

## Understanding and Adaptation of the Concept of Competences in the Water Sector

Ch. Thanopoulos<sup>1</sup>, N. Manouselis<sup>1</sup>, Ch. M. Stracke<sup>2</sup>

<sup>1</sup>Agro-Know Technologies, Greece

<sup>2</sup>University of Duisburg-Essen (UDE), Germany

### Abstract

Competence models are proved as the most sufficient tool in order to support organizations and companies to achieve their main goals (e.g. selection of the most competent employees) and to enhance the offering training opportunities and help individuals with their personal performance. This article focuses on the identification of the main issues that will support the development of a successful and adaptable competence model in the water sector. An introductory overview of competence, competence model and competence modeling process is following by the investigation of the usefulness of the competence model in all the water sector domains. The scope of this study is the analysis of the water sector requirements for competence modeling, based on the initial results of a European survey that takes place in the context of EU project WACOM ([www.wacom-project.eu](http://www.wacom-project.eu)).

### Key words

Competence, water competence model, water sector

### Introduction

A variety of organisations in all the professional sectors use competences to describe the skills that they expect their employees to have. The identification and application of the competences required for effective job performance has become a complex and sophisticated endeavor as experience with this approach has been gained in business and industry. More than 15 years ago, Van Der Veen (1993) mentioned the statement that business, industry, government institutions and nonprofit organizations in our rapidly changing world, are forced to create new, innovative responses to the “speed of light” changes in their environment.

Competences are observable performance dimensions, like individual knowledge, skills, attitudes and behaviours (Athey & Orth, 1999). The use of competences has the advantage to make the organizational expectations and the development and promotion process more clear and accessible for employees (Van Dongen, 2003).

Competence models support the main organizations goals in designing improvements to Human Resources Management systems, including job

redesign, recruitment, internal organizational training, career management, performance improvements and compensation systems (United Nations Industrial Development Organization, 2002). Competent employees are the main resource of any organization in acquiring a competitive advantage. An organization's best source of competitive advantage lies with its employees. A competence model should be firstly intended to improve and develop employee competences, which it will become the vehicle for the enhancement of Job and organizational performance and it will support the competitive strategy of the organization (Vathanophas and Thaingam, 2007).

Responding to the need for developing sector specific competence models, WACOM ([www.wacom-project.eu](http://www.wacom-project.eu)), Water Competence Model Transfer, is an European Project in the context of Lifelong Learning Program which intends to support employees and learners with the identification of required competences and qualifications for a specific working places. WACOM transfers the European Qualification Framework (EQF) and the German reference model for the competence modeling PAS 1093 (Publicly

Available Specification) into the European water sector vocational education and training. First, the developing competence model is adapted in the field of sewage treatment plants management and secondly it will be transferred to other fields of the water sector and other professional sectors.

This study reports on the initial findings from an European survey with experts from all the domains of the water sector. The outcomes of this survey inform and set the frame for the design and development of the water competence model for reporting the required and future needed employee competences for the accomplishment of specific tasks of a wide range of jobs professions in the water sector.

## Competence Model

### Overview

A required competence for a job has been defined as an underlying characteristic of a person that leads to or causes superior or effective performance (Yeung, 1996). McLagan (1996) goes on to further explain that those characteristics are composed of the knowledge and skills needed to perform a job effectively.

Competence is defined as an ability to perform a specific task adequately and all the competences that are needed for the successful accomplishment of the tasks or missions of a job are presented in a competence profile (Roe, 2002). A competence model is a model of key competences, which are generic clusters of competences (Viitala, 2005). Swiderski (1987) defined three main clusters of competences, namely hard, soft and conceptual competences. The hard skills are technical and administrative skills. The soft competences, also known as the interpersonal skills, consist of sensitivity, adaptability, creativity and flexibility (Rodriguez *et al.*, 2002). Conceptual competences can be defined as critical thinking, problem solving, judgement and decision-making (Swiderski, 1987).

According to the European Reference Framework “Key Competences for Lifelong Learning” (2007), the competences can be grouped in 8 categories of “key-competences” for a successful profession in a knowledge society: communication in the mother language, communication in foreign languages, mathematical competence and basic competences in science and technology, digital competence, learning to learn, social and civic competences,

sense of initiative and entrepreneurship and cultural awareness and expression.

The danger of using key competences is that the underlying competences become less effective and successful due to too much attention for the core competences (Van Dongen, 2003).

Spencer and Spencer (1993) distinguish two categories of competences. The first one is threshold competences: competences, such as writing skills, which every employee should possess and do not give an indication of outstanding behaviour. The second category is differentiating competences, which are competences, like decision making, that make a difference between average and outstanding performance.

A common approach is to identify several “core” or “key” competences that are essential for all employees and then to identify several additional categories of competences that apply only to specific subgroups. (Marelli *et al.*, 2005) Some competence models are organized according to the type of competence, such as leadership, personal effectiveness, or technical capacity. Other models may employ a framework based on job level, with a basic set of competences for a given job family and additional competences added cumulatively for each higher job level within the job family.

Murray (2003) described the two different concepts of competences, namely organisation competences (the main goals and strategies of a company) and personal competences (indicators of personal strengths).

Before starting the description of the process for the development of a competence model it is intentional to set the definitions for sector, competence, the components of competences (knowledge, skills) and competence model, since the Water Competence Model is referring to a specific area of Job professions.

### Sector

According to the European Qualification Framework, sector means a grouping of professional activities on the basis of their main economic function, product, service or technology (EQF, 2008).

### Competence

McClelland (1973) was the first to introduce the term “Competence” into the human resources

literature. His work “Testing for Competence Rather Than for Intelligence” was delivered to the United States Information Agency for improving their selection procedures of employees. Competences represent *the knowledge, skills, traits, attitudes, self-concepts, values or motives directly related to job performance or important life outcomes and shown to differentiate between superior and average performers* (McClelland, 1973).

Competence is a measurable human capability that is required for effective performance. It competency may be comprised of knowledge, a single skill or ability, a personal characteristic, or a cluster of two or more of these attributes. Competences are the building blocks of work performance. The performance of most tasks requires the simultaneous or sequenced demonstration of multiple competences (Hoge *et al.*, 2005).

A new approach based on the European Qualification Framework (EQF, 2008) and the Publicly Available Specification (PAS 1093, 2009) concludes the definition of a Competence as the ability to reasonably and intentionally perform a specific job and task in an unknown situation with success: Competences encompass a combination of knowledge, skills, and (intentional) behaviour and are constituted by defined activities for the observation and measurement. Competences are built and are normally demonstrated by individuals (but also by teams and whole organizations) (PAS 1093). In this paper we are following this approach as it is in line with the European policies, and required by the new knowledge and information societies as well as by the professional business, industries and enterprises.

### **Knowledge**

Knowledge depicts the awareness, information, or understanding about facts, rules, principles, guidelines, concepts, theories, or processes needed to successfully perform a task (Marrelli, 2001, Mirabile, 1997). The knowledge may be concrete, specific, and easily measurable or more complex, abstract, and difficult to assess (Lucia & Lepsinger, 1999). Knowledge is acquired through learning and experience.

According to the EQF definition, knowledge means the outcome of the assimilation of information through learning. Knowledge is the body of facts,

principles, theories and practices that is related to a field of work or study (EQF, 2008).

### **Skills**

A skill is a capacity to perform mental or physical tasks with a specified outcome (Marrelli, 1998). Similar to knowledge, skills can range from highly concrete and easily identifiable tasks, such as filing documents alphabetically, to those that are less tangible and more abstract, such as managing a quality improvement project (Hoge *et al.*, 2005, Lucia and Lepsinger, 1999). According to the European Qualification Framework, skills are defined as the ability to apply knowledge and use know-how to compete tasks and solve problems (EQF, 2008).

