p. 134), state that:

Knowledge areas and competences are connected directly with the 'requires' and 'ensures' connection (A competence 'requires' the knowledge and the good command of a knowledge area 'ensures' the existence of certain competence).

From a measurement perspective, there are many advantages associated with equating knowledge with competence in this way since by implication one need only measure knowledge to assess competence. The main issue with assessing competencies lies in their latent nature. For instance, Tett et al (2000, p. 215) define competency as follows: “A competency is an identifiable aspect of *prospective* work behaviour attributable to the individual *that is expected* to contribute positively and/or negatively to organizational effectiveness” [Italics added]. Although this definition comes close to the heart of the concept of competence as we have attempted to define it so far, operationally this definition yields the question of how to assess something that is *prospective* and *expected*. That is, assuming that one could assess such a work behaviour, what is the guarantee of it actually occurring in the future? Furthermore, how likely are job applicants to accept a rejection for the job they applied for on the basis of a behaviour that they have not even exhibited? Knowledge, on the other hand is i) readily assessable without the need to sample on the job performance or behaviour, and ii) likely to be face valid selection context individual differences variable, especially to those applicants who have just graduated from a vocational educational program, where assessment of knowledge, in the form of exams, is extremely common.

Having discussed the competency concept in terms of its discriminant validity vis-à-vis job performance, personality, cognitive ability and job knowledge, it is now time to return to the Binning and Barrett (1989) Model. Although many predictors that are used for personnel selection have been validated using one or two of Binning and Barrett’s (1989) approaches to establishing validity, researchers have seldom recognized that all three approaches may simultaneously be used to support the validity of certain types of predictors (such as job knowledge as will be discussed below).

Conclusion: Defining the competency concept

On the basis of the above it is proposed that competencies should be defined as follows for the purposes of the ONTO-HR project:

A competency is a temporally stable, narrowly defined, and trainable latent ability to complete an organizationally valued prospective job task successfully. Competencies are contingent upon both specific cognitive ability facets and identifiable, specific, and distinct educational knowledge domains.

In sum, we propose that VET programs transfer knowledge that interacts with students’ cognitive ability to produce the competence that they are expected to demonstrate on the workforce.

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3. Project Outcomes & Results

Workpackage 1

The following products have been delivered:

- **D1a Meeting Agendas (Available on the OntoHR webpage, Intranet section)**
- **D1b Meeting Minutes (Available on the OntoHR webpage, Intranet section)**
- **D1c Audioconference Agendas (Available on the OntoHR webpage, Intranet section)**
- **D1d Audioconference Minutes (Available on the OntoHR webpage, Intranet section)**
- **D1e List of Action points (Available on the OntoHR webpage, Intranet section)**
- **D2 Workplan (Available on the OntoHR webpage, Intranet section)**
- **D3 Budget control and authorization of expenditure (Available on the OntoHR webpage, Intranet section)**

Workpackage 2

The following products have been delivered:

- **D4a State of Art document (Available on the OntoHR webpage, Intranet section)**
- **D4b Summary of state of art (Available on the OntoHR webpage).**
- **D4c (extra deliverable) OntoHR Bibliography (Available on the OntoHR webpage)**
- **D4d (extra deliverable) Job Role selection process (Available on the OntoHR webpage, Intranet section)**
- **D5 Technical Guidelines (Available on the OntoHR webpage, Intranet section)**

Workpackage 3

The following products have been delivered:

- **D6a Conceptual model for the Job-Role and VET ontologies (Available on the OntoHR webpage, Intranet section)**
- **D6b (extra) Competency set for the ISA job (Available on the OntoHR webpage, Intranet section)**
- **D6c (extra) Competency validation report (Available on the OntoHR webpage, Intranet section)**
- **D6d (extra) Competency validation Interviews (Available on the OntoHR webpage, Intranet section)**
- **D6e Domain ontology (Available on the OntoHR webpage, Intranet section)**

