The Occupational Standards Development According to CROQF*

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Abstract. *Fast development of ICT, specifically AI, IoT and smart environment influence both society and everyday lives. The manner in which knowledge is collected, processed and disseminated has changed and ICT affects the growth of skill, learning and employability. It is important for universities to have modern study programs that will enable them to educate young professionals to gain competitive knowledge in this continuously evolving field. This article describes the development of occupational standards covering four very attractive areas: data technologies and artificial intelligence, management of information security and privacy systems, distributed and interactive systems and business systems transformation and innovation management.*

Keywords. occupational standards, CROQF, ICT trends

1 Introduction

Because the information and communication technologies (ICT) sector is characterized by innovation, support for parts of the industry of high value and significant dependence on continuous technological advances, ICT professionals in the future will have to combine new digital skills with managerial skills and trends such as digital leadership, big data, cloud computing, the Internet of Things and smart systems, so the creation of new occupations is envisaged (Skills challenges in Europe (2016) | Skills Panorama). According to the assessment of the World Economic Forum from 2018 (The Future of Jobs Report 2018 | World Economic Forum), changes in ICT occupations are expected, so the focus will be on occupational group: analyst and development engineer, information security analyst and data analyst, where there will be major changes in requirements for new skills of ICT professionals. These data indicate the need for new competencies and knowledge for future jobs and about parallel increase in demand for ICT professionals. Therefore, there is a need for education and training that will create adequate staff and meet the demand in the labour market and raise the level of ICT skills.

The purpose of the project "DIP2Future: Development of educational programs, qualification standards and occupational standards in the field of ICT in accordance with the CROQF" is to develop educational programs, qualification standards and occupational standards in the field of ICT in accordance with The Croatian Qualifications Framework (CROQF). The project will be implemented by University of Zagreb, Faculty of organization and informatics (FOI) Varaždin in partnership with the Department of Informatics of the University of Rijeka (OIRI), and 4 new study programs will be developed: 1) Data technologies and artificial intelligence, 2) Management of information security and privacy systems, 3) Distributed and interactive systems and 4) Business systems transformation and innovation management.

In the paper we first describe Croatian qualifications framework and proposed occupational standards, and then methodology for developing occupational standards. We also present a case study for the first part of methodology, adjustment and optimization of the survey.

2 Description of the Croatian Qualifications Framework

In Croatia the efforts and the process of modernization of education, training and qualifications systems, matching education and labour market, are incorporated into an agenda known as the Croatian Qualifications Framework (CROQF) (Institut društvenih znanosti Ivo Pilar 2019).

The Croatian Qualifications Framework (CROQF) (Agency for science and higher education 2020) is an important tool and reform mechanism to govern the qualification system in the Republic of Croatia at all levels by qualification standards focused on learning outcomes and the needs of the labour market, individuals and community. CROQF is a system that sets in place of a qualification obtained in Croatia

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where the core element is the learning outcomes or, in other words, the competencies acquired by the individual through the learning process and proved after the learning process. The important precondition for CROQF is the existence of a quality assurance system that validates the success of educational processes and research (Ministry of Science and Education n.d.).

The legislation on the Croatian qualification's framework was adopted in 2013. The Croatian Qualifications Framework Act (NN 22/2013) defines the qualification, occupational and qualification standard. The qualification applies to the set of integrated learning outcomes units for a given level, volume, profile and quality. The occupational standard is a list of all tasks performed by persons employed in a specified profession, as well as a set of competencies needed to properly execute them. Qualification standard is the content and form of the qualification. It induces all the data required to establish its level, volume and profile, as well as the data needed to ensure and encourage high quality of a qualification. Although the same qualification may be achieved at various educational institutions and by specific educational programs, there are some requirements that a qualification requires to meet in terms of specified learning outcomes. The CROQF register is a system in which occupational standards are entered and connected to qualification standards by means of competence sets and learning outcome sets. The CROQF registry is freely accessible and can be used to create innovative educational programs focused on learning outcomes, i.e. collections of qualifications that the job force has found essential. Ordinance on CROQF registry (Ministarstvo znanosti obrazovanja i sporta 2014) regulates the content and manner of keeping registry, submission of applications for entry in the registry, content and form of application forms, evaluation of applications for registration, registration procedures, names of sectors, names of sector councils, manner selection and criteria for the selection of members of sectoral councils, job description of sectoral councils and internal and external quality assurance system.