### **Competence Models**

Competence models depict a number of competences that are usually required for the successful accomplishment of a particular job, according to the tasks of work or professional specializations (Shippman *et al.*, 2000). These models can identify the needed skills, knowledge, behaviours and capabilities for the current and future staff selection in relation with the strategies and priorities of the industry/enterprise. They can enhance personal development by eliminating the gap between the required competences for a job profession and those that are available (Draganitis *et al.*, 2006).

A more concrete approach of the competence model definition emanates the Publicly Available Specification (PAS 1093, 2009) in combination with European Qualification Framework (EQF, 2008). A competence model describes the competences required to successfully perform in a particular job and organization. This set of competences is then used as basis and standard for the description of specific jobs, the selection of new staff, the evaluation of the on-going performance of the whole staff, the analysis of training needs, and the classification and provision of tailor-made vocational education and training for competence development.

### **Aims and objectives of the Competence Model**

Reihl (1998) described the most important objectives concerning the general uses of Competence Models in various professional sectors. First of all Individuals (learners or employees) are inspired with greater responsibility to develop their

valued skills and are supported with the necessary information resources to define, measure and achieve that. On the other hand, people who are responsible for the managerial issues, feel greater accountability for the needed competences, as set of skills and knowledge.

Utilization of a competence model in a specific workplace aims to satisfy the following issues:

- Identify specific employer needs
- Provide a common framework for effective performance
- Develop competence-based curricula and training programmes
- Develop industry-defined performance indicators and skill standards
- Develop assessment and testing tools / instruments

#### **Benefits for the users / stakeholders**

Competence model can be proved beneficial for both individuals / employees and organizations / employers as a whole, as it:

- Helps employees to become familiar with what is expected on the job
- Supports employers to understand the performance management with the help of a specific set of competences that are observable and measurable
- Improves the available training programmes and sets the lines for the future competence-based curricula
- Defines a common language of competences in the organization
- Screens applicants during hiring, resulting in a higher quality applicant pool
- Enables leaders to create teams with the right mix of skills and abilities
- Compensates employees appropriately based on level of competences
- Assists with easing the transition during organizational change efforts
- Allows an organization to communicate and accomplish the overarching organizational mission, goals, and/or strategy.

#### **Competence Modeling**

Marelli *et al.* (2005) presented the seven main steps of the competence modeling process in a logical sequence.

- Defining the objectives
- Obtain the support of a sponsor
- Develop and implement a communication and education plan
- Plan the methodology
- Identify the competences and create competence model
- Apply the competence model
- Evaluate and update the competence model

The design and development of the competence model should be focused on the gained benefits for the related stakeholders (individuals, organization / employers, professional training providers) and the opportunities that will come up through the competence model implementation. The professional sector is analyzed and all the involved occupations and job specialization are defined. The sponsor support will ensure the competence model success, gaining the commitment and participation of the employees, managers, professionals, or other actors.

Through the communication and education plan intends to inform all the stakeholders about the model in the early planning phases and keep everyone updated of the progress being made and what they can expect next.

Next to that, the methodology involves the selection of the experts for the sector who will contribute information, and data and the methods that will be used for obtaining the data. In the third step, the case study and the specific job professions are broadly defined, as well the required and future needed competences. Then, the competence model is determined as a set of individual competences.

The next step is the most valuable and vital for the success of the competence model in all the Human Resources related processes like Selection, Performance management, Training etc. The competence model will be applicable if the competences are used to select, develop, manage, reward, and compensate employees for a specific Job / or tasks of a job. After the evaluation and application of the competence model, Evaluation of

the competence model it is important to evaluate the competence model development process, as well as the value of the resulting model to the organization and the training programmes.

In this work we focus and we analyze the second step by analyzing the needs of the water sector concerning the competence modeling.

## Methodology

### Online survey features

In this section, the identification of the specific demands and needs of the water management and existing practice concerning competence models in the water sector is analyzed and the fundamental elements that underpin the successful application of a competence model for the job-related in the water sector are described. The identification of the water sector needs is based on a survey, using an online questionnaire.

The Online survey advantages for collecting useful feedback for the competence modeling in the water sector can be summarized as following (Marelli *et al.*, 2005):

- Considerable data can be collected quickly and inexpensively
- Information can be easily collected from geographically dispersed respondents
- Respondents may complete the survey at a time and place that is convenient for them
- Surveys permit the input of many people in the organization and thus facilitate acceptance of the competency study
- The survey questionnaires can be easily customized for subgroups of respondents
- The anonymity of surveys encourages candid responses
- The multiple-choice or rating-type questions result in quantitative data that can be easily summarized and analyzed.

The Online Survey is available in 5 different languages:

- English
- German
- Greek
- Hungarian

- Romanian

The Open Source LimeSurvey Application (<http://www.limesurvey.org/>) was used for the launch of the questionnaire, as well as for the statistic analysis of the results. The Survey aims to collect the preferences and needs of experts from all the water sector eras for the better developments and adjustment of the competence model in this sector in general.

### Target audience of the survey

The aim of the online survey is the collection of enough experts' opinions from as many work and research fields of the water sector. The intended target groups were from the EU member countries at first and secondly from interested experts from all over the world.

The stakeholders groups that were selected to be invited in the online survey are describing as follows:

- Teaching staff from universities, schools and other forms of formal education in the water sector
- Providers of vocational education and training programs in all the domains of the water sector
- Water associations
- Research institution in the water sector
- Governmental agencies, national authorities and ministries for the water resources management, environment and educational issues for the water sector
- Local and regional administration authorities (municipalities etc)
- Employees from the industry in related working fields
- Enterprises and private companies with advisory services
- Non-profit/governmental organisations

### Intended countries

The online survey was accessible via internet to all interested experts. The survey was focused mainly to the consortium partners of the WACOM project (Germany, Greece, Hungary and Romania) and secondly to the rest member countries of Europe and other third countries. Specifically, the intended countries were the following:

- Germany, Greece, Hungary and Romania (participating in project WACOM)
- Other EU countries members
- Other non-EU member countries

### Structure of the Online Questionnaire

The online survey, for defining the needs of the water sector in general concerning the competence modeling, is launched and available to all interested Water Experts. The survey was based on a comprehensive questionnaire of 15 issues-questions and available in 5 different languages: English, German, Greek, Hungarian and Romanian. The survey was active for 2 months and accessible in the

link <http://survey.agroknow.gr/index.php?sid=38344&newtest=Y&lang=en> (for English language). Main objectives of the whole initiative is to direct to as many water experts from the whole Europe (at least) and collect their aspects and visions on the development and adjustment of the competence model in the water sector.

The covering topics of the online questionnaire are the following:

- a) Current Awareness of Competence Models,
- b) Perceived Need of the Implementation of Competence Model in the Water Sector,
- c) Vocational Education and Training in the Water Sector, and
- d) Demographic Data of the participants.

The list of domains of the water sector that is appeared in the online questionnaire and gives its main divisions is the following:

- Irrigation Water
- Water Use in Animal Husbandry
- Hydrology (e.g. surface and ground water, water resources studies)
- Hydraulic Engineering (e.g. physical modeling, numerical modeling, seepage studies)
- Environmental Protection (e.g. Environmental research, protection of water resources from pollution)
- Legislation
- Hydroelectricity
- Geothermical power

- Wastewater management
- Sewage Treatment Plants
- Desalination Plants
- Water Supply (potable Water)
- Domestic Water use (indoor and outdoor household purposes)
- Transportation on water (rivers and lakes navigation)
- Water Sports / Athletic Activities
- Recreational Uses of Water Resources (e.g. baths, spas,...)

For the first section (*Awareness of Competence Models*), a number of questions are raised in order to investigate the understanding of the terms “Competence” and “Competence Models”, the aspect of the importance of competence models to explicit describe the frame of job profiles and further specializations, and the involvement or prospective application of competence models in the description of job professions/specializations in a specific field.