- **D7a Conceptual model for the VET ontologies (Available on the OntoHR webpage, Intranet section)**
- **D7b VET ontology (Available on the OntoHR webpage, Intranet section)**
- **D7c Educational competency set (Available on the OntoHR webpage, Intranet section)**

Workpackage 4

The following products have been delivered:

- **D8 Matching Interface (Available on the OntoHR webpage)**
- **D9 Adaptive test engine integration (Available on the OntoHR webpage)**

Workpackage 5

The following products have been delivered:

- **D10 Information management related learning content (Available on the OntoHR webpage)**
- **D11 Adaptive testing (Available on the OntoHR webpage)**

Workpackage 6

The following products have been delivered:

- **D12 Evaluation Report (Available on the OntoHR webpage, Intranet section)**
- **D13 Pilot report (Available on the OntoHR webpage, Intranet section)**

Workpackage 7

The following products have been delivered:

- **D14 Dissemination and Valorisation report (Available on the OntoHR webpage, Intranet section)**
- **D15a (extra deliverable) 1st OntoHR Workshop Minutes (Available on the OntoHR webpage, Intranet section)**
- **D15b (extra deliverable) 1st OntoHR Workshop Presentations (Available on the OntoHR webpage)**
- **D15c (extra deliverable) 2nd OntoHR Workshop Minutes (Available on the OntoHR webpage,)**
- **D15d (extra deliverable) 2nd OntoHR Workshop Presentations (Available on the OntoHR webpage)**

- **D15e 3rd OntoHR Workshop presentations and handouts (Available on the OntoHR webpage)**
- **D15f 1st Exploitation workshop (Antwerp) report (Available on the OntoHR webpage)**
- **D15g 2nd Exploitation workshop (Siegen) report (Available on the OntoHR webpage)**
- **D16 OntoHR Website - www.ontohr.eu**
- **D17 OntoHR Leaflet (Available on the OntoHR webpage and also printed in 200 copies)**
- **D18 OntoHR publication (Available on the OntoHR webpage)**

Workpackage 8

The following products have been delivered:

- **D19 Exploitation Plan (Available on the OntoHR webpage, Intranet section)**

Workpackage 9

The following products have been delivered so far:

- **D20a Quality Management Report (Available on the OntoHR webpage, Intranet section)**
- **D20b External Evaluation Report 1 (Available on the OntoHR webpage, Intranet section)**
- **D20c External Evaluation Report 2 (Available on the OntoHR webpage, Intranet section)**

4. Partnerships

[Corvinno Technology Transfer Center, Budapest, Hungary](#)



Corvinno Technology Transfer Center Non-profit Ltd is a spin off company of the Corvinus University of Budapest and also the coordinator of this project. It was born when a group of erudite people decided to create an organization that completely focuses on the exploitation of the gathered knowledge and experience. These people have demonstrated their aptitude and efficiency in leading organizations from the public and the private sector. The common feature of Corvinno team possesses a unique combination of innovation, management and technical expertise and above all sharing the same professional and ethical values. In accordance with the innovation life cycle, Corvinno is proud of leading prestigious research projects in the field of ICT, disseminating its results through conferences, publications and trainings, and offering consultancy and solutions to its clients.

[HRM-OB group, Amsterdam Business School, University of Amsterdam, The Netherlands](#)



The human resource management and organizational behavior section of the Equis Accredited Amsterdam Business School is a relatively young section aiming to conduct and publish high-quality internationally recognized research. Research methods the group uses are diverse and themes on which group members currently publish include human resource management, personnel selection and applicant reactions, cross-cultural issues in OB and HRM such as expatriate management, ethical and charismatic leadership in organizations, proactive and innovative behavior, meta-analysis, the role of time, motivation and emotions in the workplace, and the consequences of project-based organizing for employees and leadership. Our objectives for the coming years include further improving and expanding our research and publications, and strengthening our international ties. In addition, we further plan to extend our group by hiring 2 assistant professors in 2009.