CROQF is an significant precondition for governing the lifelong learning framework in Croatia, and is the foundation of a knowledge-based community and social inclusion (Lučić et al. 2011). In accordance with the Republic of Croatia's foreign policy, it also integrates the rules of the European Qualifications Framework (EQF), EU standards and external legislation. Creating a sustainable European economic region includes the mobility of competences (and the mobility of citizens), their identification and usage for the advantage of workers, employers and the whole society.

Currently, 29 occupational standards are entered in the register, which define a total of 317 sets of competencies. A total of 8 occupational standards are enrolled that define 329 sets of learning outcomes. A total of 167 requests are in the process of being entered in the register, 226 requests are being processed after the formal verification, 29 requests are in the process of expert evaluation and 25 requests are being processed after the professional evaluation (ISRHKO - Standardi n.d.).

In their research paper Klarin, Nazor and Celar (2019) recommended that for the process of establishment of national qualifications (CROQF) is important for them to be related to learning outcomes. The reason for that is the aim of learning outcomes to increase transparency, understanding and comparability of qualifications.

3 Proposed Occupational Standards

For the purpose of development of new master study programmes, four new occupational standards should be developed:1) Intelligent information systems architect for data technologies and artificial intelligence, 2) Security and privacy architect for management of information security and privacy systems, 3) Distributed and/or interactive system architect for distributed and interactive systems development and 4) Business systems transformation architect for business systems transformation and innovation management.

Information systems in various domains incorporate artificial intelligence technologies that improve the management of large amounts of data, information and knowledge, and thus the efficiency of these systems and the organizations that use them. Intelligent information systems enable the acceleration of the development of business, science and society in general. Therefore, it is necessary to educate information systems experts for the development and application of artificial intelligence technologies. The occupation is being developed to include knowledge and skills that enable a person to successfully work in several jobs depending on the character, size and needs of the business system. An intelligent information systems architect is an expert who, based on business requirements, uses artificial intelligence technologies in combination with other modern information technologies to design and develop intelligent information systems that provide organizations with optimal data, information and knowledge management for decision making and business improvement.

The society has acquired the conditions for building integrated security and privacy systems of business entities, so it requires specific knowledge about the activities to be carried out in order to timely protect the security and privacy of both the individual and the entire business system of the organization. The security and privacy system must be manageable, so an occupation is proposed that will include the necessary theoretical and factual knowledge and skills of system organization, risk assessment, implementation of vulnerability reduction measures, managing system

adaptation to work in an environment where threats change very dynamically. The occupation proposal is described so that a person can work in multiple jobs given the character, size and needs of the business system. The information security and privacy architect is an expert who, by applying new information technologies, will be able to offer solutions that will improve the company's business and business environment, taking into account all security and privacy protection requirements.

The development of society creates an increasing need for systems or services that are based on the innovative and efficient use of ICT. A direct consequence of this is the need to acquire the specific knowledge and skills that the development of these systems or services requires. One of the developed standard of occupation will be related to distributed and/or interactive systems and will include the necessary theoretical and practical knowledge and skills. The occupation should include the knowledge and skills necessary for a person to work in multiple jobs according to needs of the business system. Distributed and/or interactive system architect is therefore an expert who is primarily in step with upcoming ICT technologies, understands business requirements and is able to model them, design future architecture, taking into account all business aspects and implement it through the development of distributed and/or interactive system.