Next section *Perceived Need of the Implementation of Competence Model in the Water Sector* is divided in two parts with one corresponding question for each one part. The level of the importance of the competence model in the water sector in general to draw the related job profiles is inquired. In the second part, the significant reasons of the necessity of the competence model in describing the framework of job professions and specializations in the water sector and the level of their importance are listed.

The *Vocational Education and Training in the Water Sector* is comprised of two parts, one for the exploration on how the employees are well-skilled and competent enough in a list of domains of the water sector and the second one for defining the degree/level of the existence of specialised training opportunities for job professions of each one domain of the water sector.

At the end, a section with demographic questions is included for specifying the gender, age, level of higher education, country of origin, sector of work or research, and the relevance of their field of work/interest with the listed domains of water sector.

## Results of the requirement analysis

### Water sector experts' demographics

In the total, there were 87 completed questionnaires, with a national breakdown as it is presented in the figure 1. As about the sector of work and research of the participants on the survey, the results are presented in the following figure 2 without any significant difference among them. Since an expert may be involved in more than one occupational activity in his work / research field, there are marked more than one choice in this field. Only the portion of the representatives from the Research Institution is smaller than the rest.

When classifying the specialization in the work and their researching interest to the main 16 categories / domains of the water sector (figure 3), 59.77% replied that their working / researching expertise belongs to the field of *Wastewater management*, 58.62% to *Sewage management* and 55.17% to *Water supply field*. A percentage of 47.13% of the experts were involved in the *Environmental protection*. 34.48% of the total answered that their work is involved in *Legislation* issues of the water sector, 31.03% in the *Domestic water use* and 27.59% in the domain of *Hydrology*.

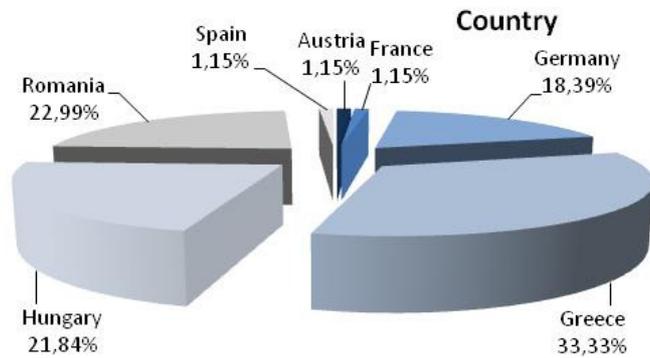


Figure 1: National breakdown of the participants.

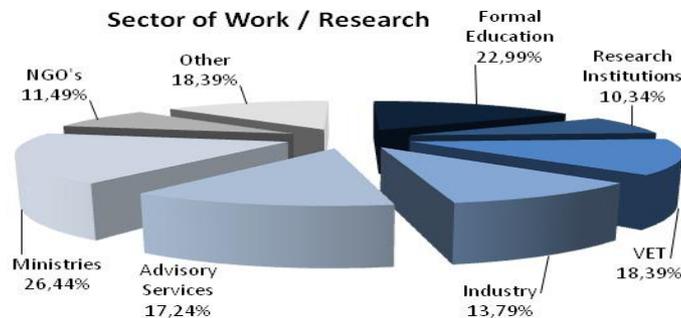


Figure 2: Sector of work / research of the participants.

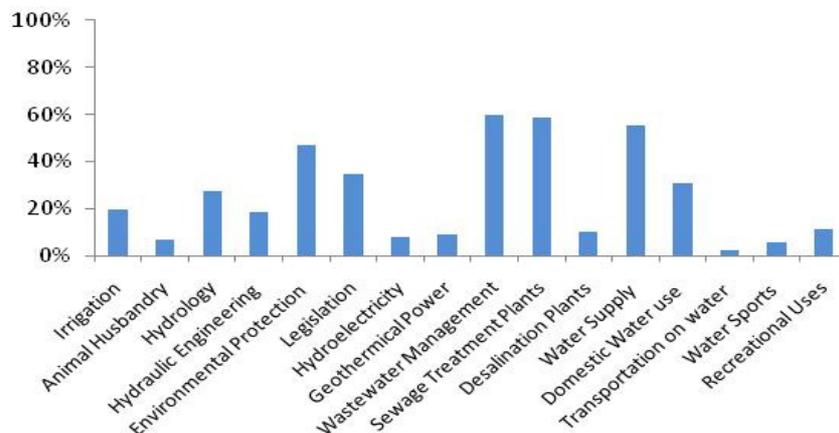


Figure 3: Classification of the work / research interest of the participants in accordance with the Water sector divisions.

Representatives from the *Irrigation* use of water were in a percentage of 19.54% as well as for the field of the *Hydraulic engineering*. The choices: water use in *Animal husbandry*, *Hydroelectricity*, *Geothermal power*, *Desalination*, *Transportation*, *Water sports* and *Recreational uses* of water resources were selected by a percentage of 10% or less than 10% respectively.

**Current awareness of competence / competence models**

In total, almost all the respondents have heard or known the term Competences (98.85%) and only a small percentage, 1.15%, gave a negative answer (figure 4). The term competence model is also well

known, but in a smaller percentage, 70.11%. The remaining 29.89% has a different opinion and of course it is bigger than the reply for the term competence (figure 5).

Rating the current understanding on how the competence models can be used for the description of a job profile, the answers vary and most of the respondents, 42.53% gave a neutral answer (level III). 35.63% of the experts supported the opinion that the competence model will be proved important for the better description of the workplace (levels IV and V). The corresponding percentage that expressed a negative opinion was only 21.83% (figure 6)

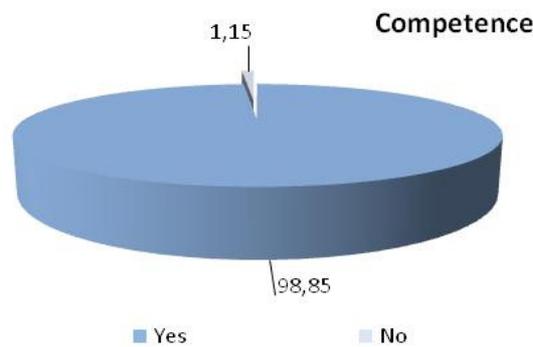


Figure 4: Awareness of the term "Competence".

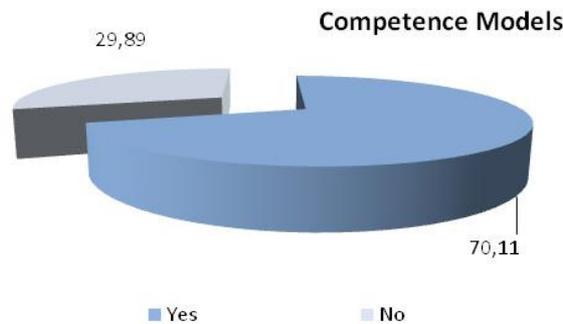


Figure 5: Awareness of the term "Competence Models".

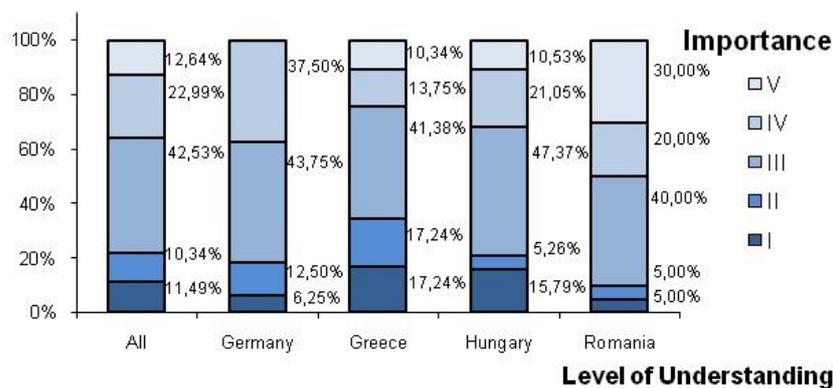


Figure 6: Understanding the usefulness of the competence model for the description of the job profile (Level I= minimum, Level V= maximum). Column "All" refers to the overall results of the survey and the rest columns to the results for the German, Greek, Hungarian and Romanian surveys.