[Dida Network Srl, Rome, Italy](#)



Italian training, research and consultancy company, Dida is renowned for the high level of competence in the fields related to the individual, organisational and system development. Dida has an extensive experience in designing and managing multichannel training and consultancy services as well as in designing and managing complex training and communication projects, also mediated by technologies. The training approach considers both individual learning needs and those of the company in which the individual works. A multidisciplinary team of highly qualified professionals and a specialized group dedicated to R&D guarantees each aspect of a project and assures the ongoing and constant improvement of method, solutions, programs. We are actively engaged in diverse research projects on technology enhanced learning and in many training & consultancy activities for SMEs (such as Cooperative Banks); SMEs networks (such as optics district); large corporations (such as BNL and Poste Italiane).

Qompas BV, Leiden, The Netherlands



Qompas bv is a publisher of online-choice products for highly educated people and offers tools for the selection of education, career orientation and personal development. The key activities of Qompas are centred on five online titles and affiliated print editions. The online products of Qompas are supported with Decision Tools that match user preferences with education and career criteria. The company is commercially active in three different sectors. First, Qompas licenses online study-choice programmes to deans and student advisors of secondary education institutes. Secondly, Qompas offers higher education institutes promotional opportunities for the recruitment of new students. And thirdly, Qompas services top-500 organizations with labour market communication products for the recruitment of young-graduates.

Most of the partners have worked together on previous European Commission projects and in this project have worked in total harmony throughout, with deep respect for the competence of the other partners and a willingness to cooperate on project activities well beyond the required levels.

5. Plans for the Future

The long term-exploitation plan has not been changed since the start of the project, it still will be based on the actual project results. Based on these results, the consortium will decide what are the best ways to exploit the outputs of OntoHR. The partnership however is dedicated towards open innovation. Regarding to this idea, OntoHR is part of the Flexilab Living Lab (www.flexilab.eu) Living Labs are open innovation platforms which provide research, development, innovation and market validation services in real-life environments. Living Labs are willing to share knowledge, research services and products through a common platform. Participants of a Living Lab come from all segments of public and private sectors: private companies (profit and non-profit), public and private research organizations, governmental institutions, public bodies and also individuals can benefit from this cooperation. Flexilab living lab is dedicated to educational technology and eGovernment. OntoHR project developments are listed among featured projects and news and trial products (see the screenshots below). After a registration process stakeholders can try and comment on the OntoHR outputs.

Qompas - Exploitation in the Netherlands

Since Qompas has an existing network of relationships with the educational institutes as well as companies who would be the major target groups for the product we developed. We also have existing relationships with students. This network will be key in exploiting the product. We are an experienced company whose core business is in helping people making big decisions based on testing and self-reflection.

Target Groups:

We have identified multiple target groups for the project.

1. The candidate who will take the test.
2. Human resources department of the companies recruiting for the job-roles.
3. Recruitment centers, which can use the method to test applicants.
4. Educational institutes who train students for a specific job-role.
5. Training centers that will help the student to qualify for the role.

The project generates valuable feedback for the students on their fit for the job-role selected. The product will generate a report which will detail if the student meets the criteria set for that specific job-role as well as information where and how to get the failed competencies.

The HR department or recruitment center would get feedback per candidate and get insight how this specific person would fit the job-role and what steps would need to be taken to acquire the competencies needed. This feedback will give the recruiter valuable information to assess the candidate for the job.

Educational institutes could get valuable information on how to adjust the curriculum so the students acquire the required competencies for the job-role selected by the student. They could even begin to offer courses to individual students to prepare them for the selected job-role.

Information which also can be offered to training facilities who could offer the targeted training required.

Exploitation ideas

The different identified target groups would require a individualistic approach of exploiting the product.

The students would in our estimation not be interested enough to pay for the product themselves. The test could be offered free of charge to individuals.

