Sectoral Qualifications Framework for

INFORMATION TECHNOLOGY (SQF IT)

European Funds
Knowledge Education Development

IBE kwalifikacje dla każdego

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Introduction

An indispensable condition for modern, knowledge-based socio-economic development is the continuous improvement and adaptation of employees' skills for a dynamically changing labour market. In 2014, 80% of surveyed employers conducting recruitment activities reported problems in finding workers who met their expectations for the job positions offered (Kocór et al., 2015). School and academic education is not enough to keep up with the pace of change, making lifelong learning all the more important today. The principles of lifelong learning include:

- an appreciation of learning in various forms and places at every stage of life;
- the validation of learning outcomes regardless of the way, place and time of their achievement;
- effective investments in learning opportunities, and making such activities generally available (*Perspektywa uczenia się przez całe życie*, 2013).

This is the context for implementing Poland's Integrated Qualifications System (IQS), governed by the Act of 22 December 2015 – the IQS Act (Journal of Laws of 2016, item 64).

One of the main tools of the IQS is the Polish Qualifications Framework (PQF). The PQF has eight levels of qualifications, like the European Qualifications Framework (EQF). Each PQF level is characterised by general statements about the learning outcomes required for a given qualification level. These general statements are called "descriptors". In determining a qualification's PQF level, it does not matter whether its required learning outcomes are attained within a structured education system or in another way.

PQF descriptors describe the full range of qualifications' required learning outcomes in the categories of knowledge, skills and social competence. The descriptors of successive PQF levels reflect the increasing requirements in these areas (Chłoń-Domińczak, Sławiński, Kraśniewski, Chmielecka, 2016). PQF level descriptors are initially described at two stages of detail. The first stage generic descriptors, or "universal descriptors", are the most general and apply to all types of qualifications. These are then further detailed (second stage generic descriptors) for the different types of qualifications that are typically awarded in general, vocational and higher education.

The Integrated Qualifications System enables the various qualifications in Poland to be gathered into one system and ordered. Because qualifications are awarded by different entities, institutions and organisations on the basis of various regulations and laws, until now, it was difficult to compile them according to uniform criteria. With the IQS Act, qualifications operating in the free market can now be included in this system, which is especially valuable for a number of reasons. To meet the criteria for inclusion, such qualifications must now be described in the language of learning outcomes. The state also guarantees the quality of these qualifications through regulations on the process of their inclusion and functioning, as well as by

requiring that they comply with the principles of validation and quality assurance. The functioning of the IQS should therefore intensify the implementation of lifelong learning policies in Poland, making it easier to attain competences in line with one's own interests or the needs of the labour market.

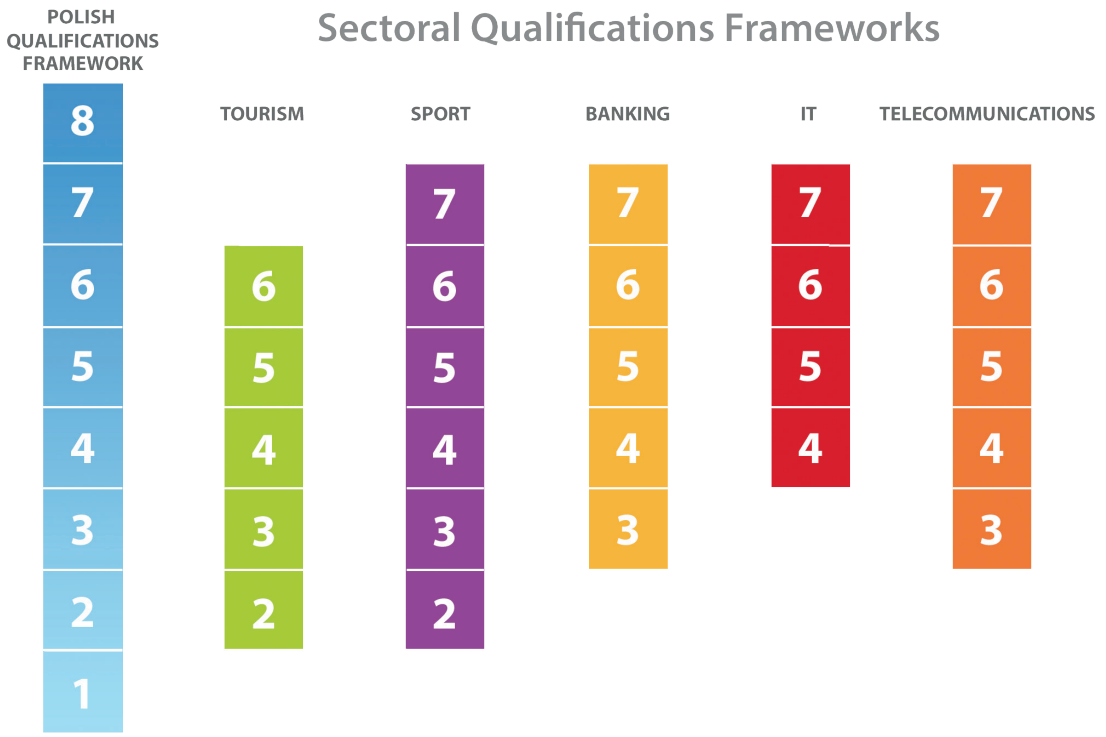
Art. 11 of the IQS Act provides for the further elaboration of PQF descriptors through the development of sectoral qualifications frameworks (SQF). A sectoral qualifications framework is defined in the Act as a description of the levels of qualifications functioning in a particular sector or industry. SQFs are developed at the initiative of specific sectors.