In Germany, Greece and Hungary, most of the answers prove the medium level III (basic understanding) as an accurate result. The German results indicate that the high level of understanding is selected by a percentage of 37.5% and the rest of them (19%) underline the first levels I and II as not so important. It is also interesting that no one of the German experts has selected the highest level V. In Hungary the results are almost equal with a percentage of 31.58% for the highest levels IV and V and 21.07% for the levels I and II.

Results from the Greek survey release the same pattern to the one that emerged from the analysis of the total results of the survey. The majority of the answers (41.38%) underline the medium level (level III). The levels of low understanding (levels I and II) have been selected in a greater percentage than the upper levels IV and V (I: 17.24%, II: 17.24%, IV: 13.79% and V: 10.34%). In addition to the previous results, Romanian experts expressed the opinion that they understand it sufficient, since half of them selected the levels IV and V, 40% the medium level III and only 10% the low levels I and II.

It is interesting that a significant percentage, 57.47%, of the experts has already used a competence or a set of competences for the description of a job profession or specification in their working / researching field. Similar to the overall results, German experts answered positive in a percentage of 56,25%. The corresponding percentages for the cases of Hungary and Romania are higher, 68,42% and 75% respectively. On the other hand, only one third of Greek experts agree with this aspect (figure 7).

#### **Usefulness of competence model in the water sector**

Concerning the implementation of the competence model in the water sector, most of the replies imply a high level of usefulness of the competence model for the job professions in the fields of the water sector (figure 8).

Overall, 76.76% of the experts marked the upper 2 levels, with 44.83% having mentioned the level IV and 31.93 noticing the highest level (level V) of the importance. A smaller percentage, 7.75%, can't find a significant need for competence modeling into the water sector. Also, 18.39% of the experts are not quite sure for the usefulness of the

competence model into the transparency of the job description of the water sector.

Concerning the results from Germany and Hungary, the majority, 62-63% of them chose the high levels of usefulness, which is smaller than the overall percentage. A significant percentage of the experts recognized a basic importance (level III) of its usefulness (Germany: 25% and Hungary: 31.58%) Finally, the remainder 12.5% or less of the experts answered the first 2 levels I and II of the importance.

In Greece and Romania the experts believe strongly that the competence model can support the water sector, offering better description of the involved job occupations and recording the needed and required competences in a specific area of work. The upper levels IV and V were selected by the 79.31% of the Greek experts and 90% of the Romanian experts. Neutral answers (level III) were given by a smaller percentage 17% for the Greek survey and 6% for the Romanian respondents.

The presented reasons in the figure 9 proves the importance of the competence model in the water sector. All the respondents identify the importance of these reasons in this specific occupational field, selecting the highest levels IV and V.

For the better understanding and *Description of the job profiles*, that are involved, a noticeable percentage of 60.92% mentioned its importance, selecting the level IV (33.33) and the level V (27.59%). 13.80% of the answers mentioned this reason as not so important (levels I and II) and 25.29% gave a neutral answer (level III of importance). Responses from Greece, Hungary and Romania present similar results with the overall findings of the survey. 60-63% of the experts mentioned the highest levels IV and V of the importance, 21-27% expressed a neutral opinion and less than 15% believe that this reason is not very important. On the other hand, only half of the German experts support the great importance of this reason, 31.25% expressed a neutral opinion and the rest of them mentioned the low levels I and II.

*Acquisition of the qualifications* is proved as a stronger than the previous reason. A bigger portion, 67.82% answered the levels IV (39.08%) and V (28.74%) of the importance. On the other hand, almost the same percentage of 15.14, as before, replied the lowest levels (I and II) and 17.24% of the experts believed that the level III of the

importance is more appropriate for the qualifications. The differences among the countries answers release interesting results. In Greece case, this reason proved one of the most important, since 86.2% of the experts have voted it. The results from the Hungarian survey follow the same pattern with the overall results of the survey (Levels IV+V: 68,43%, Level III: 15.79% and Levels I-II: 15,79%). In Germany and Romania, the percentages of the levels IV and V present a reduction in comparison with the overall results. Only 55% of the Romanian experts and 43,75% of the German experts identify this reason as important element for the utilization of the competence model in a specific professional sector.

Additionally, *Organizational requirements* are proved as not so important as the previous 2 reasons. Only 57.47% of the answers, mentioned it with the higher level of importance. Small percentage (8.05%), as for the previous two reasons, marked the first 2 levels (I and II). It is also interesting, that bigger portion of the respondents (34.48%) than the previous two reasons find more accurate the medium level of the importance (level III). Greek experts consider that this reason is also beneficial for the implemented workplaces as the previous (Levels IV+V: 86,20%). Results from Germany, Romania and Hungarian surveys indicate the *Organizational requirements*

as a reason with the minimum necessity, concerning the application of the competence model.

Regarding the *Comparability of the training opportunities*, a noticeable percentage of 65.52% believe that it is a significant reason (levels IV and V of importance). Only 8.05% of the respondents underlined the lower levels of the importance of this reason (levels I and II). Another 26.44% mentioned the normal level of the importance. The results from the Greek survey are quite similar with the overall findings. In Hungarian and Romanian surveys, the percentage of experts that indicate the importance of this reason are higher, 84.21% and 75% respectively. In contrast, 43.75% of the experts mentioned the importance of the Comparability of training opportunities.

At last, the reason of *Measuring the training needs* into a specific working field is proved as the most crucial reason. The biggest percentage of experts, 74.71%, revealed this reason as a very important fact (level IV and V) for the water sector. A small portion of the answers marked the low levels of the importance and 21.84% of the respondents underlined the medium level III of the importance. Alike to the overall findings, the results of the Greek, Hungarian and Romanian survey indicate this reason as critical for the implementation of the competence model. In addition, only 43.75% of the German experts believed that this reason is essential.

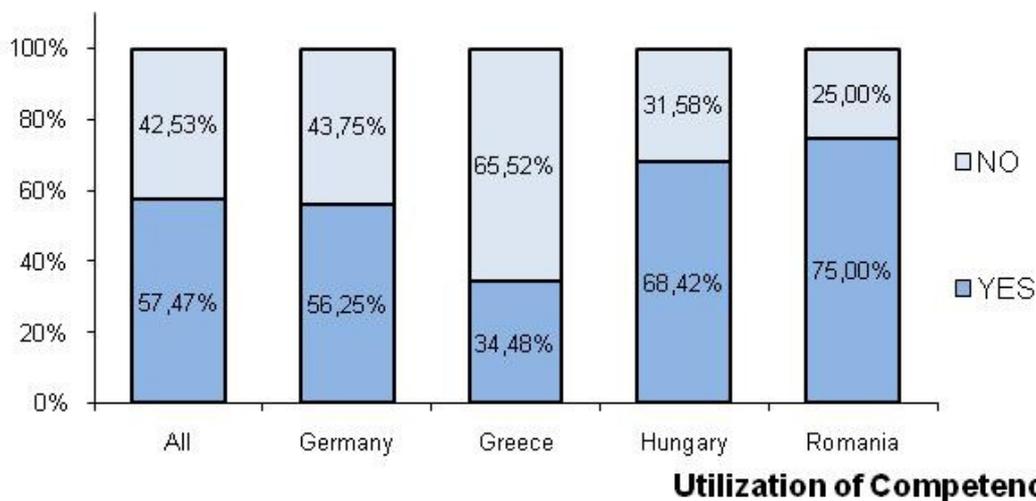


Figure 7: Utilization of competences in the description of a job profession in the participants work / research field. Column "All" refers to the overall results of the survey and the rest columns to the results for the German, Greek, Hungarian and Romanian surveys.

