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Competence-based Selection and Customized Education with the Help of an E-learning System

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1. **Introduction**

Nowadays human resource managers - especially those who deal with international clients – face increasing challenges. It is essential interest of economic players to employ the best workforce but it is more and more complicated to find the most suitable person for a certain position. Difficulties already begin in the stage of defining specific requirements i.e. during creating a job profile. It is even more complex and time-consuming task to sort out those people who meet the terms at the potentially highest level. Analyzing the actual labor market we can state that majority of the problems arises from the fact that the cooperation between education and economical players is not tight enough.

The main target of European Union’s OntoHR Project is to change this situation and make progress towards more intensive harmonization of supply and demand sides. We are developing an E-learning system which is designated to map the competences of the applicants. The system will be able to support the selection process, giving feedback to educational institutions and providing customized learning content for the applicants.

The E-learning System includes an ontology model which provides the range of competences a certain job profile requires. This paper attempts to present the process of preparing the ontology model for the job of Information System Analyst. This will cover the pilot phase of the project. I took part in the development of the competences and the learning content, but in this paper I also discuss the topic of job-role selection, furthermore the analysis of the developments of the project and an interesting improvement in the research, the debut of Mental Ability.
The Thesis searches for and gives answer to the following questions:

1. What are the steps of creating an ontology model for a job-role? How does the process look like?
2. Are the E-learning system and the developments of the project appropriate to reach our targets?

Its demonstration will be separated to 7 chapters:

In the second chapter we will go through the definitions of the technical terms used in the Thesis.

The next chapter will comprise the background of the research work. It elaborates the roots of the present problems and the ways the EU intends to achieve improvements.

After that the OntoHR Project will be introduced. We will write about the objectives of the Project, the Educational Ontology and its application in the selection system, and about the planned process provided by the developed tools.

In the fifth chapter we will show the steps of developing the ontology model for a specific job-role. We divided it to three parts, namely job-role selection, competence development and content development.

The Educational Ontology was extended with the concept of Mental Ability. Its role and utilization will be described in the sixth chapter.

In the end results and final conclusions will be summarized.
2. Theoretical Background

In this chapter we discuss the concepts that will come up hereinafter and the advantages and challenges of their application. The primary purpose is to define the terms to be applied so as to support proper understanding of the work.

First and foremost we will sum up the major concepts that will be mentioned in the chapter. The connections between these concepts will be described too. The work of Binning and Barrett will be discussed next, in order to get to know the origin of nowadays’ recruitment and selection theory foundations. That is followed by the key components of competence-based recruitment and selection itself: the process and its effects will be explained. The next part will examine competence management: we will look at the features of competences, competence management and job-role design. At the end of the chapter the term of ontology will be introduced.

2.1 Concepts in Brief

In order to see the concepts and the context clearly we would like to settle and clarify some definitions at the beginning.

The most important concept that will appear continuously in this Thesis is competence. ‘Competence is a temporally stable, narrowly defined, and trainable latent ability to complete an organizationally valued prospective job task successfully.’ (Mol, to be published)
In order to benefit from competences, competence models should be built up for a job-role or an entire organization. A competence model refers to a group of competences required in a particular job (OntoHR project 2010a).

If the competence-model is complete the next step is job design. ‘Job design refers to the way tasks are combined to form complete jobs.’ (Robbins & Stuart-Kotze 1987)

Competences and the relationship between competences can be described with the help of ontologies. According to their definition ‘Ontologies aim to capture consensual knowledge in a generic and formal way, so that they may be reused and shared across applications (software) and by groups of people. Ontologies are usually built cooperatively by a group of people in different locations.’ (Corcho et al. 2003, p.44) They also provide further practical possibilities for researchers.

The most relevant appliance fields of the competence-ontologies are recruitment and selection. ‘The aim of recruitment: exploration and identification of as many potential candidates as possible, attraction of their attention to the job prospects at the company.’ ‘When HR experts managed to recruit right applicants, the selection of the most qualified ones and of those who fit the organization and the job the best, can start.’ (Bokor et al. 2009, pp.142-143)

2.2 Binning and Barrett – The Roots

First of all we would like to introduce the theory of Binning and Barrett who put down the foundation of today’s recruitment and selection. According to them there are three approaches to establish the validity of predictor measures: the content-related
approach, the criterion-related approach, and the construct-related approach (Binning & Barrett 1989):

![Figure 1 - Model for personnel decision research (Binning & Barrett 1989, p.489)](image)

The main objective is to find the connection between the Predictor Measure and the Performance Domain (Figure 1). The simplest way is inference 9, which links directly the two points. In this case only the Predictor measure is used to establish validity. This is the content-related approach. The criterion-related approach takes inference 5 and 8. There the sampling of the Performance Domain, the Criterion Measure (inference 8) is compared to the Predictor Measure (inference 5). The last possibility is the construct-related approach, which is a more theoretical one. It connects the two points applying inference 6 and 7. The Underlying Psychological Construct Domain should be created according to the Performance Domain (inference 7). The Predictor Measure will rest on this domain (inference 6).

These inferences are advisable to think through and utilize when designing ontology- and competence-based recruitment and selection methods.
2.3 Competence-based Recruitment and Selection

Recruitment and selection is used for predicting the potential job performance of the applicants. With the help of this method organizations can find the best people to achieve their objectives. The difference between traditional and competence-based recruitment and selection is that the second one concentrates more on formal, measurable competences.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Identify HR and recruitment needs.</td>
</tr>
<tr>
<td>Step 2</td>
<td>Complete job or position documentation.</td>
</tr>
<tr>
<td>Step 3</td>
<td>Identify recruitment sources.</td>
</tr>
<tr>
<td>Step 4</td>
<td>Create recruitment materials and implement the recruitment process.</td>
</tr>
<tr>
<td>Step 5</td>
<td>Determine the selection criteria.</td>
</tr>
<tr>
<td>Step 6</td>
<td>Screen the applicants.</td>
</tr>
<tr>
<td>Step 7</td>
<td>Train the interviewers and conduct behavioral event interviews with the leading candidates.</td>
</tr>
<tr>
<td>Step 8</td>
<td>Complete competency assessments, prepare the selection recommendation list, and select the candidate.</td>
</tr>
<tr>
<td>Step 9</td>
<td>Verify the selected candidate’s qualifications.</td>
</tr>
<tr>
<td>Step 10</td>
<td>Negotiate the compensation and benefits package with the successful candidate and extend an employment offer after the package has been accepted, first by the organization and then by the candidate.</td>
</tr>
<tr>
<td>Step 11</td>
<td>Validate the selection.</td>
</tr>
</tbody>
</table>

Figure 2 - Competency-based recruitment and selection (Dubois & Rothwell 2004, p.113)
However the figure speaks for itself, it is important to mention that from the first to the fourth steps the recruitment process is defined and the ones after show how the selection works.