The main principle adopted in establishing sectoral qualifications frameworks is that they be developed by the sector for the sector. This means that a wide range of stakeholders are involved, representing different entities functioning in the sector – companies, industry chambers and organisations, representatives of higher education and professional bodies, as well as regulatory authorities. Developing a framework starts with discussions on the competences and standards of a given sector, enabling industry representatives to exchange information and reach consensus on contested issues. Industry stakeholders are therefore both the creators as well as the recipients of the resulting sectoral framework.

A team of sectoral experts develops a draft SQF, which is then consulted with their professional community. One of the most important elements of the work on an SQF is defining the key areas of the sector's activities, known as the sectoral determinants. This then helps in determining the descriptors of each level.

SQF levels must match specific PQF levels, but the level descriptors should be sector specific. While it is theoretically possible for a sectoral framework to cover all PQF levels, past work indicates that the number of described levels depends on the specific nature of the industry. So far, seven SQFs have been developed for inclusion into the IQS: banking, IT, sport, tourism, telecommunications, development services and construction.

Figure 1. The levels of various sectoral qualifications frameworks



Source: IBE.

Sectoral qualifications frameworks are incorporated into the IQS by means of a regulation issued by the minister responsible for education. The inclusion process is begun by the minister with jurisdiction over the sector, either at his/her initiative or at the request of an interested party. In mid-2017, the sectoral qualifications frameworks for sport and tourism were officially included in the IQS.

There are many benefits to developing a sectoral qualifications framework. First and foremost, the framework is the result of dialogue among industry representatives who work together to establish a common vision of their field of work and its needed competences. Such cooperation allows many universal solutions to be developed. The framework also facilitates work on describing and including qualifications in the IQS, as it translates the language of the PQF into a language specific to the sector. With an SQF, it is easier to understand how to relate PQF descriptors to a particular sector. This in turn makes it easier to accurately assign a PQF level to a specific qualification functioning in the sector.

Work is currently underway at the Educational Research Institute (IBE) with the aim of developing additional sectoral frameworks. It is worth pointing out that the concept of developing multiple sectoral qualifications frameworks and integrating them into a national qualifications system is unique in Europe. Soon, SQFs could be a showcase for Polish industry in the European market.

This publication presents information on the development of the Sectoral Qualifications Framework for Information Technology, carried out in 2014–2015.

1. Sectoral Qualifications Framework for Information Technology (SQF IT) – aims and premises

A project was initiated to develop a sectoral qualifications framework that would elaborate the level descriptors of the Polish Qualifications Framework for the information technology sector.

Sectoral qualifications frameworks (SQF) are developed to organise the qualifications of the various sectors of the economy in a hierarchy and to describe their learning outcomes in the categories of knowledge, skills and social competence. This makes it possible to link sectoral qualifications with specific occupational tasks, business processes and job positions, and thus better align education programmes with the needs of employers in a given sector.

The work undertaken to develop sectoral qualifications frameworks was the basis for initiating joint, intensive activities in the IT sector so that its qualifications would not be found at the margins of the current mechanisms being implemented in Poland to maintain the value of employees in the labour market and facilitate lifelong learning. It is expected that implementing the sectoral qualifications framework will contribute to:

- increased transparency of the qualifications awarded in the sector,
- the development of more adequate qualifications to meet the needs of employers in the sector,
- the design of more adequate education and training programmes for the labour market,
- the identification of key competence areas for the sector.

As a result, SQF IT will serve as a tool to facilitate the alignment of PQF levels with specific sectoral qualifications, which in turn will allow qualifications to be better understood and benchmarked, develop conditions for the increased mobility of IT professionals, and enable a more informed and personalised approach to career development.