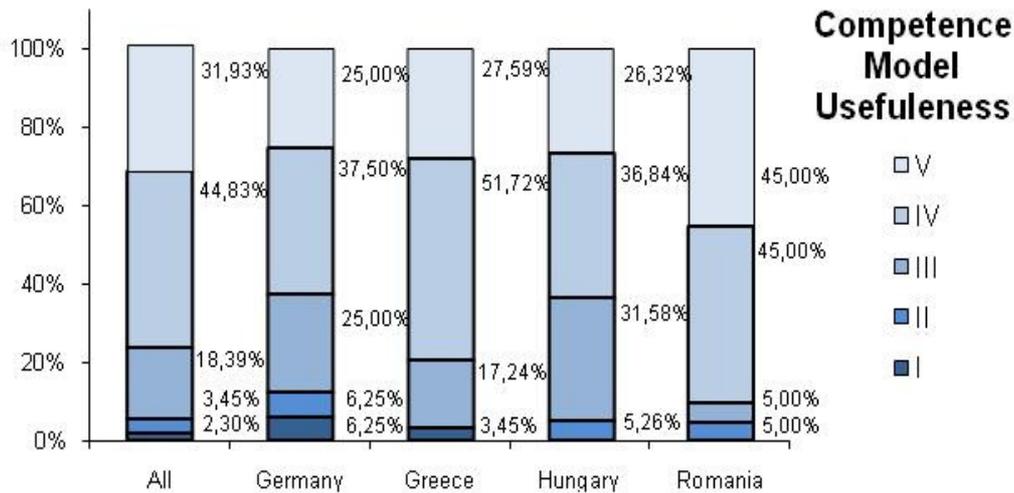


Figure 8: Usefulness of competence models for the water sector (Level I= lowest level of importance, Level 5= Highest level of Importance). Column "All" refers to the overall results of the survey and the rest columns to the results of the German, Greek, Hungarian and Romanian surveys.

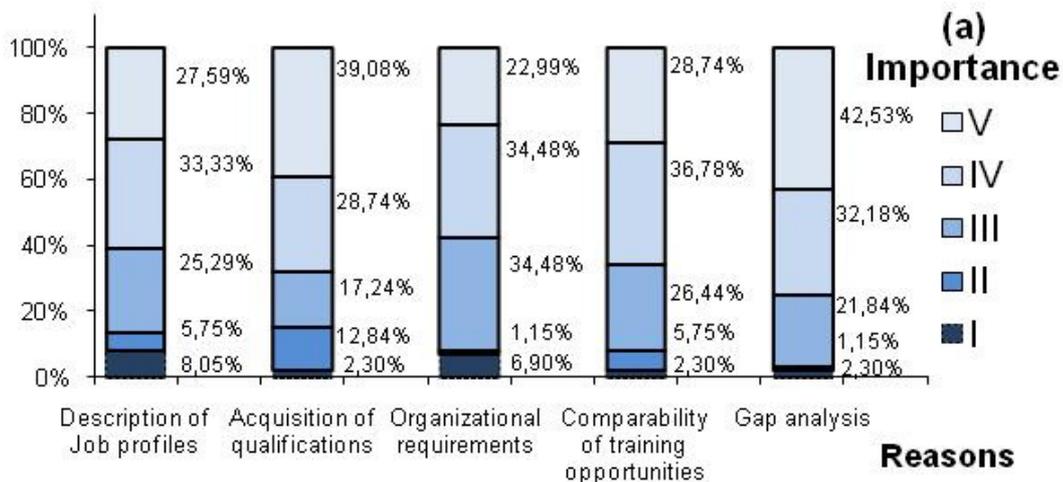


Figure 9: Reasons of importance of the competence model in the water sector (Level I= lowest level, Level V= Highest level) for the overall results.

*Acquisition of the qualifications* is proved as a stronger than the previous reason. A bigger portion, 67.82% answered the levels IV (39.08%) and V (28.74%) of the importance. On the other hand, almost the same percentage of 15.14, as before, replied the lowest levels (I and II) and 17.24% of the experts believed that the level III of the importance is more appropriate for the qualifications. The differences among the countries answers release interesting results. In Greece case, this reason proved one of the most important, since 86.2% of the experts have voted it. The results from the Hungarian survey follow the same pattern with the overall results of the survey (Levels IV+V: 68.43%, Level III: 15.79% and Levels I+II: 15.79%). In Germany and Romania, the percentages of the levels IV and V present a

reduction in comparison with the overall results. Only 55% of the Romanian experts and 43.75% of the German experts identify this reason as important element for the utilization of the competence model in a specific professional sector.

Additionally, *Organizational requirements* are proved as not so important as the previous 2 reasons. Only 57.47% of the answers, mentioned it with the higher level of importance. Small percentage (8.05%), as for the previous two reasons, marked the first 2 levels (I and II). It is also interesting, that bigger portion of the respondents (34.48%) than the previous two reasons find more accurate the medium level of the importance (level III). Greek experts consider that this reason is also beneficial for the implemented workplaces as the previous (Levels IV+V: 86.20%).

Results from Germany, Romania and Hungarian surveys indicate the organizational requirements as a reason with the minimum necessity, concerning the application of the competence model.

Regarding the *Comparability of the training opportunities*, a noticeable percentage of 65.52% believe that it is a significant reason (levels IV and V of importance). Only 8.05% of the respondents underlined the lower levels of the importance of this reason (levels I and II). Another 26.44% mentioned the normal level of the importance. The results from the Greek survey are quite similar with the overall findings. In Hungarian and Romanian surveys, the percentage of experts that indicate the importance of this reason are higher, 84.21% and 75% respectively. In contrast, 43.75% of the experts mentioned the importance of the *Comparability of training opportunities*.

At last, the reason of *Measuring the training needs* into a specific working field is proved as the most crucial reason. The biggest percentage of experts, 74.71%, revealed this reason as a very important fact (level IV and V) for the water sector. A small portion of the answers marked the low levels of the importance and 21.84% of the respondents underlined the medium level III of the importance. Alike to the overall findings, the results of the Greek, Hungarian and Romanian survey indicate this reason as critical for the implementation of the competence model. In addition, only 43.75% of the German experts believed that this reason is essential.

### **Educational level of the job professions in the water sector**

The aspect of the experts for the level of the people that are enough skilled and competent in the major domains of the water sector revealed interesting results. The full list of the water sector domain is presented in the figure 10.

Concerning the agricultural professionals that are related with the water sector, a noticeable percentage (29.74%) believed that people who are occupied with the *Irrigation* are enough competent and only 11.49% have the same opinion for the job professions related to the water use in the *Animal husbandry*. Almost equal results are presented for the Greek and Hungarian surveys. In the case of Germany, the corresponding percentages are smaller (almost half) of the overall results. On the other hand, Romanian experts expressed the same

opinion for the water use in *Animal husbandry* and believe that the job professions that are dealt with the *Irrigation* are not skilled enough at all (only 5%).

The respondents mentioned the domains of *Hydrology*, *Hydraulic engineering* and *Environmental protection* as more crucial and the job professions from the related working places are skilled enough in a greater percentage than the agricultural section. Specifically, the percentages of the well educated people are: 44.83% for *Hydrology*, 35.83% for *Hydraulic engineering* and 39.08% for *Environmental protection*. The results from Greek and German surveys agree with the overall findings. In contrast, experts from Hungary come in agreement with the overall results only for the job professions in the *Hydrology* domain. They believe that people from *Hydraulic engineering* and *Environment protection* are well educated in a smaller percentage than the presented results in Germany and Greece (less than 30%). Alike to the Hungarian results, the Romanian survey revealed that people from the corresponding fields are not well educated as the average results from the rest countries (20%, 20% and 30% respectively).

The domain of *Legislation* of the Water Use includes well educated people in a smaller percentage, 18.39%. In Germany and Greece, experts believe that the involved job professions are well educated in a greater than the average percentage (31,25% and 24,14% respectively). On the other hand, people from the related domain are less well performed as the average (15%) in case of Romania or not at all well educated in case of Hungary.