This method results in numerous advantages, for example:

- It is result-oriented.
- Discrimination is out of the question.
- Identifying backups for positions is easier.
- Traditional training times are less; employees’ performance-levels are higher.

Although competence-based recruitment and selection has several benefits, there are some challenges too:

- A disciplined approach to job and work analyses is necessary so the preparation for the recruitment and selection processes needs more time.
- Inefficient when recruiting unskilled or semiskilled workers.

So if the conditions are suitable this can be a highly effective technique to develop an organization’s human capital.

2.4 Competence Management

In order to carry out competence-based recruitment and selection for a position a competence model is essential to evaluate applicants. But obviously this is not the only field that can benefit from the concept of competence. Competence management can make things easier for organizations by facilitating the design of job-roles and its competences according to the organizational objectives.
2.4.1 Competence

Competences have come up as a conception for naming and managing abilities, knowledge and skills and applying them on many different areas. Once the competence-based approach is applied candidates’ performance can be anticipated more easily and more exactly. It provides a more precise approximation of future performance than the testing of knowledge since it also explains how the knowledge is applied.

Besides knowledge there are other terms, like job performance or personality that are similar to competence but must not be mixed up with it. The difference between job performance and competence is that job performance describes an actual work behavior, while competence refers to the propensity of it. Personality also differs in a lot of ways from competence: personality is more stable but not as specific as competences and it is not so significant within the educational and organizational context. It is also a crucial matter that competences have a value ‘component’ according to how much they worth for the company. Furthermore, contrary to personality, competence is related with knowledge (OntoHR project 2010b).

In order to get a deeper understanding of competences, the classification of them and their components will be depicted now.

Different competences are classified as hard competences and soft competences. Hard competences are based on educational background and knowledge. Soft competences can be derived from the personality of an individual, but they are still rooted in knowledge.
Besides these, competences can be divided into another four categories (ExploreHR.org 2007):

- Employee Core Competence: related to the values, mission and strategy of the organization
- Managerial Competence: related to skills for performing managerial work and process. Application of it relates to those situations when there is interaction with other people.
Managerial Competence can be divided into two categories:
  - Human Competence: ability to work with, understand, and motivate other people.
  - Conceptual Competence: ability to reduce the complexity in a given situation
- Technical/Functional Competence: it covers specific knowledge, techniques of a narrow field.
- Personal Attribute: competences related to inherent personal characteristics that potentially affect work attitude and performance.

Since competence is a complex concept, it consists of different components. The followings are its four elements (ExploreHR.org 2007):

- Skill: practical experiences developed during training.
  As well as competences skills also can be classified as hard and soft ones. While technical knowledge belongs to hard skills, the abilities that depend on our personalities are considered as soft skills. Soft skills include both interaction skills and motivation skills.
- Knowledge: the product of learning. Knowledge is simply and solely the information that is necessary to know in order to perform a job.
- Personal attributes: inherent characteristics, essential for developing knowledge and skills.
- Behavior: the observable manifestation of utilizing knowledge, skills, competences and personal characteristics.

### 2.4.2 Competence Modeling

The concept of competence allows us to collect competences and then develop competence models for particular job-roles and also for the whole organization. The organization’s and the job-roles’ competence models should be consistent. Moreover the job-roles’ competence model should be derived from the organization’s one.

To be successful in developing a competence model it is important to examine some relevant circumstances (ExploreHR.org 2007):

- **Context** – Will the model refer to the total organization, an entire function, a specific role or a specific job?
- **Level of orientation** – Will future or current job requirements be in the focus?
- **Level of complexity**
- **The model must be linked to strategy** (it should be company-specific, flexible and future-oriented).

Once the model is elaborated, the company, the managers and also the employees can profit from it in several ways (ExploreHR.org 2007):
- The effectiveness of the trainings can be enhanced by connecting it to the success criteria. (for the company)
- Employees can move across business boundaries as there are common standards for career levels. (for the company and for employees)
- Performance criteria can be identified in order to improve the accuracy and ease of the hiring and selection process. (for managers)
- Performance standards are more objective. (for managers)
- Different tools and methods are available for employees for developing their skills. (for employees)

2.4.3 Job Design

The life of organizations that employ numerous people possessing different competences can be complicated as they have to pay attention to their employees’ satisfaction too. With the aim of keeping employees motivated, the most suitable and satisfying tasks have to be found for them, that is why job design methodology is invented and applied. Luckily with the help of competence management this task is simpler and more comfortable.

According to (Bowen et al. 2001, p.15) the application of job design consists of five steps which are the followings:

1. Review the mandate or mission of the organization

2. Look at how various functions/components/tasks are carried out to achieve the mission/mandate (task analysis, task identity, task significance)

3. Establish the qualities that will be needed to perform the various components or tasks, as defined
- Skill analysis: find the characteristics and abilities that will be necessary to complete the tasks.

- Skill variety: prospective workers should have most of the required skills and learn the ones they don’t.

- Autonomy: the level of control an employee has over the tasks and assignments.

4. Identify and describe discrete assignments (job descriptions)

5. Match selected human resources to jobs or assignments

2.5 Ontology

Competence modeling approaches can be more effective if they are supported by ontology. Ontology is a semantic technology which is used for defining concepts of phenomena and the relationships between certain objects. Tom Gruber drafted the most widely known definition in the topic: ‘An ontology is a specification of a conceptualization.’ (Gruber 1993, p.1)

To build an ontology researchers have to take the following steps (Kő 2010, p.12):

- Analyzing the domain, knowledge acquisition
- Actual ontology building
- Executing ontology
- Evaluating ontology
The built ontologies consist of five components (Kő 2010, pp.8-9):

- Classes: the concepts of the domain that can be arranged into taxonomy
- Relations: the types of interrelationships between the concepts
- Attributes: properties of the concepts
- Axioms/Rules: statements on the conceptual model that are always true; limitations for the attributes
- Individuals: specific elements of the classes

One of the numerous benefits of using ontology is that in theory even the most complex systems can be described in a well-structured way. Furthermore, this structured description is sharable and reusable, which is considering that more organization can use the same structure with minor modifications - useful from the project’s point of view.