The development of technologies and the speed with which this development takes place open the possibility for the development of new key jobs and accompanying knowledge and skills. The key question, along with the development of technology, is how to achieve a competitive advantage by applying them, i.e. how to transform the company's business in the direction of achieving greater business success. The business systems transformation architect is described as an expert who, by applying new information technologies, will be able to offer solutions that will improve the company's business and the business environment in which the company operates. The business systems transformation architect should know the methods of analysis of the environment, factors arising from business and technology in order to be able to propose initiatives in business improvement and realization of technological potential of companies to implement the process of digital transformation.

4 Methodology for Developing Occupational Standards

To facilitate the process of the development of the occupational standard proposal, Ministry of Labour and Pension System issued the methodology that contains a set of guidelines for the development of occupational standards and provides detailed information and examples on: steps and procedures in activities related to the organization and implementation of the occupational standard survey, systematization of information and data collected by the survey as well as information on activities related to formalizing occupational standard proposals.

The first section of the methodology describes CROQF and the second section explains how a form for occupational standard proposal should be filled with the goal to assess strategic, sectoral and analytical grounds of the proposal (Ministarstvo rada i mirovinskog sustava n.d.).

4.1 Description of Guidelines

The aim of the guidelines is to establish a uniform, identical and standardized framework for all occupations for which an occupational standard is being developed.

The guidelines include supporting materials and forms necessary for the implementation of steps and activities in the implementation of the survey, systematization of information and data collected by the survey and formalization of proposals for occupational standards, as well as for verification of their implementation. They also provide examples that clarify certain concepts (e.g. examples of key jobs, examples of certain types of knowledge and skills), as well as examples that illustrate the expected outcomes of individual tasks and activities in the development of occupational standards (e.g. lists of key jobs, lists of knowledge and skills, lists of sets of competencies). They are mainly taken over and/or adapted from existing documents, registers and databases (e.g. CROQF Register - Sub-Register of Occupational Standards, European Skills/Competences, Qualifications and Occupations (ESCO), Slovenian Database of Professional Standards).

The first part of the guidelines presents the content of the occupational standard survey, detailing the parts of the survey and the questions contained in each part of the survey. The survey structure includes an introductory part, which collects basic technical information and five thematic parts that focus on different sets of information. Given that the development of occupational standards is divided into four groups of activities, the further content and text of the guidelines are designed accordingly in four parts that describe:

- tasks and activities related to the adjustment and optimization of the survey to a particular occupation or group of occupations, with examples showing the expected outcomes of individual tasks and activities,
- the procedure of conducting the survey,
- the procedure of systematization of information and data collected by the survey,
- the procedure of formalizing the proposal of occupational standards.

Adjustment and optimization of the survey

The aim of this step is to adapt and optimize the general form and content of the survey to individual occupations in order for employers and employees to fulfil it, and it is described in terms of the goal, outcome of activities and responsibilities for the implementation of activities. The guidelines define the adjustment and optimization of the survey through 3 tasks: (1) adapting and optimizing of the list of key jobs; (2) adapting and optimizing the list of knowledge and skills; and (3) a report on the adjustment and optimization of the survey. A "group of experts" is formed to implement this step, and general guidelines are given for their selection and engagement.

Conducting the survey

The aim of the survey is to collect and confirm information relevant to the development of occupational standards from the perspective of employers and employees. The guidelines define this step through the following related tasks: (1) selection of employers and employees to participate in guided surveys and structured interviews; (2) preparation of facilitators and assistants for guided surveys and structured interviews; (3) conducting guided surveys and structured interviews; and (4) systematization of information and data through the preparation of reports on the implementation of the survey.

Systematization of collected information and data

This part of the guidelines describes the activities of systematization of information and data collected by the occupational standard survey. These activities need to be started during the implementation of the survey, by keeping detailed notes and observations, and after collecting information from employers and employees, they need to be completed. The aim is to make lists of key jobs, knowledge and skills that will be included in the proposed occupational standard. The set of activities related to the systematization of information and data collected by the survey consists of 2 basic tasks: (1) making a list of key tasks and (2) making a list of knowledge and skills.