2. Organisation of the work on the SQF IT

2.1. Basic definitions

Prior to beginning the work on the Sectoral Qualifications Framework for IT, agreement had to be reached on terminological issues that were of key importance for subsequent activities. The terminology used in the project is in line with *A Glossary of Key Terms related to the National Qualifications System* (Sławiński, Dębowski, Michałowicz, Urbanik, 2011). This publication contains definitions of the terms used in the Polish Qualifications Framework, which in turn is in line with the European Qualifications Framework. This means that a coherent conceptual framework is used in the project for understanding basic concepts such as competences, qualifications, occupation/job position and related terms, such as knowledge, skills and social competences.

The following definitions were adopted in the project:

- **Knowledge** – a set of descriptions of facts, principles, theories and practices assimilated during the learning process, relating to a field of learning or professional activity.

- **Skills** – the ability to carry out tasks and solve problems relating to the relevant field of learning or professional activity.

- **Social competence** – the ability to shape one's own development, as well as the autonomous and responsible participation in professional life and society, taking into account the ethical context of one's own behaviour.

- **Business process** – a set of one or more linked procedures or activities that collectively accomplishes a business purpose or business policy goal, typically within an organisational structure, by defining functional roles and relationships.

- **Professional task** – a logical and distinct sequence of actions that lead to one specific goal/effect.

- **Key competences** – a defined range of knowledge, experience, skills, abilities and aptitudes required to perform professional tasks and crucial in terms of the effectiveness of the work carried out in a specific job position.

- **Specific competences** – a defined range of knowledge, experience, skills, abilities and aptitudes required to perform professional tasks carried out only in a specific job position.

In addition, the following definitions were used in the project:

- **Occupation** – a set of tasks (group of activities) distinguished as the result of the social division of labour, performed continuously or with minor changes by

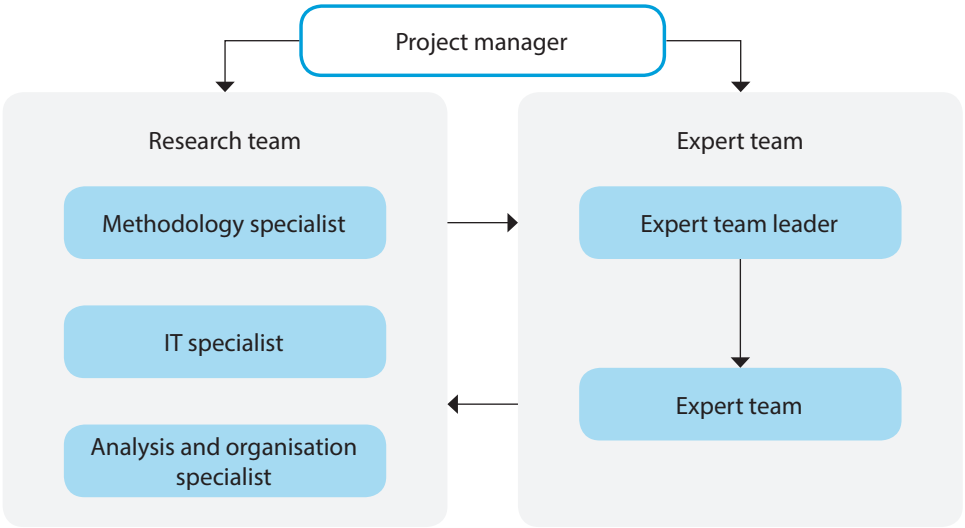
specific individuals, and requiring appropriate qualifications and competences attained through education or practice (Regulation of the Ministry of Labour and Social Policy, 2010).

- **Job position** – a basic element of organisational structure, defined by a job description that sets out the scope of occupational tasks (duties/activities), responsibilities and the qualifications and competences required to carry them out (Juchnowicz et al., 2013).

2.2. Project management

The SQF IT project was implemented by a team of experts under the direction of Altkom Akademia S.A. (Leader) and the Institute for Labour Market Analyses. The project management process was crucial to the success of the project, both in terms of the quality of the final results and the timeliness of completing the work. Two teams were involved in the work – a team of experts responsible for developing the draft SQF IT and a research team, whose main task was to support the expert team during the project and to produce reports and other documents. Both teams were coordinated by a project manager. The structure of the project management is illustrated in the figure below.

Figure 2. Project management structure



Team members had the following responsibilities:

- The project manager was responsible for coordinating the work of the entire research team, carrying out the overall methodological and substantive oversight of the project, and accepting all products and materials. In addition, the project manager resolved all issues that arose during project implementation and was responsible for ongoing working contacts with IBE.

- The methodology specialist was responsible for ensuring that the proper methodology was applied in all project work and products. In particular, he supported the expert team and conducted all the training anticipated in the project.

- The IT specialist was responsible for ensuring the proper substantive content of all project work and products. In particular, he supported the expert team and consulted all materials and reports prepared during the project.