If an organization decides on developing an ontology model, it will recognize that ontology-based competence-oriented modeling approaches have to deal with some challenges (Schmidt & Kunzmann 2007):

- A well-defined common understanding of each competence is required.
- Semantically coherent systems and services have to be constructed.

Therefore these efforts often run into a problem, namely that more distinct and realistic models go with more complicated management and controlling tasks. For example, it is more complicated to prepare a job advertisement or to rate the candidates on the basis of a model which comprises a great deal of competences as if we have only a few competences.

But if this difficulty is handled, the use of ontologies can be a very profitable solution. In the following chapters we will see why.
2.6 Sustainable Competence-oriented Human Resource Development with Ontology-based Competence Catalogs

The work of the Professional Learning project of the FZI in Karlsruhe, Germany is a good example of ontology-based competence-oriented modeling approaches (Schmidt & Kunzmann 2007). An ontology based reference model for Human Resource Management (hereinafter referred to as HRM) was developed within the frame of the project.

*Figure 3 - Professional Learning Ontology (Schmidt & Kunzmann 2007, p.3)*
Their model supported HR development by connecting its’ strategic and operational levels. Besides not only the continuous updating of the organizations’ competence catalogue became possible but the competences of individuals and the organization are also connectable with the help of the model. Furthermore competence models can be integrated into business processes since – thanks to the ontology - the model is sharable and reusable across different IT platforms.

From their work we understand how beneficial it can be to use ontology and studying their model we can proceed with our own task more easily.
3. Political Background – The Aims of the European Union

After finishing the explanation of the theoretical background the next topic is about the political background of the research. The OntoHR Project is supported by the European Union, which - as in many other sectors - set the target of standardization and transferability in the field of education. Promotion of mobility and lifelong learning are the main aims which should always be kept in focus. The key issue in the development is comparability of competences, skills and qualifications.

Nevertheless, there are many difficulties the EU should cope with:

- As it was mentioned in the introduction, the cooperation between education and economy is not tight enough, thus knowledge of the school-leavers can hardly meet the requirements of a certain job.

- Competences belonging to a scope of activities should be determined and taught in a more logical way.

- Furthermore, different institutions have different curriculums for the same professions. It is characteristic not only at international but at national level, too.

The Bologna Process was called to life to solve the last problem by facilitating the standardization in higher education. This way the improvement of mobility of people who are involved in higher education is supported and the level of quality is raised. Higher education itself was divided into 3 phases: bachelor (BSc/BA), master (MSc/MA) and doctorate (PhD, DLA) degrees, and learning outcomes also became unified (About the Bologna Process 2011).
The above mentioned problems triggered the establishment of the European Qualification Framework (hereinafter referred to as EQF) too. ‘The EQF is a common European reference framework which links countries’ qualifications systems together, acting as a translation device to make qualifications more readable and understandable across different countries and systems in Europe.’ (Comisión Europea. 2008, p.3) It has 8 reference levels to which countries’ qualification systems can adjust.

Competences and skills are critical factors in this issue because educational background and naming of the profession are not sufficient anymore to define an actual situation. More detailed profiling and set of special competences and skills are required in order to comply with the fundamental principles of European Union’s education and labor market policy.

Information and Communication Technology (hereinafter referred to as ICT) is a relatively new area. There are many innovations that is why here the relevance of the results is even higher.

European e-Competence Framework (e-CF) is a common European framework as well as EQF, but it concerns ICT professionals. It contains 32 ICT competences that can be a useful tool for ICT workers, ICT managers, human resource managers, educators, policy makers or market researchers (European e-Competence Framework 1.0 2008).

The OntoHR Project was funded as the consequence of these attempts.
4. OntoHR Project

At first we will begin with a few lines about the Project and its objectives in brief. Then three topics will be discussed, that are essential to achieve our targets. The first one will be the Educational ontology, which is the corner stone of the whole research. After that we will show the way personnel selection can be carried out with the help of ontology. The last topic will be the OntoHR Flow, which demonstrates the planned process.

4.1 The Aims of the Project

The OntoHR partnership consists of participants from The Netherlands, Italy and Hungary. They are Corvinno Technology Transfer Center (HU), Amsterdam Business School (NE), Dida Network (IT) and Qompas (NE). The main purpose of the Project is to bring education and labor market closer. To achieve this, such qualifications should be developed that are compatible with certain job-roles.

The keywords in the project are ontology and competence. An ontology-supported selection and training system will be built, which will deliver the following useful possibilities:

- Map qualifications in vocational education to current and valid job-roles (Official Leaflet of the OntoHR Project 2010):

Models for job-roles and for trainings can be compared, this way educational institutions can modify their programs in order to teach the competences that will be useful for the students at their future workplace.
- Test and evaluate students on the basis of valid, labor market driven competences (Official Leaflet of the OntoHR Project 2010):

Supporting of selection is one of the main functions of the E-learning system. With the help of the test questions, it can be elicited if the applicant has all the required competences.

- Identify missing competences and provide learning content needed to acquire them (Official Leaflet of the OntoHR Project 2010):

Maybe one of the biggest novelties of the system is the possibility to provide customized learning material. Obviously all of the candidates possess different knowledge and different competences, especially because different institutes grant different learning outcomes even by trainings with the same titles. The system maps the applicants’ competences and tells which competences are missing. After that only the missing competences have to be taught and learnt through the E-learning system.

- Address the weaknesses of particular VET curricula, and thereby provide ad-hoc support (Official Leaflet of the OntoHR Project 2010):

In the end, according to the test results, the system provides feedback to find the shortcomings of the training in question.
With these features the system will be able to support the targets of the Bologna Process (About the Bologna Process, 2011):

- Introduction of the three cycle system: it can’t be effective and useful without well-built curriculum. The system helps educational institutions to develop the curriculum’s structure and content.
- Quality assurance: with this development the quality level of education also rises.
- Recognition of qualifications: working with competences makes it easier to identify the value of a qualification anywhere in the World.

4.2 Educational Ontology

To understand the following chapters and the project itself it is really important to talk about the basis of the research.