Formalization of occupational standard proposals

According to the guidelines, the process of formalizing the proposal of occupational standards takes place after the implementation of the survey with employers and employees and the activities of systematization of information and data collected by the survey. The aim is to create a list of competencies, sets of competencies and key tasks with associated individual competencies for their performance, description of occupations and working conditions and fill in a defined form (Form HKO_SZ (PART B)). basic tasks: (1) compiling a list of competencies; (2) associating individual competencies and key tasks; (3) defining sets of competencies; (4) defining occupational descriptions and working conditions; and (5) filling in a defined format. Occupational standards should rely on their professional knowledge related to the occupation for which the standard is developed, as well as on systematized information and data collected by the Survey from employers and employees and possible external experts.

In the next chapter, the first activity, adjustment and optimization of the survey, will be described in more detail.

4.2 Activities Related to the Adjustment and Optimization of the Occupational Standard Survey

The survey was conducted with the aim of aligning future study programs in higher education with the needs of employers in the fast-growing and innovative labour market. In order to examine the needs of employers, a survey on occupational standard was carried out by the Ministry of Labour and pension system, the Croatian Employment Service and the Ministry of Science and Education (Bedeković, Kadlec, and Tolušić 2016). The first phase in the occupational standard survey preparation is to adapt and refine the general type and content of the survey to a specific profession or occupational category. Two basic activities need to be carried out: (1) adapting and optimizing the list of key jobs and (2) adapting and optimizing the list of knowledge and skills.

The first activity refers to adjustment and optimizing of the list of key jobs in the survey. There are nine types of jobs: (1) Analysing, planning and organizing work; (2) Workplace preparation; (3) Operational activities related to the occupation/job; (4) Administrative affairs; (5) Commercial affairs; (6) Communication and cooperation with others; (7) Research, development, innovation; (8) Quality assurance; (9) Health and environmental protection. Key jobs are listed only in those of the nine offered types of jobs that are assessed to be performed by the occupation.

The occupational standard should contain a list of key jobs in which each key job is associated with all the individual competencies necessary for its successful performance. The second activity refers to adjustment and optimizing of the list knowledge, skills and competencies necessary for a worker to be able to successfully perform the work in the workplace where he/she works. In reviewing knowledge and skills, it is important to ensure that the lists of knowledge and skills include all the knowledge and all the skills needed to perform the tasks listed in the list of key jobs. Knowledge can be factual or theoretical. Factual knowledge applies to a collection of facts learned independently. The facts gained could be concepts, their definitions, as well as other factual knowledge that may not in itself offer up a strong prospect of generating fresh knowledge. Theoretical knowledge refers to a set of linked information which have been acquired. Linking separate information may apply to various ideas, models, as well as other theoretical knowledge that allows the more valuable separate information being generated unambiguously.

Skills refer to whatever enables knowledge to be properly applied. Skills can be cognitive, psychomotor and social. Cognitive skills apply to a collection of objectively and creatively learned ideas. Psychomotor skills relate to the learned physical strength and the application of techniques, devices, resources, and materials previously identified. Social skills refer to a set of acquired skills that are needed to create and develop interpersonal relationships.

Furthermore, knowledge and skills need to be grouped into (1) occupation-specific, (2) sector- or cross-sector-specific, and (3) transferable knowledge and skills. Occupational-specific knowledge and skills are usually applied within only one occupation. Sector-specific knowledge and skills relate to one sector, but are important for more than one occupation within that sector. Cross-sectoral knowledge and skills are important for several economic sectors. Transversal knowledge and skills are important for a wide range of occupations and sectors. They are often called basic, basic or "soft" knowledge and skills and represent the foundation of an individual's personal development

4.3 Case Study of the DIP2Future Project

Research can be divided according to different criteria: applicability, methodological approach, types of data collected and studied, frequency of implementation, objectives and scope of research, time and object of research (Tkalac Verčić, Sinčić Ćorić, and Pološki Vokić 2014). The methodology defines conducting the survey of employers 'and employees' opinions related to key jobs, knowledge and skills required for a certain occupation with the obtained Guidelines for the development of occupational standards. A set of methods was used to define key jobs/knowledge/skills for those interviews.