The same percentage for the occupations that are related with the water use for the production of Hydroelectricity is 24.14% and for the people who work in the *Geothermal power* units is 10.34%. Similar to *Geothermal power*, only 12.64% of the answers underline that people from the *Desalination plants* are enough competent. Results from the German and Hungarian surveys indicate that personnel from Hydroelectricity are not well performed as the overall percentage from all the countries (12% and 15,79% respectively). Also, Greek and Romanian surveys point out that the involved people in the Hydroelectrical units are well performed in a greater percentages than the corresponding in Germany and Hungary (27,59% and 35% respectively). *Geothermal power* seems

to not include well performed people, since the results are less than 6% (Hungary and Romania) or 0% (Germany), with the exception for Greece (20,69%). As about the *Desalination plants*, the personnel are well educated in a smaller percentage than the average, less than 6,25% (Germany and Romania) or 10,53% for the Hungary and in a greater portion than the average, 17.245 for the case of Greece.

It seems that *Wastewater management* and *Sewage treatment* are the two water sector domains with plenty of educational and training programmes. 54.02% of the respondents mentioned that the field of the *Wastewater management* includes well competent employees. The same percentage for the field of the *Sewage treatment plants* is 59.77%. The difference between the results of *Wastewater* and *Sewage management* fields maybe is influenced by the fact that citizens are well informed and more interested about the *Environmental protection* and the impacts of human activities into the environment. The results in Greece are similar to the overall findings of the survey (*Wastewater management*: 55.17% and *Sewage treatment plants*: 51.72%).

In Romania, the percentage for the *Sewage treatment plants* is similar to the average of the survey and completely greater from the corresponding for the *Wastewater treatment plants* (30%). Experts from Hungary expressed also the opinion that the corresponding percentage is equal

for the *Wastewater* and *Sewage management* plants and greater than the overall findings (almost 70%). The majority of German experts believe that people from these two water sector domains are well performed in a greater percentage than the overall results or the results in the rest countries (*Wastewater treatment plants*: 93,75% and *Sewage treatment plants*: 81,25%).

Besides, 62.97% of the experts believe that people from the *Water supply* are well educated since this is an effect of the improvement of the living conditions and the fluently of the related training programmes. The corresponding percentage is smaller for Greece and Germany (50-55%) or bigger for Hungary and Romania (70-74%) than the overall findings. It is also interesting that the people in the *Water supply* domain are well educated as the rest from *Wastewater* and *Sewage treatment plants* in Greece and Hungary, less enough competent as their colleague from *Wastewater* and *Sewage treatment plants* in Germany and better performed for the case of Romania.

Domestic water use seems to not have so many attention from the answers, since only the 22.99% of them believed that people and related jobs are well skilled. Alike to that, the results from the Romanian survey indicate a percentage of 25%. Smaller but not trivial percentage came up for the Greek (17,24%), and Hungarian (15.79%) survey and greater presented in the German survey (31.75%).

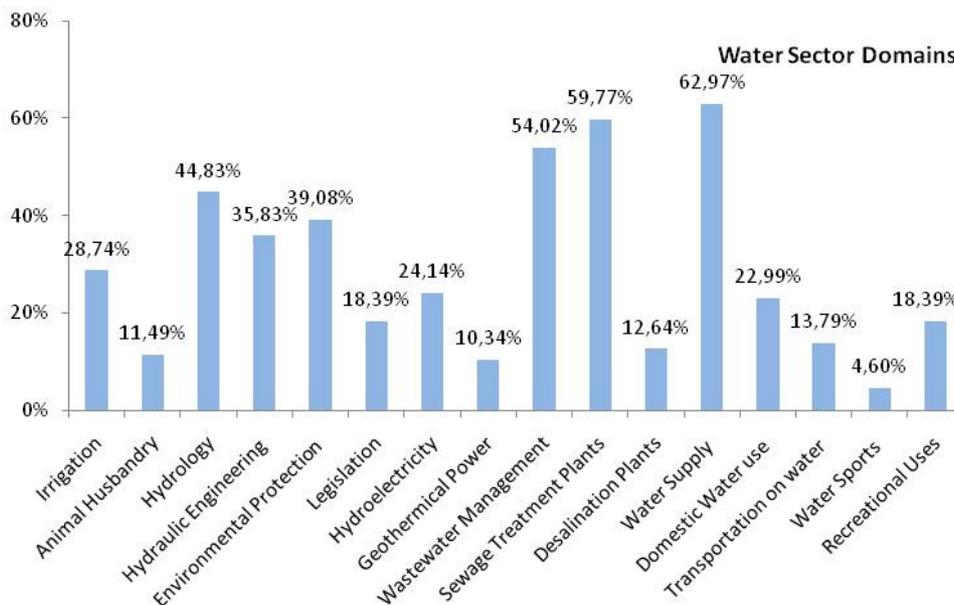


Figure: 10. Percentages of the enough skilled and competent people for the 16 main water sector domains.

In total, a smaller percentage of experts, 13.79%, has the same opinion for the *Transportation* on the water (rivers, lakes etc). The corresponding percentages for Romania, Germany and Hungary are greater, 15%, 18.75% and 21.05% respectively. In contrast, there is no interest in Greece, since the answers are less than 4%.

Experts from all the countries expressed the opinion that less than 5% of people who are involved in the *Water sports* are enough skilled. It is also interesting that there are no results from Germany and Romania surveys. Finally, 18.39% of total answers underline that people from the domain *Recreation use of the water resources* are enough competent. The same opinion was supported by 31% of the Greek and Hungarian experts. In case of Germany and Romania, no one of the experts mentioned this field.

**Training opportunities in the water sector**

The responses about the existence of education and training opportunities in the listed main domains of the water sector revealed significant results and in accordance with the previous issue of the educational level of the job professions and specialisations in the Water Sector disclose a very distinguish state of the vocational education and training in the main domains of the water sector (figure 11).

Concerning the use of water resources in the agriculture, the existence of the training opportunities varies and it is in close relation with the job profession and specialization. On one hand,

for the *Irrigation*, 41.66% of the responses mentioned the lack of training opportunities (levels I and II) and a bit greater portion, 47.91% have the opinion that there are plenty of training opportunities (levels IV and V). Also, 10.42% of the answers underline a normal level (level III) of training opportunities. These results are similar with the answers from the Greek survey, in which the existence was mentioned by a percentage of 48% and the absence in percentage of 40%. The difference between the level of the existence is greater for the German results, 66.67% and 33.33% corresponding. Instead the German and Greek cases, in Hungary and Romania the results indicate mainly the low levels of existence related training programmes. Experts from Hungary gave a positive answer in a percentage of 44.44% and a negative in a percentage of 55.56%. The corresponding percentages for the Romanian survey are 36,36% and 45,45% respectively.

On the other hand for the water use in *Animal husbandry*, 27,66% of the experts believe that a great number of training programmes exists (levels IV and V), 51,70% mention the low levels I and II of the existence and 21.28% of them select the medium level III. The answers from Germany, Greece and Hungary indicate a great number of training programmes in the percentages of 40%, 36.67% and 33.33% and the absence of them in the percentages of 60%, 50,09% and 66,67%. In the case of Romania the results show the small number of training programmes (Levels IV+V: 20%, Levels I+II: 30%) and the majority of the experts expressed a neutral opinion (Level III: 50%).