Vas Réka’s Educational Ontology (Vas 2007) was developed for the Department of Information Systems at the Corvinus University of Budapest. The Educational Ontology is a general ontology model for describing different training programs.

As it will be visible on Figure 4 the top half of the model describes the concepts that belong to the job. On the other hand the bottom half pertains to the training. The connection between the two parts is provided by the ‘competence’ class, considering that competences should be picked up through education and then utilized at the workplace.
The ‘Scope of Activities’ class involves the activities that can be performed after finishing a given training program. Its elements are ‘specified by’ or ‘served by’ the ‘Tasks’. In order to be able to carry out the tasks defined by the ‘Task’ class the relevant competences have to be acquired. The ‘Group of Tasks’ and the ‘Competence Module’ classes define the sets of tasks and competences. The ‘Competence’ class is in ‘require’ relation with the ‘Knowledge Area’ that belongs to a certain ‘Curriculum Module’. The ‘Basic Concept’, ‘Theorem’ and ‘Example’ classes are parts of the ‘Knowledge area’, which can be part of other ‘Knowledge Areas’ too. With the help of the ‘Test Questions’ the ‘Knowledge Areas’ and the Sub-Knowledge-Areas can be assessed.
With that Réka accomplished the first two steps of building ontology: analysis of the domain and the actual ontology building. It shall be followed by the execution of ontology. This phase includes preparing the model for the Information System Analyst job-role. Finally the evaluation of ontology should be carried out via the pilot run.

### 4.3 Framework for an Ontology Supported Personnel Selection System

After discussing the Educational Ontology we can go on and see how it is applied in our Project.

The following figure (Figure 5) illustrates the application of ontologies in the selection process. The framework consists of a Domain Ontology, a Job-Role Ontology, a Mapping Engine and an Adaptive Testing Engine (Kismihok, G., Mol, S.T. 2008). The Educational Ontology is the base of the before mentioned ontologies’ structure.

![Framework for an ontology supported personnel selection system](image)

*Figure 5 - Framework for an ontology supported personnel selection system (Kismihok, G. et al 2008 p.3.)*
The Domain Ontology provides the competences, skills and knowledge - and the relations between them - that are required to fulfill all the tasks at the whole organization.

On the other hand Job-Role Ontology refers only to the tasks that are required for a single job-role. As you can see, the Domain Ontology is the combination of all the Job-Role Ontologies in the organization. The fifth chapter will cover the topic of creating the Job-Role Ontology for a chosen job-role.

The mapping engine performs the matching between the competences of the Domain Ontology and the Job-Role Ontology.

Applicants' competences can be measured with the help of the Adaptive Testing Engine. This way, it can be found out if they are capable to fulfill their tasks at the given job-role or not.

With the help of this method, selection can be proceeded in a more logical way, resulting better choices from the crowd of the applicants.

4.4 OntoHR Flow

Now let’s look at the process of applying the above mentioned system from the view of the three participants. In the following illustration (Figure 6) you will see three layers: Organization Layer, Applicant Layer and Educational Institution Layer. As we go along the figure and follow the arrows we can see what will happen to the three actors: the organization, the applicant and the educational institution.
We will use three types of shapes with different meanings. Rectangles are events, they mean that something is happening. Rhombuses sign decision points. The third shape indicates documents, the inputs and the outputs of the process, and arrows show the direction of the progress.

The first element of the organization layer is the organization itself. To describe the organization, the Educational Ontology has to be used and also a competence-based job description about all the necessary competences are required within the organization.

Meanwhile at the applicant layer we have the applicant who is characterized by his or her personal competences. At the third layer we can see that educational institutes provide training programs. These training programs can be described with the help of the Educational Ontology and the competences that they provide to their students (output competence description).

Going back to the organization layer, we can see that the organization selects the relevant ontology components, the ones that will be necessary to do the future job. At the educational institute layer these components are compared to the specific training programs (competence matching) and about this a competence matching report is created.

The organization decides to open a position. To find the best person for this position they set up the selection test. The selection test consists of a mental ability test and a knowledge test. At the applicant layer the applicant decides to apply for the job. When the registration of the applicant is done, he/she takes the test prepared by the corporate. After finishing it, the test results are computed. The organization analyses the test results what leads to three outputs: applicant ranking, applicant competence alignment and training needs analysis. Meanwhile the personal results are also analyzed and as the result of it a personal mental ability report and a knowledge gap report is made. Having the results, the decision is made about selecting the applicant or not.
Furthermore these results also provide feedback to educational institutions. On the basis of them educational programs can be evaluated which materializes in a program evaluation report.

Competence-based recruitment and selection’s fifth and eighth steps are covered by this process: ‘determining selection criteria’ and ‘assessing the candidates and selecting the best one’.

Not long ago a question came up about the relationship between the Applicant and the Educational Institution. In the latest figure there is no connection between them, but it will be reviewed and maybe updated in the future. The cause of this possible addition is the fact that the Applicant acquires his/her Personal Competences at the Educational Institution after taking part in a Training Program. If this assumption is correct, there should be connection between the Training Programs and the Personal Competences. Ideally the Output Competence Description and the Personal Competences are the same. However such situations can come up when the Applicant doesn’t learn everything that is offered, or its opposite, when he/she learns more or takes part at another training too. There are many questions about it, but one thing is for sure, the Training Program has an effect on Applicant’s Personal Competences.
Figure 6 - The OntoHR flow (OntoHR project 2011a)
We already summarized the features of the system in the beginning of the fifth chapter, but now - at the end of it - let us show the connections between them and the outputs of the flow:

<table>
<thead>
<tr>
<th>Map qualifications in vocational education to current and valid job-roles</th>
<th>Competence Matching Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test and evaluate students on the basis of valid, labor market driven competences</td>
<td>Mental Ability Test</td>
</tr>
<tr>
<td></td>
<td>Knowledge Test</td>
</tr>
<tr>
<td></td>
<td>Personal Mental Ability Report</td>
</tr>
<tr>
<td></td>
<td>Personal knowledge gap report</td>
</tr>
<tr>
<td></td>
<td>Applicant Competence Alignment</td>
</tr>
<tr>
<td></td>
<td>Applicant ranking</td>
</tr>
<tr>
<td>Identify missing competences and provide learning content needed to acquire them</td>
<td>Training Needs analysis</td>
</tr>
<tr>
<td>Address the weaknesses of particular VET curricula, and thereby provide ad-hoc support</td>
<td>Program Evaluation Report</td>
</tr>
</tbody>
</table>

*Figure 7 - The aims and the outputs of the flow*
5. **The Pilot - Ontology Model for the Information System Analyst Job-role**

As we got familiar with our aims and developments we can go on and see if we can put the theory into practice. To check it, we have to prepare the pilot for the project. This means that we choose a job-role and create the ontology model for it that can demonstrate the future operation of the system. We will name individuals for the elements of the Educational Ontology. As the size of the end results of the development (competence list, knowledge elements, learning content, test questions, and so on) is quite massive, in this chapter we concentrate on the presentation of the process itself.