The first step in defining key jobs was to review existing classifications and frameworks that can be incorporated into the domains of a particular occupational standard. The ESCO classification (European Skills/Competences, Qualifications and Occupations) (ESCO - Using ESCO - European Commission n.d.) and the ISCO classification (The International Standard Classification of Occupations) (ISCO - International Standard Classification of Occupations n.d.) were used as the basic to create pool of key jobs, skills and knowledge. Furthermore, European e-Competence Framework (European e-Competence Framework n.d.) and SFIA (Skills Framework for the Information Age) (About SFIA — English n.d.) were consulted. Both describe skills and competencies required by professionals in roles involved in information and communication technologies, digital transformation and software engineering and applied at the ICT workplace. For data technologies and artificial intelligence was also used EDSF (EDISON Data Science Framework) (EDISON Data Science Framework (EDSF) | Edison Project n.d.)

The second step included the study of the content of professional certificates that can be related to the field of security, interactive and distributed systems, data technologies and artificial intelligence, management of transformation and innovation of business systems.

The third step was to get acquainted with the content and structure of existing study programs in a particular domain, where the consulted foreign study programs, domestic study programs and organized study trips. It was identified that there are no similar study programs in Croatia that would cover the vision of new occupational standards, so the most similar study programs abroad have been identified. Therefore, study visits were organized to the faculties that conduct study programs most similar to the required domains.

The fourth step was the analysis of job vacancies related to a particular occupational standard. Job vacancies on EU and Croatian portals were studied. For certain jobs, job descriptions were obtained from the companies themselves, which in their organizational structure have defined jobs that are related to a certain standard of occupation.

The last step was to define the final set of key jobs, required knowledge and skills. For this step, four focus groups were organized with the aim of validating the content as well as adding key jobs, knowledge and skills that were not included. In this step, a group of experts was engaged who had the same task as the focus group. Groups of experts are teachers from the Faculty of Organization and Informatics and the Department of Informatics, University of Rijeka who are experts in the field of occupational standards.

Table 1 shows the systematization of the described steps for each occupation in DIP2Future case study.

5 Conclusion

Adoption to the new digital culture, or digital future is necessary for grow and change, even more for educational institutions (Hinchcliffe n.d.). Digital technologies are among the main change accelerators that can transform educational systems, and these changes demand action and decisions in educational institutions (Begičević Ređep, Klačmer Čalopa, and Tomičić Pupek 2020).

To be competitive in today world job market in the field of ICT, computer science professionals need knowledge and skills for specialised occupations that are dealing with new challenges, such as large amounts of data, information, and knowledge, various applications of artificial intelligence, distributed and interactive systems, disruptive force of digital transformation and growing problem of security and privacy. University study programs must ensure acquiring knowledge and skills that will enable graduates to enter job market prepared for those challenges.