We can see an educational institute taking a licence on using the product for their students in their student guidance process. This could be done in a model where the institute would pay a fee per user or it could acquire a volume license where the number of tests would be unlimited. The feedback from their own students results would be included in a volume license where this feedback is an additional item when a certain number of tests are bought. The most financial interesting group we identified are assessment centers as well as human resources departments of (big) companies. The tests could be used in the hiring process as well as reviewing the already hired employees and would give results per candidate. This result could include training recommendations which could be tailored to the individual by a training center based on the results.

The data gathered in the recommendations for improvement could be used by training institutes to offer individual training per candidate or educational institute. This is of course very valuable information and could be licensed to one or more companies offering training in the specific field

Recommendations for the future of the project:

The project would have to be refined in different areas in order for deployment in the market.

- Expansion of the number of job-roles will be a priority; this can be developed with different market partners or objective surveys of the market.
- It should be adapted on the technical side to deploy easily into an existing intranet.
- The product has to be easily customizable to conform to the branding of the customer.
- Reporting should be improved; all end users should get easy access to the required information.

This could all be accomplished but would require considerable investment. This is where funding of some source should be sought.

In all, we see a bright future for the OntoHR project in the market.

Dida – Exploitation in Italy

The exploitation goals will make sure that the partner DIDA:

- The obtained results and so the related technical innovations developed will be carried into future national and international research projects, deeply rooting ONTOHR's results in R&D activities.
- It will be specifically focused on the direct involvement of its industrial network of SME's who can, e.g., rapidly exploit ONTOHR services. These exploitation goals are achieved by educating the customers and business relations of the industrial partners about the new technical possibilities and by developing attractive offerings.
- By publishing high-quality papers from ONTOHR's results, DIDA and all the partners will obtain improved international visibility and improve their position in attracting new customers and new research project proposals.

Moreover, in order to spread the services implemented in ONTOHR as much as possible, Dida, will approach:

- The local Union of Industries to inform the associated industries about the learning services delivered by ONTOHR;
- Some Italian specific agencies (as ADECCO) that can contact for example the Italian SME.
- The ISFOL agency: during the future meetings with ISFOL DIDA will ensure to propose the ONTOHR services and related research topics for preparing together new research proposals.
- The Universities in order to organize tutorial lessons or in order to use the system for orientation activities for students.

Furthermore the Consortium could transfer the model of the system ONTOHR for different and new profiles or with private projects (HR selection and recruitments companies; department of companies; Universities interested in using a support tool for orientation; high schools) or also with new projects (or for new profiles or for extending the services to coaching). In this way the consortium could offer to companies not only support for HR Management regarding the selection and subsequent supervision of staff, but also an intelligent method to upgrade the delivery of specific and customized paths for the progression of an employee's career; The method for the presentation to private clients is to define a demo demonstration that the Partner can present in their countries.

6. Contribution to EU policies

European Lifelong Learning policies are an integral part of the EU Information Society development programmes, treated as a key factor for enhancing the competitiveness of Europe in global markets. The OntoHR project after a careful examination of the EU policy background identified several relevant European policy instruments.

As part of the Lisbon strategy the European Commission launched the Education and Training 2010 work programme in 2001 with various sub programmes such as the eLearning development programme, “Programme for the Effective Integration of Information and Communication Technologies (ICT) in Education and Training Systems in Europe (2004 – 2006)”. This initiative consisted of 4 major action lines (European Council, 2009; European Parliament, 2003):

1. Promoting digital literacy
2. Establishing and supporting European digital campuses
3. Developing partnerships between schools
4. Promoting e-Learning throughout transversal actions

During the last decade, priorities of the Lisbon strategy have continuously moved towards supporting social dimensions of education and training (DG Education and Culture, Joint Research Centre, Centre for Research on Lifelong Learning, & Eurostat, 2008) and establishing key competencies needed for lifelong learning (European Commission, 2007). This movement concluded in the latest “*strategic framework for European cooperation in education and training 'ET2020'*” notice from the European Council, which forces competency based education, creativity, social cohesion, active citizenship, mobility and innovation to be appear at all levels of education (European Council, 2009).