---

**Figure 8 - Steps of creating an Ontology model for the ISA job-role**

- **Job-role selection**
  - Drawing up criteria
  - Analyzing the situation in the concerned countries
  - Checking the possibilities
  - Making the decision

- **Competence development**
  - Collecting possible competences
  - Defining competences
  - Validation

- **Content development**
  - Defining knowledge areas
  - Looking for learning material
  - Transforming the found material into learning content
  - Adding multimedia to the content
  - Creating test questions
You will see how to use the system, and these steps also cover the ones, that - hopefully - HR managers will take in the future. The two main parts are competence development and content development. But before these we should explain why did we choose the Information System Analyst job-role.

5.1 Job-role Selection

In order to have a successful pilot it was essential to find the job-role which is the most suitable for our purposes. To ensure this we took the following steps:

- Step 1: Drawing up criteria
- Step 2: Analyzing the situation in the concerned countries
- Step 3: Checking the possibilities
- Step 4: Making the decision.

**Step 1: Drawing up Criteria**

Obviously we cannot choose a random job-role, while not all of them are capable of demonstrating the possibilities. In order to choose a proper one we need criteria that help us to avoid problems due to a wrong job-role selection.
We named three criteria (OntoHR project 2009):

- The first criterion focused on definition. The job-role had to be well-defined and it was also important that knowledge had to be the primary determinant of performance.

- The second one was linkage. We had to find a job-role which is linkable to a vocational educational program.

- And we also had to pay attention to feasibility.

These criteria are further itemized thus we got sub-criteria, but here we put aside publication of the detailed list because of its large size.

**Step 2: Analyzing the Situation in the Concerned Countries**

After naming criteria and sub-criteria we had to clarify what is the situation in the countries that take part in the project. Therefore Italy, The Netherlands and Hungary was analyzed in order to see what is the situation and what kind of improvements took place in these countries recently.

In the Netherlands ICT plays an important role both in the economical and in the social life. The development of Vocational Education and Training (VET) is really important, as the demand for ICT professionals on the labor market is continuously growing. Therefore vocational education’s improvement is one of the critical challenges. The three educational levels that prepare for entry on the labor market are lower vocational-, higher vocational- and academic education. In The Netherlands the Bachelor-Master structure of the Bologna Process is already implemented. The Dutch
higher vocational and lower vocational education counsel (HBO Raad, MBO Raad) also tries to adhere to the standards of the EQF. Besides, in vocational educational institutes a wide range of ICT study programs are offered and they already intensified the cooperation with industry (OntoHR project 2010c).

These days in Italy there are several researches in progress to facilitate being innovative and competitive. One of these researches is about skills and training credits. The model, developed by ISFOL (Institute for the training of worker) is used in the professional training design and emphasizes centrality of the skills instead of the learning content. ISFOL model’s purposes are the followings:

- the promotion of a system of certification and recognition of competence that can ensure transparency in the vocational training systems;
- the creation of preconditions for the capitalization, by individuals, of the skills acquired in their training and professional credits;
- the creation of preconditions for mutual recognition of credits corresponding to the acquired skills, in order to facilitate the integration of routes, the comparability of training courses and the transparency of valuation procedures and certification (OntoHR project 2010d).

In Hungary there are two vocational tracks (vocational secondary school and vocational training school) along with higher education. Higher education went through some significant changes in the past years. In 2006 the three-cycle structure of Bologna process was introduced. Because of these changes the educational portfolio had to be reformed extremely. However there are too many graduates, the number of people with vocational educational background is less and less.
Step 3: Checking the Possibilities

When all circumstances are clarified we should have a look at the possible job-roles. The EUCIP model and O-net online were the best starting points for it.

EUCIP:

EUCIP model is a model of skills in Europe in the topic of digital technology. The model consists of 3 Core modules (Plan, Build, Operate) and a set of elementary knowledge units. 21 job-profiles are defined and the IT Administrator. The model can be used by organizations, vocational institutes, universities or individuals (OntoHR project 2010c).

Figure 9 - EUCIP model (I profili EUCIP - EUCIP 2009)
O*Net Online - The Occupational Information Network:

The O*NET program provides information about occupations in the United States. It has a huge database which contains standardized descriptions about job-profiles, and is available at no cost. On their web page you can find everything what you need about occupations (O*NET Resource Center – Overview 2011).

We faced some challenges, as there are some dissimilarities between the specialties of the countries, but at the end we picked 3 possible profiles: IT administrator, System Analyst and Information System Analyst.

Step 4: Making our Decision

Comparing the possibilities, our final choice was the Information System Analyst job-role (hereinafter referred to as ISA). It met the criteria and matched all our expectations. It has a wide range of competences, that can be used again later with other job-roles and no previous work experience is needed. That’s good because the job-role is comparable with the training programs. Less soft competences are required, which makes the job-role more suitable for demonstration. EUCIP is commonly used in Italy and in the Netherlands, so from this point of view it seems to be a good choice too (OntoHR project 2010c).
According to the EUCIP model, description about the ISA is the following:

‘A EUCIP Information Systems Analyst is expected to be very effective in identifying requirements for ICT systems and defining models of information flows and business objects. A wide and thorough ICT competence has to be combined with the ability to interact with users and colleagues.’ (OntoHR project 2010c, p.6)

5.2 Competence Development

By the identification of the job-role the scope of activities and the tasks are given. As we saw earlier in the Educational Ontology, in order to perform the tasks, existence of different competences is necessary. Competences are the most important parts, so we have to start building up our ontology model by defining the elements of it. On the following pages we will discuss how the appropriate competences are chosen. The competence development process had 3 steps:

Step 1: Collecting possible competences

Step 2: Defining competences

Step 3: Validation

Still before starting to go through these steps we should mention that our ontology-based system consists of three components: the Content Repository, the Developer and the Presentation. The content we develop is stored in the content repository. The Presentation tool is used to transmit the content to the users. We will use the Developer during the competence and content development steps to build the ontology model.
**Step 1: Collecting Possible Competences**

In the beginning we had to survey the competences of Information System Analysts.