- The analysis and organisation specialist was responsible for conducting and coordinating all analytical work carried out during the project. In particular, he was responsible for developing the analytical documents needed by the expert team and for the analysis of the initial verification results of the SQF IT project. In addition, he was responsible for organising the work of analysts, researchers, recruiters, ongoing contacts with members of the expert team, and participants of the quantitative research and seminars.

- The expert team leader played a key role in the project. His task was to directly oversee the substantive quality of the work carried out by the expert team, participate in the seminars organised for the verification of the initial SQF IT draft, to determine the scope of work of specific expert team members and resolve any conflicts that may arise, etc. The expert team leader accepted the initial and verified drafts of the SQF IT.

- The experts were responsible for preparing the draft SQF IT.

2.3. Team of experts

The main task of the expert team was to design the proposed SQF IT, particularly to develop the sectoral determinants and the SQF IT level descriptors. Thus, the selection of appropriate members was a key factor in the success of the project. 14 persons from various IT sector organisations joined the team to work on the draft, specialists with broad knowledge of the IT sector, its required competences and the awarded qualifications. They represented the following types of institutions:

- three companies involved in computer engineering, including two small and medium-sized enterprises (SMEs) and one large company;

- four companies involved in computer software production, including three SMEs and one large company;

- one sectoral organisation;

- four institutions providing formal education for the IT sector, including three higher education institutions;

- two institutions involved in non-formal education for the IT industry.

A key success factor of the project was the effective recruitment of experts. When talking about the effectiveness of the recruitment, it is important to bear in mind not only the direct result, i.e. securing the involvement of the target number of people meeting certain criteria, but also the positive relationships that were

established among the experts and their institutions, which benefited successive stages of the project. The following factors were also important:

- the experience, skills and appropriate preparation of the recruiters for carrying out their work;
- the proper organisation and control of the recruitment process to ensure its compliance with accepted procedures;
- motivating the organisation to agree to have their staff participate in the expert team;
- the motivation of the experts to participate in the project.

Taking into consideration the progressing specialisation of IT competences, the selection criteria for expert team members, and all analysed fields of IT sector activity (areas), the tasks of developing the SQF IT were divided among the experts according to their experience in specific areas. Therefore, all expert team members had the same tasks, but the subject areas were individualised. In addition, a person with particularly broad knowledge of the IT industry was selected as the team's leader from among the experts. The leader participated in the seminars conducted during the preliminary verification stage of the SQF IT draft and set the scope of work for individual team members, resolved disputes, etc. The work of the expert team included:

- reviewing the materials developed for the substantive concept of the SQF IT;
- participating in a seminar preparing experts from a methodological point of view to work with the team;
- identifying and describing the sets of key competences for areas of activity identified by the sectoral determinants in the language of learning outcomes (categorised by knowledge, skills and social competence);
- developing SQF IT level descriptors;
- preparing a draft of the SQF IT;
- analysing the results of the verification of the prepared SQF IT draft;
- amending the draft SQF IT according to the results of the verification in a manner agreed to with IBE;
- participating in expert team meetings;
- maintaining contact with other experts, members of the research team and IBE representatives on all issues that require agreement on the positions of all parties involved;
- delivering all products to the research team in a timely manner.

2.4. Stages of project implementation

The SQF IT project was developed in two stages. In the first stage, the team of experts prepared the preliminary draft of the SQF IT. The work took place in several phases. First, core IT areas were identified, for which descriptions of key competences were developed. Then, on the basis of these key competences, the experts developed level descriptors, which allowed them to order the competences into a hierarchy and align them with different PQF levels. This work resulted in the preliminary draft of the Sectoral Qualifications Framework for IT.

The next stage was the verification of the preliminary SQF IT draft. Seminars were organised for representatives of key IT sector stakeholders (representatives of companies, higher education and vocational education institutions, training companies and industry organisations). The seminars included not only discussions on the draft SQF IT, but also deliberations on:

- how to implement the SQF IT and its possible functioning in the Integrated Qualifications System,
- the principles and conditions of the sector's use of the SQF IT,
- directions for the further development of the SQF IT.

Next, a quantitative study was conducted using a survey questionnaire addressed to a wide range of IT stakeholders. The study focused primarily on the adequacy of the formulated key competences and the SQF IT level descriptors. The results of the verification were included in the final draft of Poland's Sectoral Qualifications Framework for IT.

A diagram of project implementation is shown in Figure 3.

Figure 3. Diagram of the work conducted on the proposed SQF IT

3. Development of the SQF IT

Within the various stages of project implementation, a number of analytical and research tasks were carried out, resulting in the development of a draft Sectoral Qualifications Framework for IT. The course of the work and its results are described below, noting the problems that were overcome.