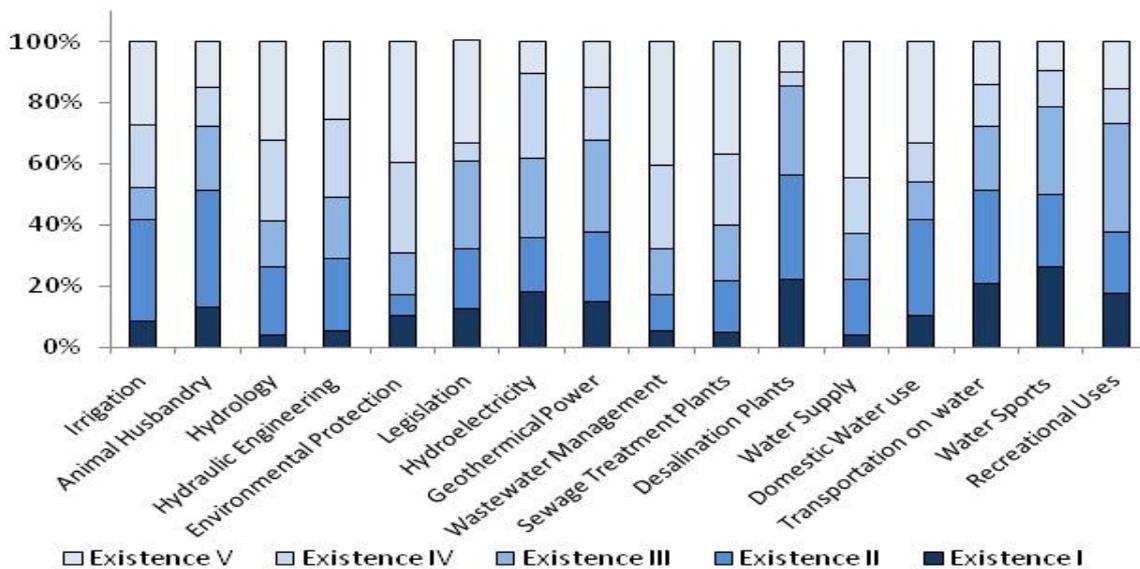


Figure 11: Level of the existence of training opportunities in the 16 water sector domains (Level I= lower, Level V= higher).

As about *Hydrology*, *Hydraulic engineering* and *Environmental protection* fields, the results are more distinguished. For the first field of *Hydrology*, most of the answers (58.55%) identify the existence of plenty of training programmes, choosing the levels IV and V. 24.34% chose the lowest levels I, and II and only a small percentage, 15.09% mentioned the medium level of existence. Similar results are presented for all the countries. In Germany the difference between existence and absence is greater (existence: 87.5%, absence: 12.5%) and in Greece (44%, 28%), Hungary (55%, 18%) and Romania (66,67%, 33,33%) it is similar to the average of the survey.

In the domain of Hydraulic engineering, 50.90% answered the levels IV and V for the existence, 29.19% the low levels I and II and only 20% mentioned a basic level of existence (level III). Results from Hungary and Romania indicate that the percentage of existence related training programmes is 53-55% and the 33% of the experts expressed a different opinion. In Greece the corresponding percentages are 41.67% and 25%. Experts from Germany, mentioned a greater percentage for the existence (71,43%).

The answers for the existence of training opportunities into the domain of *Environmental protection* were 68,97% for the high levels (IV and V), 13,79% for the medium level III and 17,24% for the low levels I and II. For the German survey, 62,5% of the answers indicate a well organized educational system with plenty of related courses and only 12,5% mentioned a lack of them. The corresponding percentages for Greece are 57,69%, and 26,92%. In Hungary almost all the participants mentioned the high levels of existence (90.91%). On the other hand, answers from Romania present equal percentage of 33.33% for the existence, absence and medium level of existence (level III).

Educational and training programmes into the domains of Legislation, Hydroelectricity and *Geothermal power* have almost the same results. 33-39% of the experts have the opinion of few training opportunities and the same percentage has the aspect of high level (IV and V) of existence of the training opportunities. Also, 26-30% of them believe that there is a medium level of training opportunities. The training opportunities for the employees of the *Desalination plants* are mainly few (56.09%), levels I and II. A smaller percentage, 29.27% answered that there is a medium level

(level III) and no more than 15% of the experts selected the high levels IV and V.

In Germany and Greece, experts believe that mostly of the training opportunities are sufficient for the people in the *Legislation* domain. 57.15% of the Germans and 43% of the Greek experts supported the opinion of existence. The corresponding percentages with different opinion are 42.86% and 29.17%. The answers from Hungarian and Romanian surveys mainly imply that there is not a clear opinion, since 50% of the respondents answered the medium level III.

As about the results for Hydroelectrical plants in Germany, 40% of the experts have the opinion that the educational system includes a lot of related training programmes, as well as there is narrow for such programmes. The answers from Germany for the *Geothermal power* imply the existence of a lot of training programmes (level III: 50%, level V: 50%) and for the *Desalination plants* prove the disinterest of the experts, since such kind of units are not common in Germany (50% of them chose the level II and the remainder 50% the level III).

In case of Greece, the same portion of experts supports the existence and absence of training programmes for the Hydroelectrical plants (36.8%). They also recognize the absence of related training programmes for the *Geothermal* plants (levels I+II: 39.89%, Level III: 38.89%) and for the *Desalination plants* (Levels I+II: 41.91%, Level III: 19.05%).

The results from the Hungarian survey mostly revealed the absence of related training programmes or were not quite sure for the topic areas of Hydroelectricity, *Geothermal* and *Desalination plants*. The first opinion was supported by 62.5% of them for the field of Hydroelectricity, 44.44% for *Geothermal power* and 55.55% for *Desalination plants*. On the other hand, the second opinion was chosen by 25% for the Hydroelectricity, 33.33% for the Geothermics 22.22% for Desalination units.

Experts' opinions for the Hydroelectrical, Geothermal and units of Desalination in Romania present various results. It seems that a huge number (75% for the levels IV and V) of training opportunities are already existed for the occupations in Hydroelectrical field. In *Geothermal* and Desalination units, 60-66% of the participants are not able to classify the situation (level III) and

33-40% identifies the lack in the offering training opportunities.

The overall results for the *Wastewater management*, Sewage treatment plants and *Water supply* are almost equal as has already happened for the level of education of the people in the same domains of the water sector. 60-68%% of the responses mentioned the existence of plenty of training programmes (levels IV and V) and 17-22% noticed the low levels I and II of the existence. Only 15-18% of the answers identify the medium level III. In Germany, domains of *Wastewater and Sewage management* indicate the consensus of the respondents that a huge number of training opportunities are existed (levels IV and V). In case of *Wastewater management*, 63.63% of the experts marked the levels IV and V of the importance and only 27.27% of the experts advocated the gap of such training programmes. For the field of Sewage treatment, 80% of the experts mentioned the huge number of training programmes (levels IV and V). The results for the field of *Water supply* resemble with the results for the Sewage treatment plants. 88.88% of the experts alleged the existence of a lot of training opportunities and only 11.11% mentioned that new related courses, seminars etc could be developed.

In Greece, the results for the domains of Sewage treatment plants and *Water supply* were equal. The majority of experts expressed the opinion of the existence plenty of training opportunities in a percentage of 50% (levels IV and V), lack of sufficient related courses in a smaller percentage of 40% and only 10% of them replied the medium level (level III). In the field of *Wastewater management* the results are more distinguished. The respondents in a greater portion (60%) answered the high levels IV and V, 32% the low levels I and II and only 8% didn't had a clear opinion (level III).

Experts from Hungary believe that a huge number of training programmes are available for the personnel of related units or individuals, who want to be occupied on these fields. Indeed, 66.67%, 76.92% and 75% of experts selected the high levels of existence for *Wastewater management*, *Sewage management* and *Water supply* respectively. The corresponding percentages for the lowest levels I and II are 26.66%, 23.08% and 8.33%.

In Romania, concerning the *Wastewater and Sewage management*, the majority of participants (55-57%) chose the level III of existence, referring to the development new or improvement the already

existing training courses. The rest portion of the experts expressed mainly the existence and the absence of such kind of training courses. The answers for the domain of Water supply, mentioned mainly the existence, levels of IV and V (44.44%) or not so distinguished situation, level III (44.44%).