It is sufficient to create a relatively general model which can also be applied by other enterprises. Especially technical and functional competences can be modeled, tested and trained and some parts of managerial competences. (Personal attributes belong to the scope of General Mental Ability subject which is enlarged in chapter 6.)

Therefore we checked the Internet. Such databases were hunted that include different competences, skills, knowledge elements or other useful concepts about the job-role. At the end we used databases both from Europe and from other parts of the World like the US:

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>EUQUASIT competence catalogue (EU – Germany)</td>
<td><a href="http://www.biat.uni-flensburg.de/euquasit">http://www.biat.uni-flensburg.de/euquasit</a></td>
</tr>
<tr>
<td>Cio platform (EU The Netherlands)</td>
<td><a href="http://www.cio-platform.nl">http://www.cio-platform.nl</a></td>
</tr>
<tr>
<td>Disco (EU)</td>
<td><a href="http://www.skills-translator.net/">http://www.skills-translator.net/</a></td>
</tr>
<tr>
<td>ESCO (EU)</td>
<td><a href="http://esco.tenforce.com/esco-browser/">http://esco.tenforce.com/esco-browser/</a></td>
</tr>
<tr>
<td>Eucip (EU – Italy)</td>
<td><a href="http://compass2.di.unipi.it/didattica/EUCIP">http://compass2.di.unipi.it/didattica/EUCIP</a></td>
</tr>
<tr>
<td>HBO-i, Bachelor of ICT (The Netherlands)</td>
<td><a href="http://freedom.nowonline.nl/global/sites/hboi.nl/files/13/712/HBO-i%20Bachelor%20of%20ICT-Engels8184.pdf">http://freedom.nowonline.nl/global/sites/hboi.nl/files/13/712/HBO-i%20Bachelor%20of%20ICT-Engels8184.pdf</a></td>
</tr>
<tr>
<td>O-Net (USA)</td>
<td><a href="http://online.onetcenter.org/">http://online.onetcenter.org/</a></td>
</tr>
<tr>
<td>Philippines National Computer Center (Philippines)</td>
<td><a href="http://www.ncc.gov.ph/">http://www.ncc.gov.ph/</a></td>
</tr>
<tr>
<td>VSNU UFO Profiles (EU - The Netherlands)</td>
<td><a href="http://fws.e-office.com">http://fws.e-office.com</a></td>
</tr>
<tr>
<td>WISCO (EU - The Netherlands / Worldwide)</td>
<td><a href="http://www.wageindicator.org">http://www.wageindicator.org</a></td>
</tr>
</tbody>
</table>

*Figure 10 - Databases for collecting possible competences*
After that, we also checked job offers from all over the World in order to find some extra information to complete our list.

Although it wasn’t easy to collect the appropriate competences, since competence doesn’t have a widely used definition. The competences in the databases were very diverse. Sometimes we found competences under other keywords, like skills or knowledge, and sometimes we found incongruous elements in competence lists. After all we grabbed everything that might be useful in the future in order not to miss out anything.

Step 2: Defining Competences

After that, the useful ones had to be selected.

This was three domain experts’ job to process the raw material. The competences were sorted out and systematized, and lastly they named 8 competences and in all 83 sub-competences. Taking the discussed points about the competencies into account they named the following competencies:

- Conduct needs analysis
- Design computer applications
- Develop documentation
- Design a system project
- Perform a detailed system investigation and analysis
- Install / implement computer application system
- Run a system
- Deal with interpersonal issues
Since this is one of the most important outputs of the research, you can find the whole list with the subcompetences in the Appendix.

These competences cover all parts of the Information System Analyst job-role. If these competences are possessed all the tasks can be fulfilled, that are expected.

**Step 3: Validation**

The only step left was to validate the competence set. In order to make sure that the competences are valid, Dida Group decided to involve some of the possible future stakeholders: Adecco (Unit of Benevento) and some Italian small and medium sized enterprises. They were interviewed about the job-role and our competence set. The answerers were mostly HR managers or people who take care of Information System Analyst tasks at the company.

The content of these interviews were (OntoHR project 2011c, p.1):

- ‘Competences concerning the ISA job-role (activities linked to each competence)’;

- ‘Open questions about the competences model quality (concerning the reliability of the competence model)’;

- ‘Knowledges (both technical and transversal) considered essential for practice as Information System Analyst’.
They analyzed and evaluated the results and produced tables and diagrams about them. The results were satisfying. Everybody thought that the competence set covers all the necessary issues. There were a few notifications about some competences, but in the end the list labeled to be correct and kept its original elements.

At this point we finished with the competence development process, the base of our ontology model was ready.

5.3 Content Development

The next challenge that brought us closer to a fully operating system at the end of the pilot phase was content development. At first we provide individuals for the knowledge class of the Educational Ontology, then we look around to find material for the learning content, and finally the individuals of the test questions will be created. After the following steps the model will be finished and the system will be ready to try out:

Step 1: Defining knowledge areas

Step 2: Looking for learning material

Step 3: Transforming the found material into learning content

Step 4: Adding multimedia to the content

Step 5: Creating test questions
Step 1: Defining Knowledge Areas

As it was visible earlier on the figure of the Educational Ontology (Figure 4) we had to define the knowledge elements that ensure the existence of the competences and the sub-competences. Therefore we had to assign knowledge elements to them.

We analyzed every single sub-competence and decided which knowledge elements are necessary. In order to get a more detailed list we defined these knowledge elements more precisely by naming different levels of them. These are the individuals of the knowledge class.

As the end-result we got the knowledge areas that will be educated during an Information System Analyst training.

Figure 11 - Knowledge areas in the E-learning system
Step 2: Looking for Learning Material

The next step was to find resource that can be used up as learning content. DIDA Group undertook to find and process learning material for competence 3, 4 and 5. We cared for the 1st, 2nd, 6th, 7th and 8th competences.