3.1. Desk research

The first stage of the project was desk research analysis. Its aim was to provide the expert team with a synthesis of information on key IT sector competences, identified within various qualifications and certification systems both in Poland and abroad. An additional purpose of the analysis was to use existing knowledge on developing level descriptors for qualifications/competences. The following materials were analysed:

- Core curriculum for vocational education of the following IT qualifications: E13 Designing local area computer networks and network management, E14 Developing internet applications, databases and database management, E19 Designing and programming mechatronics equipment and systems;
- Selected IT education programmes of a leading higher education institution (the choice of fields of study and higher education institution were based on the institution's *Perspektywy* rank and expert opinions): the first and second cycle studies in computer science conducted by the Faculty of Mathematics, Informatics and Mechanics, Warsaw University were analysed;
- EUCIP certification system;
- Selected sectoral certificates: Microsoft SQL server certificates;
- US Department of Homeland Security, National Initiative for Cybersecurity Careers and Studies (NICCS) – Curriculum Evidence Standards (United States);
- Documents of the European IT Certification Institute (EITCI);
- Council of European Professional Informatics Societies (CEPIS) – standardised professionalization in IT (ECDL);
- Regulated Qualifications Framework for England and Northern Ireland, Credit and Qualifications Framework for Wales (United Kingdom);
- Frameworks for Higher Education Qualifications of UK (United Kingdom) (FHEQ);
- Scottish Credit and Qualifications Framework (SCQF);
- Qualifications Framework, The Government of the Hong Kong Special Administrative Region (HKQF);

- Specification of Competency Standards in Information and Communications Technology (SCS, Hong Kong);
- Australian Qualifications Framework (AQF);
- European e-Competency Framework.

Desk research analysis also provided the information needed to precisely define the fields of activity (areas) in the IT sector.

3.2. Defining the fields of activity (areas) in the IT sector

Identifying the areas of activity in the IT sector was important for the results of the work on the framework. In the analysed documents, the categorization of the areas was most often prepared on the basis of:

- the criterion of the product of a given activity (as adopted in the Polish Classification of Activities), or
- the criterion of the similarity of performed tasks (method adopted in the Classification of Occupations and Specializations), or
- other criteria (different systems of qualifications and the standardisation of competences in IT).

The analysis made it possible to identify the basic criteria for distinguishing areas of activity in the IT sector:

- the similarity of professional tasks that can be identified as similar competences, since similar sets of competences are required to perform similar professional tasks;
- the results of the work carried out (products or services);
- IT technologies;
- business processes.

The typologies analysed belonged to one or more of the above models, for example, the combination of the business process criterion and the similarity criterion. Based on the analysis of various solutions in the standardisation of IT competences and qualifications, the following functional areas in the IT sector were distinguished:

- IT analytics (an area that covers the analysis and development of computer systems, IT architecture, application development, application security, etc.);

- Programming (the programming of applications and systems, including mobile applications and multimedia in various programming languages, software testing);
- Databases and computer networks (the design and administration of databases, computer systems and networks, their analysis and development, as well as data security);
- Computer engineering (a whole range of issues pertaining to the architecture and operation of single or complex computer systems);
- Internet technologies (website design and management, producing web applications, developing Internet technologies, etc.);
- IT support (IT and technical support for software or hardware users in their daily work with software, systems, or hardware);
- IT management (IT organisation and management issues including: IT business strategy development, operational project management, product management, risk management, customer and vendor management, business process improvement, quality management, change management, information security management, etc.).

For such distinguished functional areas, it was then possible to indicate general (common to all areas) and specific competences that were directly related to the tasks performed.

3.3. Identifying the sets of key competences for the areas of activity (sectoral determinants)

Distinguishing sets of key competences for the areas of activity was a complex issue, requiring a detailed analysis of the IT sector as a whole and of its individual business processes. The criterion for identifying these sets was based on the assumption that the competences in question had a varying effect on the results of the work performed in a particular process. Some competences have little relevance to the results of a given process, which means that even if they are at a relatively low level, they will not significantly impact the course and results of the work (in terms of quality). Such competences can be described as auxiliary. On the other hand, other competences will directly and strongly affect the course of the work, its quality and the final result, and therefore are crucial for the results of the process.

Expert team members had to identify, distinguish and describe the key competences that strongly impact work results. The following definition was adopted in the project:

> Key competences – a specific set of learning outcomes described in the language of knowledge, skills and social competence that significantly impacts the results achieved in the work of a given process.

The analysed methods of distinguishing key competences are based on the assumption that they differentiate qualifications (or their components). This means that auxiliary competences, i.e. those that do not significantly influence the outcome of a given process, are bypassed. The analysis of sectoral competences should therefore cover only those that are key. Key competences can include general ones, i.e. competences that can exist in various job positions and different sectors, as well as specific competences that are only required for IT job positions.