The current lifelong learning programme (2006-2013) of the European Commission identified four target sectors for development: schools, higher education, vocational education and training, and adult education (European Parliament, 2006). Furthermore, also four transversal (key) activities were envisaged, namely: policy cooperation and innovation, languages, information and communication technologies (ICT) and dissemination and exploitation of results (European Parliament, 2006). Majority of these target sectors and key activities require the use – and not the development – of advanced technology. European policy makers do not need that participants of this programme incorporate particular technologies into their activities. Their goals are different: enhancing learning environments and experiences, forcing formal learning and supporting learners in expanding their relevant skills and competencies in order to be digitally literate (European Commission, 2007).

Within the abovementioned framework, the OntoHR project targets the following, Lifelong Learning domain specific and transversal policy objectives:

To help promote creativity, competitiveness, employability and the growth of an entrepreneurial spirit

VET graduates have better chances to enter the labour market, as using our approach their competency portfolio is adjusted to the workplace requirements within a particular field. Due to the matching process VET institutions will be able to provide higher quality programs which also improves the students' chance of getting a suitable job.

To support the development of innovative ICT-based content, services, pedagogies and practice for lifelong learning

The proposed system enhances the barriers of current content development and delivery mechanisms. With this ontology based approach content is tailored automatically and delivered according to the missing competencies of students.

To promote co-operation in quality assurance in all sectors of education and training in Europe

This project requires and also supports collaboration between VET and related industry members. Using ontologies we create a very clear and formalized structure of the knowledge required for certain competencies. Through the matching process the participating bodies will reach agreement about this structure, which will enable the acceptance of the same competencies by both the industry and VET sector. This matching will affect the VET sector's quality assurance systems in practice.

To support participants in training and further training activities in the acquisition and the use of knowledge, skills and qualifications to facilitate personal development, employability and participation in the European labour market

With the proposed outputs of this project, VET students will be able to assess their acquired competencies against the competencies needed to fulfil a real job within their field of expertise. The assessment will enable them to have a clear picture about the valid knowledge required for the desired job and they will be able to obtain learning content based on their missing competencies. This facilitates personal development and employability using innovative technology for knowledge transfer.

To improve the quality and to increase the volume of cooperation between institutions or organisations providing learning opportunities, enterprises, social partners and other relevant bodies throughout Europe

VET and industry must work together continuously - through automated processes - in order to match competencies. This cooperation provides closer ties and improved learning services for the VET sector. Ontologies create a very clear and formalized structure of the knowledge required for a certain jobs. Through the matching process the participating bodies will have an agreement about this structure, which enables the acceptance of the same competencies both by the industry and the VET sector

Develop Vocational Skills considering the labour market needs

This is the main priority of the OntoHR project. This ontology based approach not only fosters the involvement of different stakeholders in making VET more responsive to the needs of the labour market, but the matching process will also enable stakeholders to account for systemic changes such as the shift to learning outcomes and competency based systems. Furthermore, learning content based in integrated learning management is reusable for all involved in this system.

Raising competence levels of groups at risk

Structural unemployment is a great risk emerging from the financial crisis Europe experiences nowadays. With this approach unemployed people can assess their competencies against criteria of possible fields of work, getting detailed information about missing knowledge and/or competencies. This enables unemployed people to target their learning efforts in order to regain employment.

Promoting equality between men and women and contributing to combating all forms of discrimination based on sex, racial or ethnic origin, religion or belief, disability, age or sexual orientation contributing to combating all forms of discrimination based on sex, racial or ethnic origin, religion or belief, disability, age or sexual orientation

The assessment procedure proposed in the project will support the set up of new learning experiences where heterogeneous learners are tested and their knowledge/skills/competencies will be developed further, regardless of their sex, race or culture. In fact, the

virtual context provided by this system allows participants to share a positive experience in a context where everyone can have access to learning.

Relevant EU references:

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