We looked for open educational resources which can be used freely and found some promising web sites where we discovered useful books and slides in the topic. I would like to highlight two of these, which were the best material for the content development:


Step 3: Transforming the Found Material into Learning Content

After collecting all the resources, we started to map the content of the materials. We go through each chapter of the books, wrote down what is it about, what topics does it cover and put its structure into an excel table. The result was a detailed structure of the book.
As seen in the educational ontology learning content (basic concept, theorem, example) can be adjoined to the knowledge elements. Therefore the next step was to pair them. Analyzing the excel table, the experts connected the topics to the knowledge elements. For the knowledge elements that hasn’t got any content or was incomplete we looked for further material, and lastly we found content for all of the elements.

After that we inserted the content into the ontology model. According to the excel table we designated the content for the specific knowledge areas, formatted it and copied into the model. Some knowledge areas already had learning content from earlier researches. In these situations we didn’t have to overwrite them, only recheck and complete it if it was necessary, but if they were written in Hungarian we also had to translate them to English.
Step 4: Adding Multimedia to the Content

We find it very important to make our learning contents interesting and colorful. Because of this we looked for videos, pictures, slides and so on to enhance the learning experience. We found the most useful multimedia on Youtube and Slideshare.

Step 5: Creating Test Questions

The last topic, ‘Creating test questions’ is closely related to the development of the learning content.

According to the Educational Ontology, competences are not measured directly. Test questions are applied to examine if the applicants possess the knowledge elements. Of course, these questions refer to the learning content.

Figure 13 - Test questions in the Educational Ontology (Vas, R. 2007, p.128)
We use classic test questions with 4 possible choices and one proper answer. In the E-learning system the question and the possible answers have to be typed in, and the correct answers have to be marked as well. In special cases we could write a short hint to the question. Applicants get the result about the knowledge area which can be positive or negative according as they achieved the minimum level or not.

![Figure 14 - Creating test questions in the E-learning system](image_url)

We saw on the illustration of the OntoHR flow that setting up the selection test consists of two elements: Knowledge Test and Mental Ability Test. Taking Mental Ability into account is a new improvement and we will discuss it in the next chapter.

After all these steps our model is complete. We have the competences, we have knowledge elements, learning content to these knowledge elements and also the test questions.
6. Mental Ability

6.1 Extended Educational Ontology

Educational ontology went through a small transformation during the time of the project.

We think that knowledge is not enough to prove that the applicant has the specific competences. In our opinion it also needs intelligence to precisely predict the potential performance of the applicants. That’s why we extended the Educational Ontology with the concept of Mental Ability.

As we see it, competence consists of Knowledge and Mental Ability (Intelligence). Therefore to have a competence it is required to have a desired quality of Mental Ability too. In other words, the existence of a competence is ensured by the Mental Ability (besides Knowledge).

The structure of our Extended Educational Ontology’s Mental Ability is based on the 9 abilities, used by O*NET Ability Profiler (O*NET Ability Profiler 2011). 6 of these abilities are applied as the Intelligence facets that will be tested to evaluate Mental Ability. Namely they are: verbal ability, arithmetic reasoning, computation, spatial ability, form perception and clerical perception. The last three abilities of the Ability Profiler (motor coordination, finger dexterity, and manual dexterity) are not part of our system, because they measure different kind of physical abilities instead of mental ones.
Figure 15 - Extended Educational Ontology (OntoHR project 2011b)
6.2 Testing Mental Ability

As you can see in the figure (Figure 15) the method of testing also changed. Besides Knowledge, Mental Ability has to be checked too. It will be very similar to an IQ test. There will be multiple choice test questions. Mostly images will be used both in the questions and in the answers. As the result of the test, we will get a numeric value, which will be IQ coefficient.

The results of the Mental Ability Test and the Knowledge test will be combined, this way we will get the results for each competence. Competences are accepted only if the knowledge and the mental ability tests are both successful. If the competence is not accepted, the applicant will get a written explanation about the results. For example:

<table>
<thead>
<tr>
<th>Competence</th>
<th>IQ</th>
<th>Knowledge</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>below general</td>
<td>KAs accepted</td>
<td>restricted mental abilities (show the underperforming facets), but possession of required knowledge. Applicant has probably limited capabilities in the underperforming facets, e.g. difficulties of learning new concepts</td>
</tr>
<tr>
<td>C2</td>
<td>above general</td>
<td>some areas missing</td>
<td>good mental abilities, but the following KAs are missing : list of missing KA</td>
</tr>
<tr>
<td>C3</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

*Figure 16 - Example of test results (OntoHR project 2010e p.6)*
We are sure that the application of Mental Ability and its testing can lead to a more effective approximation about the future performance of the applicants and makes selection more adequate.
7. Conclusion

In this paper we illustrated, how the E-learning system of the OntoHR project is able to serve selection and education.

After reviewing the theoretical background, which was about selection, competences and ontology, we described the political background too. It turned out what are the aims of the European Union. Then we outlined our ideas to achieve these objectives. The OntoHR flow was described, which showed the way, our goals planned to be reached. These goals are supporting the education and making selection and trainings more effective. After that we went through the steps of the development of the pilot model: job-role selection, competence development and content development. At the same time we saw how it can be applied, and what will be the tasks of HR managers while using the completed system. In the end, we introduced a novelty in the project, the appearance of Mental Ability. With its help, competences can be described more precisely, so selection can be more effective.

OntoHR Project’s developments should be beneficial for HR managers, educational institutes and also for individuals:

- HR managers of organizations can complete their tasks – such as job design, selection, recruitment and training - more easily and at a higher level.

- Education can obtain more precise input for development concerning the marketable knowledge, thus well-grounded answer to the question of ‘What is to be taught and how?’ can be worked out.

- Applicants can benefit both from the development of education and from job trainings. Besides these, standardization facilitates their movement within the European Union.
It would be really important to use this method primarily with the latest job-roles and the latest competences. This way the speed of acquiring and using the competences of these modern topics could reach a higher level, which can lead to faster improvements in numerous issues in the World.

After all, we can say that we have high expectations for the success of the Project. Putting competences into the center and applying ontology provided a wide range of possibilities. There are just the final touches and the pilot will be completed and ready to be tried out. Hopefully both HRM and education will take advantage of our E-learning system and the connection between organizations and educational institutions will become stronger as well.
8. References


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OntoHR project, 2010c. Preliminary Study on target jobs for the ONTOHR pilot project.