Two complementary methods for identifying key competences were adopted. The first was to distinguish the sets identified through desk research. Where possible, the level of a particular competence was also indicated. The second identification method was based on the decisions of the expert team. Team members could supplement or modify the identified competence sets based on their knowledge and experience. As a result of the work, a compilation of key competences was prepared which took the following form:

IT analytics	• Knowledge of the types of computer memory and data • Understanding of computer decision-making structures (3/5) • ...
Programming	• Knowledge of programming languages used in the company for specific applications: C, Java, Objective-C, C++, PHP, Visual Basic, Python, Transact-SQL, JavaScript, SQL, Pascal, Delphi itp. (2/3) • ...
Computer engineering	• Knowledge of the tools and environments for software development • ...
...	• ...

During work on identifying the sets of key competences for the IT sector's areas of activity, the principle of sequentiality was used in both methods described above. First, documents were analysed to identify key competences. On this basis, an initial version of the competence sets for each IT area was prepared. When this phase was completed, the experts began working on supplementing and modifying the sets. This resulted in definitive sets of key competences, supplemented and modified on the basis of team members' expertise.

This work resulted in the identification of two areas designating the sectoral determinants: **programming** and the **administration of IT systems**. These two determinants encompass all previously identified key competences for the analysed areas of activity. In the course of the expert team's work, additional analytical criteria had to be taken into account, which in themselves are not specific to the IT sector, but constitute an essential supplement to the technical competences defining the sectoral determinants. The additional categories analysed are in fact general competences in three areas:

- ensuring the quality of IT products and services,
- ensuring congruity with IT market trends and changes,
- ensuring economic efficiency.

3.4. Developing the SQF IT level descriptors

In accordance with the *Referencing Report* (IBE, 2013), the reference point for level descriptors are the relevant entries of the European Qualifications Framework, which makes it possible to clearly refer the level of Polish qualifications to the eight levels of the EQF. The PQF descriptors were defined very similarly to those presented in the Recommendation of the European Parliament and of the Council on the European Qualifications Framework (European Commission, 2008). In the PQF, as in the EQF, learning outcomes are described in three categories: knowledge, skills and social competence. PQF level descriptors cover a wide range of learning outcomes. They reflect progress in a person's learning from the lowest to the highest level. As the result of learning in various contexts and in different stages of life, they show the gains made in knowledge, skills and social competence.

When developing the Polish Qualifications Framework, great importance was attached to ensuring the coherence and completeness of the general level descriptors. For this reason, many different aspects were taken into account. The point of reference for formulating the SQF IT level descriptors was the PQF universal level descriptors and the level descriptors for vocational education and training (VET). Thus, descriptions of qualifications awarded both in the formal education system, higher education, as well as outside these systems can be referenced to the SQF IT level descriptors.

Developing the SQF IT level descriptors was a four step process. In the beginning, two categories of key competences were identified – general competences and those which had an assigned level as indicated in a given industry standard. Working with the general competences made it possible to identify common elements of the sector, serving as an essential foundation for the sectoral qualifications. These general competences thus served to define the sets of knowledge, skills and social competence that should be reflected in the SQF IT descriptors. On the other hand, the analysis of competences with already assigned levels enabled us to determine whether it was possible to show their progression within the given category of key competences.

The result of the second stage was the development of two categories of preliminary descriptions of SQF IT level descriptors: descriptors based on analysing general competences and descriptors based on analysing the progression of key competences. The method of competent judges was used, consisting of two tasks:

- developing the initial descriptors for the knowledge, skills and social competences identified in the analysis of general competences;
- developing the initial descriptors for the knowledge, skills and social competences identified in the analysis of the key competences which progress through the levels.

In the third stage of the work, the two preliminary categories of SQF IT level descriptors were combined into one coherent structure of descriptors for the sectoral qualifications framework. This consisted of unifying the earlier defined

sets of descriptors into a coherent system encompassing the categories of knowledge, skills and social competences.

In the last step, expert team members used their own experiences and expertise to supplement the developed descriptors. In effect, the descriptors were formulated and supplemented in a way that allowed them to encompass all the qualifications and competences of the IT sector.

The SQF IT level descriptors were referenced to specific second stage descriptors for vocational education and training. In developing the SQF IT level descriptors, a semantic analysis was performed of the identified sets of key competences, which led to the formulation of universal SQF IT descriptors for all qualifications that are awarded at a given level.

The adopted multi-step approach resulted in a unified and universal qualifications framework for the entire IT sector, understood not only as all of the companies in the sector (i.e. those offering programming and IT services), but above all, understood as the community of IT professionals. Such an approach was taken because of the following factors:

- The developed sectoral framework is quite general, enabling a broad spectrum of sectoral qualifications to be developed, covering all areas of activity in the IT sector.