Table 1: Systematization of the DIP2Future case study

Steps / Occupational standards	Information security and privacy architect	Distributed and interactive systems architect	Intelligent information systems architect	Business systems transformation architect
Review existing classifications and frameworks	ESCO: ICT security legislation; Information architecture; Information categorization; Information extraction; Information security strategy; Information structure etc. ISCO: sub-major groups Science and Engineering Professionals; Business and Administration Professionals; Information and Communications Technology Professionals; units Software Development, Database and Network Professionals, ICT Services Managers etc.	ESCO: Embedded system designer, Software architect, Embedded system developer European e-Competence Framework 3.0: DevOps Expert SCRUM Master, Digital Media Specialist, Developer, Systems Administrator, Network Specialist, Technical Specialist	ESCO: ICT intelligent systems designer, ICT information and knowledge manager, Chief data officer, Knowledge engineer, Data scientist, Data analyst European e-Competence Framework 3.0: Data Analyst, Data Specialist EDISON: Data Science / Big Data Infrastructure Managers, Data Science Professionals, Database and Network Professionals	Four key frameworks for digital transformation: The Adaptable Digital Transformation Framework, A Digital Transformation Initiation Framework, A Leadership Framework for Digital Transformation, The Digital Transformation Target Model ISCO: sub-major groups Business and Administration Professionals; Information and Communications Technology Professionals; ICT Services Managers etc.
Study of the content of professional certificates relates to the fields	ISO/IEC 27001, ISO/IEC 27032, ISO/IEC 27002, ISO/IEC 27034, ISO/IEC 27005, ISO/IEC 27035, Risk Assessment Methods were contemplated. CompTIA - Security+, (ISC)2 - Certified Information Systems Security Professional (CISSP), EC-Council - Certified Ethical Hacker (CEH), ISACA - Certified Information Systems Auditor (CISA), Cisco Certified Network Associate - Security (CCNA Security), and others	***	***	***
Acquainted with the content and structure of existing study programs in a particular domain	No similar study programs in Croatia. Study visits to: École Supérieure d'Informatique, Électronique, Automatique (ESIEA) and Université Paris-Est Créteil (UPEC)	No similar study programs in Croatia. Study visits to: École Supérieure d'Informatique, Électronique, Automatique (ESIEA) and Université Paris-Est Créteil (UPEC). Foreign master study programs: Distributed Systems Engineering (TU Dresden), Software Engineering of Distributed Systems (KTH), Distributed Systems and Web Technologies (TUIASI), Parallel and Distributed Computer Systems (VUA), Informatics: Programming and Networks(UIO), Communication Technologies and Multimedia (UNIBS), ICT for Internet and Multimedia (UniPD)	No similar study programs in Croatia - there are programs oriented to data science but with no or little orientation on business organisations. Foreign master study programs – Data Science and Artificial Intelligence (TU/e), Artificial Intelligence and Data Engineering (UniPisa), Artificial Intellgience (UvA), Artificial Intelligence (UU), Data Science and Entrepreneurship (JADS – Tilburg University and TU/e), Data Science for Decision Making (UM)	No similar study programs in Croatia. Study visits to: École Supérieure d'Informatique, Électronique, Automatique (ESIEA) and Université Paris-Est Créteil (UPEC)
Analysis of job vacancies related to a particular occupational standard	Keywords: cyber security, data protection, information security	Keywords: Distributed systems, Interactive systems, embedded development, software architect, Internet of things specialist	Keywords: data scientist, data engineer	Keywords: digital transformation, Business Intelligence, digital innovation
Defining the final set of key tasks, required knowledge and skills	Focus group with Companies: AKD, Privredna bak, Diverto, EGCP	Focus group with Companies: Mobilisis, Ericsson Nikola Tesla	Focus group with Companies: Poslovna inteligencija, IBM Hrvatska	Focus group with Companies: Omega Softwaerre, Speck, Northwest, Erste Bank

To develop modern study programs, corresponding qualification standards and prior to them, occupational standards should be developed. Although various classifications and frameworks, as well as existing study programs and description of job offers give insight into needed knowledge and skills, development of occupational standards is not possible without the cooperation of employers and employees. They are solving current problems in organisations and improving business with the help of ICT, and also foreseeing possible future issues. Their contributions in generating conclusions and recommendations to improve study programs in accordance with the principles of the Croatian Qualifications Framework are of utmost importance. Therefore, next parts of methodology, conducting the surveys and their analysis should be approached with particular attention.

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