In the field of Domestic water use (indoor and outdoor household purposes), 45.83% answered the high levels and 41.67% mentioned the low levels (levels I and II). This may due to the differentiation of the experts' opinions from country to country. A percentage of 12.5% of the experts answered the medium level of the existence. The corresponding percentages of existence and absence of training programmes are 50% and 33% in case of Germany, equal 47% for both of them in Greece, 40% and 50% in Hungarian results and finally 40% and 30% (and 30% for the medium level III) for Romania.

The training opportunities for the employees in the *Water sports* and *Transportation* domains are mainly few (51%), levels I and II. A smaller percentage, 21-28% answered that there are plenty of related training courses. In Germany, 40% of the experts answered that exist a lot of training programmes in the field of *Transportation* in water and a similar percentage mentioned the lack of such training opportunities. Concerning the *Water sports*, the majority of the experts mentioned the absence of related training programmes. In Greece, the majority believe that new training programmes are needed. Experts from the Hungarian survey pointed out the need of new training programmes (levels I and II) or revealed a aspect that they don't have a clear opinion on that level III). In Romania, the positive aspect that the available training programmes are efficient to educate the related job occupations was mentioned by 40% for the Domestic water use, 25% for the *Transportation* and *Water sports* for 60%.

Finally, the respondents gave equal portions for the levels I, II, IV and V of the existent training opportunities for the employees of the domain Recreation use of water resources (11-20%). Contradictory, 35.56% of the answers identify a basic level for the training programmes that already exist. In Germany and Greece, the experts mentioned the lack of related training programmes. In Hungary, equal percentages of 33.33% of the experts chose the option lack, existence or expressed a neutral opinion. Finally in Romania, the majority of the experts state a neutral opinion (level III).

## Conclusions and Discussions

In the past, a lot of theories and opinions have been put across for the better depiction of the term competence (McClelland, 1973, Spencer and Spencer, 1993, Hoge *et al.*, 2003). Nowadays, the necessity of competences and competence models have been proved inextricable tools in designing, and developing the vocational training and creating experts and specialized employees in accordance with the industry demands.

In that way, the case of the implementation of the competence models and the identification of the required and future competences should be taken place in the job professions of the water sector. The determination of the requirements of the experts from the water sector in general divulges the variation of experts needs from different domain of the water sector as well as the different European country.

In total, the survey participants come from the Public Sector (Ministries and Local / Regional administrations), having critical position into the process of making decisions for the Water Sector. The next important representative group is the staff of formal education, playing a major role in the education of the people who are going to be involved in related jobs with the Water Sector. Their research and work fields are more corresponding to the Wastewater and Sewage management, Water supply and Environmental protection. Domain of Legislation is also included in the selected domains of the German participants. The work and research fields of the Greek experts are also correlated with the Hydrology, Hydraulic engineering and Irrigation. Option of Domestic water use is presented in the answers of the Hungarian Romanian survey. In addition, participants in the Romanian survey select the Legislation.

Concerning the experts' level of understanding, almost all of them have already known the word competence, since the incorporation of new technologies into the Industry boosting the necessity for more specialized and competent personnel. Also, the term competence model, a number of competences, seems to be well-known in a smaller percentage of the experts. Exploring the common understanding on the usefulness of the competence model in the better description of the job profiles, the majority of experts keep a neutral side, which it means that further information and explanation is needed. The results on the experts'

awareness of usefulness of competence model in job description and the usefulness of the competence model in the water sector are presented in the following table 1.

When experts were asked for the usefulness of the competence model in the water sector most of them replied positive, mentioning the benefits for individuals as well as the organization and vocational training providers.

Concerning the educational level of the job professions and specializations in the water sector, the domains of Wastewater and Sewage treatment plants, as well as the Water supply seems to include a great number of enough competent employees in all countries. People from the domain of Hydrology are also well performed for the most of the participated countries in the survey.

As about the existence of the training opportunities, the diversity among the different water sector domains is interesting. A sufficient number of training programmes are available in all countries for the Wastewater and Sewage treatment, Water Supply, Hydrology, Hydraulic engineering, Environmental protection. Design of new training programmes is also needed for Transportation, Water sports and Recreational Uses, water use in Animal husbandry and Desalination plants. Differentiation of the existence of training courses among European countries is presented for the Irrigation, Legislation, Hydroelectrical and Geothermal plants and Domestic water uses. This outcome in comparison with the lack of sufficient performance of employees in some of the water sector domains could be proved helpful for the design of new courses or the improvement of the already existed.

Water supply, Wastewater, and Sewage management could be the fields of the water sector for the first implementation of the competence model. These domains include a considerable portion of well performed and skilled people and a lot of available training opportunities. The concept of knowledge, skills and Competences have been described and analyzed in details for the related job tasks and specializations. In that case, the implementation of the competence tools is essential and feasible. Next to these, Hydrology, Hydraulic engineering, Environmental protection and Irrigation could be the water sector domains for further testing and evaluation of the Water Competence Model.

Awareness	Usefulness of Competence Model in the job description in general			Usefulness of Competence Model in the Water Sector		
	Low	Neutral	High	Low	Neutral	High
Overall		x				x
Germany		x				x
Greece		x				x
Hungary		x				x
Romania		x				x

Table 1: Experts' awareness of the usefulness of the competence model in the job description in general and into the water sector.

Adaptation of the Water Competence Model	
<b>Pilot testing of the Model</b>	Wastewater Treatment Plants Sewage Treatment Plants Water Supply
<b>Further testing and evaluation of the Model</b>	Hydrology Hydraulic Engineering <i>Environmental protection</i> Agricultural Use: Irrigation

Table 3: Water sector domains for pilot testing and further testing of the Water Competence Model.

The main outcomes and important clues for the design and development of the Water Competence Model can be concluded in the following lines:

1. Understanding the experts' awareness on the competence modeling
2. Analyzing the experts' opinion on the need and usefulness of Water Competence Model
3. Recording the level of the competence-based education of the personnel in the water sector
4. Describing the existence of the training opportunities in all the water sector domains
5. Defining the diversities on the need of competence model among the water sector divisions and European countries
6. Establishing of the domains for the pilot testing of the Water Competence Model
7. Determining the water sector domains for further testing and evaluation of the competence model

8. Enhancing the training opportunities by suggesting the design of new training programmes or improving the already existed training courses

### Implications for Further Research and Practice

The design and development of competence models should be drawn according to the preferences, requirements, and innovations of each professional learning sector in which they will be implemented. The water sector is a wide range sector with a lot of fields of work and research and plenty of job professions and specializations. European policies have been developed and adopted for the protection and sustainable utilisation of water creating a huge demand in particular in the vocational training. This work provides the main lines and the tools for recording the specific requirements and needs of the domains of the water sector in order to develop a successful and applicable competence model for this Professional Learning Sector.

The Water Competence Model should be drawn heavily on the experience of competent personnel and to focus on the relationships emerge from these

people working in different workplaces or accomplishing different tasks. An investigation of the cases of many successful companies and organizations will assist in the better identification and description of the key and important competences for a number of occupations.

Courses need to be redesigned and created in order to meet the high-level competence needs of the job professions in an organization. In that way individuals and employees can take advantage of the new career opportunities in their work field and become more professionalized.

Implications for further research and practice is mainly referred to the detailed description of the job content and the job tasks, as well as the required competences as sets of knowledges and skills. The most valuable and vital issue for the successful development of the Water Competence Model is its

implementation in a specific field of the water sector and its evaluation for the continuous improvement for the utilization from all the water sector domains.

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*Corresponding authors:*  
*Charalampos Thanopoulos*  
*Agro-Know Technologies, Greece*  
*e-mail: [cthanopoulos; nikosm]@agroknow.gr*

*Christian M. Stracke*  
*University of Duisburg-Essen (UDE), Germany*  
*e-mail: Christian.Stracke@icb.uni-due.de*

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