- The general nature of the SQF means that it will be a tool with greater longevity. However, the need to ensure its longevity is in contrast to the dynamic nature of the IT sector, where competences and qualifications develop very rapidly, driven by the fast-paced changes in applied information technology. The only effective way of ensuring the tool's longevity was for it to be as general as possible, but also to reflect the specificity of the sectoral competences as much as possible.

- The presumed longevity of the SQF IT will extend the period before modifications to the framework become necessary due to changes in the sector.

3.5. Verifying the initial SQF IT draft

Stakeholder groups representing the potential users of the sectoral framework and who would experience the effects of its implementation were involved in verifying the SQF IT preliminary draft. Involving the right groups is one of the main factors deciding the quality and effectiveness of implementing the sectoral qualifications framework. Therefore, the contractors proposed that representative proportions of particular stakeholder groups be maintained in the verification process.

The process of the preliminary verification of SQF IT project was conducted as follows:

1. Representatives of key stakeholder groups were consulted, primarily on the adequacy of the sectoral determinants and SQF IT level descriptors.

The consultations took place in the form of two seminars with key stakeholder representatives.

2. A quantitative study was carried out using a survey questionnaire on the adequacy of the sectoral determinants, SQF IT level descriptors, and issues relating to the implementation of the SQF. The survey was targeted to the most important SQF IT stakeholder groups. The contractors based the verification on the results of 100 questionnaires.

3. A summative seminar was held after conducting the consultation seminars and completing the analysis of survey results. This seminar focused on presenting the verified SQF IT draft and the conclusions from the verification conducted among industry representatives.

4. The expert team approved the final design of the Sectoral Qualifications Framework for IT.

Consultation seminars

Two seminars were held to verify the initial draft of the Sectoral Qualifications Framework for IT. The participating organisations represented a broad range of SQF IT stakeholders: higher education institutions, vocational schools, public institutions, NGOs, large firms, and small and medium-sized enterprises.

The seminar topics followed the planned division of specialty areas, first focusing on computer system administration and then on programming. The seminars were conducted by the research team and selected members of the expert team and consisted of the following scenario:

- presentation of the premises of the PQF and SQF,
- presentation of the preliminary SQF IT draft,
- discussion,
- formulating recommendations on modifying the SQF IT draft.

The general conclusion was that the basic premises of the Sectoral Qualifications Framework for IT were well described and reflected the examples of various qualifications and certificates presented by the participants. The participants believed, however, that editing was needed, mainly relating to the choice of vocabulary and writing style. It was also felt that a clearer presentation was needed on the consequences of dividing the framework into two main IT areas, namely administration and programming. Concerns were also raised about the need to include a broader spectrum of social competences, whose lack is a significant barrier to the professional development of IT professionals.

Participants additionally noted that while the very idea of developing a single qualifications system for the entire IT sector was entirely acceptable, opinions were divided about how its implementation would work in practice. The

divergence of interests was particularly evident among large organisations (both companies and sectoral organisations) awarding various qualifications and certificates. In this context, seminar participants stated that the involvement in the expert team of specialists from large companies, which issue their own certificates, was especially valuable. It was noted that the participation of such firms in the project could be crucial in encouraging other organisations to accept and adopt the mechanisms of the proposed qualifications system.

Quantitative study

The second component of the SQF IT's initial verification process was a quantitative study, carried out using several complementary techniques: PAPI, CATI and CAWI. A specific technique was used depending on the ability to reach a given respondent and his/her personal preference. The study was conducted throughout the country on a purposive sample of business entities.

The questionnaire was prepared in a way that allowed any of the survey techniques to be used. It was assumed that the respondents would receive the survey questionnaire together with the proposed SQF IT a few days before the actual interview date to allow them to become acquainted with the topic and materials.

The results of the study are as follows:

- More than 60% of the respondents rated the language used in the proposed SQF IT as understandable, although some adjustments might be required. A list of the respondents' comments and questions was prepared on the basis of the responses indicating problematic language.

- 75% of the respondents considered that the majority of the most important IT competences were included in the proposed SQF IT.

- The SQF IT level descriptors indicating a progressive attainment of knowledge, skills and social competence were also assessed by the respondents. In this case as well, over 60% of the respondents believed that the descriptors correctly indicated such progress.

- Due to the nature of the sectoral qualifications framework, it should encompass as many certificates and qualifications of the sector as possible. 62% of the respondents confirmed that most of the certificates could be covered by the proposed SQF IT.

- An important element of the SQF IT verification process was reviewing its eventual implementation and functioning. The first question on these issues was intended to assess the benefits of implementing the framework. An important benefit of implementing the SQF, according to respondents, should be the ability to compare the qualifications functioning in the IT sector.