OntoHR project, 2010d. Competence Based Selection and Recruitment with Ontology Supported Information Systems - State of the Art
OntoHR project, 2010e. OntoHR Architecture


OntoHR project, 2011c. Stakeholder interviews about ISA job role: Evaluation report.


9. Appendix

List of competences

<table>
<thead>
<tr>
<th>1. Conduct needs analysis</th>
<th>1.1 Define business problem to be solved by the application (e.g., through interview process)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.2 Define business information requirements</td>
</tr>
<tr>
<td></td>
<td>1.3 Align information system (IS) design with the business process</td>
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<td></td>
<td>1.4 Determine software needs</td>
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<tr>
<td></td>
<td>1.5 Determine hardware needs</td>
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<tr>
<td></td>
<td>1.6 Interpret data</td>
</tr>
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<td></td>
<td>1.7 Review organizational structure</td>
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<tr>
<td></td>
<td>1.8 Interpret existing operating documents for the system</td>
</tr>
<tr>
<td></td>
<td>1.9 Interpret existing operating procedures for the system</td>
</tr>
<tr>
<td></td>
<td>1.10 Observe existing procedures</td>
</tr>
</tbody>
</table>
| 2. Design computer applications | 1.11 Document existing procedures  
1.12 Document possible alternative solutions |
|---------------------------------|------------------------------------------------------------------------------------------|
|                                 | 2.1 Establish standards to govern the development of organizational information systems  
2.2 Establish policies to govern the development of organizational information systems  
2.3 Determine the roles of user and management in the computer system development process  
2.4 Outline steps for program development cycle (e.g., prototyping, storyboarding)  
2.5 Develop system design procedures  
2.6 Develop test procedures  
2.7 Develop quality standards  
2.8 Identify constraints (e.g., political, financial, time, hardware, and systems)  
2.9 Establish input and output (I/O) requirements |
<p>| 2.10 Design system input/output processes |
| 2.11 Determine compilers to be used in design |
| 3. Develop documentation |
| 3.1 Identify documentation needs |
| 3.2 Prepare program documentation |
| 3.2 Prepare user documentation |
| 3.4 Prepare dataflow diagrams |
| 3.5 Update design documentation |
| 3.6 Establish documentation-update method |
| 3.7 document system design procedures |
| 3.8 document test procedures |
| 3.9 document quality standards |
| 3.10 revise system design procedures |
| 3.11 revise test procedures |
| 3.12 revise quality standards |
| 4. Design a system project |
| 4.1 Identify the phases in a system project |
| 4.2 Select basic fact-gathering techniques |</p>
<table>
<thead>
<tr>
<th>4.1 Analyze information processing needs</th>
</tr>
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<tbody>
<tr>
<td>4.2 Analyze information computation needs</td>
</tr>
<tr>
<td>4.3 Define the scope of the systems project</td>
</tr>
<tr>
<td>4.4 Conduct a preliminary investigation</td>
</tr>
<tr>
<td>4.5 Maintain project scope</td>
</tr>
<tr>
<td>4.6 Plan computer systems</td>
</tr>
<tr>
<td>4.7 Define the goals of the system</td>
</tr>
<tr>
<td>4.8 Plan use of the results</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>5.1 Identify evaluation criteria</th>
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</thead>
<tbody>
<tr>
<td>5.2 Develop test plan</td>
</tr>
<tr>
<td>5.3 Identify time constraints</td>
</tr>
<tr>
<td>5.4 Identify technology constraints</td>
</tr>
<tr>
<td>5.5 Identify resource constraints</td>
</tr>
<tr>
<td>5.6 Determine investigation techniques to be used</td>
</tr>
<tr>
<td>5.7 Record facts gathered through system investigation</td>
</tr>
<tr>
<td>6. Install / implement computer application system</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>5.8 Perform appropriate diagnostic tests</td>
</tr>
<tr>
<td>5.9 Analyze test data</td>
</tr>
<tr>
<td>5.10 Present test results</td>
</tr>
<tr>
<td>5.11 Research technical alternatives</td>
</tr>
<tr>
<td>5.12 evaluate technical alternatives</td>
</tr>
<tr>
<td>5.13 Review performance indicators</td>
</tr>
<tr>
<td>5.14 analyze performance indicators</td>
</tr>
<tr>
<td>5.15 locate code problems</td>
</tr>
<tr>
<td>5.16 correct errors by correcting codes</td>
</tr>
<tr>
<td>5.17 Assess the usefulness of pre-developed application packages</td>
</tr>
<tr>
<td>6.1 Design implementation plan</td>
</tr>
<tr>
<td>6.2 Present implementation plan to users and management</td>
</tr>
<tr>
<td>6.3 Perform implementation to new system</td>
</tr>
<tr>
<td>6.4 Perform changeover to new system</td>
</tr>
<tr>
<td>6.5 Perform post-implementation</td>
</tr>
<tr>
<td>6. Identify ongoing support requirements</td>
</tr>
<tr>
<td>------------------------------------------</td>
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<tr>
<td>6.7 adapt pre-developed application packages to a user environment</td>
</tr>
<tr>
<td>6.8 link the computer systems within an organization to increase compatibility and so information can be shared</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7. run a system</th>
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<tbody>
<tr>
<td>7.1 maintain computer programs</td>
</tr>
<tr>
<td>7.2 maintain computer systems</td>
</tr>
<tr>
<td>7.3 monitor computer programs</td>
</tr>
<tr>
<td>7.4 monitor computer systems</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8. Deal with interpersonal issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.1 serve as project leaders for particular systems projects</td>
</tr>
<tr>
<td>8.2 Supervise computer programmers</td>
</tr>
<tr>
<td>8.3 Supervise other systems analysts</td>
</tr>
<tr>
<td>8.4 Train staff and users to work with computer systems</td>
</tr>
<tr>
<td>8.5 Train staff and users to work with computer programs</td>
</tr>
<tr>
<td>8.6 Provide staff and users with assistance solving computer related problems, such</td>
</tr>
<tr>
<td>as malfunctions and program problems</td>
</tr>
<tr>
<td>-------------------------------------</td>
</tr>
<tr>
<td>8.7 coordinating the installation of</td>
</tr>
<tr>
<td>computer programs</td>
</tr>
<tr>
<td>8.8 coordinating the installation of</td>
</tr>
<tr>
<td>computer systems</td>
</tr>
<tr>
<td>8.9 Identify development team</td>
</tr>
</tbody>
</table>