- Respondents agreed that the qualifications referenced to the SQF IT should be better adapted to the needs of employers. Also, most agreed that the education

and training programmes developed on the basis of the SQF will be better adapted to the needs of employers than those currently in place.

- Implementing the SQF IT was a separate issue addressed by the survey. 60% of the respondents agreed that a framework is needed in the IT sector (a negative response to the statement "The sectoral qualifications framework is a tool that is not needed in the IT sector"). Most respondents believed that the framework should be implemented together with IT entrepreneurs, which should ensure the success of the implementation process. Most of the responses also indicated that the use of the framework should be voluntary, i.e. entrepreneurs should not be required by law to use the framework.

- It is worth emphasising that more than 60% of the respondents agreed with the following survey statement: "The sectoral qualifications framework will be used only by educational institutions and public administration; it will have little significance for companies operating in the sector." Only 26% of the respondents did not agree with this statement. This indicates the need to appropriately inform and educate the sector about how the SQF IT can be used by companies, emphasising the resulting benefits.

- Almost 70% of the respondents believed that education and training institutions offering training to the IT sector should use the SQF IT when developing programmes. This is consistent with previous statements that sector-specific training programmes will be better adapted to market needs. As the IT sector is one of the fastest growing industries (technological changes in terms of devices, user requirements, etc.), more than 65% of the respondents indicated that the framework must take into account such changes and developments in advance. Further development of the framework will be necessary, because despite its anticipatory character, it is impossible to take into account the changes that will occur in 5 or 10 years. This task should be entrusted not only to companies and organisations in the IT sector (53% indicated this). As with the initial design of the SQF IT, it follows that its future development will require the involvement of representatives of universities, schools, educational institutions, industry organisations, etc.

- When asked to identify the decisive factor that could affect the acceptance of the SQF IT by IT companies and organisations, respondents highlighted the need to simplify the language and message of the sectoral framework. This can be viewed as a recommendation for developing information about the framework. However, a full description of SQF IT should also be available.

Summative seminar

The last element of the process verifying the proposed SQF IT was a summative seminar held after the quantitative survey was carried out. The organisations participating in the seminar were represented by a broad spectrum of SQF IT stakeholders: training organisations, research institutes, NGOs and large companies, as well as small and medium-sized enterprises. The seminar was conducted by the research team and selected members of the expert team.

Sectoral representatives participating in the summative seminar concluded that the concept of developing the SQF IT proposed by the expert team was on target. It was noted that the adopted structure of the framework allows two requirements to be met – the universality of the framework, i.e. it encompasses all IT qualifications awarded in the sector, and stability, evidenced by the relatively long period of its potential use before the descriptors will need to be amended. Seminar participants pointed to the further need to improve and refine certain descriptors in a way that would prevent them from being interpreted arbitrarily. Stylistic and language corrections were also reported, to be included in the final draft of the SQF IT.

The detailed comments of panel participants summarising the event pertained to the specific entries that they believed needed improvement, but the overall shape of the framework was considered to be accurate, in line with the premises and expectations of IT sector representatives.

Participants did not propose a specific way of implementing the presented solutions. In their view, the IT sector plays a key role in developing the framework, but the implementation process itself should be proposed by the regulator. Participants were rather more interested in the specific ways of implementing the qualifications system and how this could be done given market realities. It was mentioned in this context that developing uniform implementation solutions from the bottom up is not likely to happen, as the IT sector is too fragmented and divided. The need to bring order to the market of certificates and qualifications in the sector was recognised, but the participants acknowledged the lack of a sufficiently strong centre to push through such a bottom-up process. For this reason, the participants believe that the only option is to have external institutions impose solutions developed in cooperation with the sector. It was noted that IT companies could be encouraged to adopt the solutions of the Integrated Qualifications System by connecting the framework with qualifications awarded under EU-funded programmes, as well as with the qualifications attained by unemployed persons trained in programmes organised by the labour offices.

Seminar participants were also very interested in the mechanisms of the quality assurance system and how validation was to take place. It was pointed out that these are areas where IT companies have not had good experiences. Therefore, in the view of the participants, a campaign promoting the qualifications system should especially emphasise these solutions.

3.6. Recommendations on implementing and utilising the SQF IT

The recommendations on implementing the Sectoral Qualifications Framework for IT in Poland and the possibilities and ways of overcoming barriers to its functioning in the national qualifications system are presented below. They also relate to the principles and conditions of using the SQF IT by the sector and directions for the further development of the sectoral qualifications framework in line with IT sector expectations.

1. Implementing the Sectoral Qualifications Framework for Information Technology (SQF IT)

A crucial element for the effective implementation of the Sectoral Qualifications Framework for IT is to ensure its acceptance by key stakeholders of the IT sector in Poland. These include large companies and training organisations, the most important providers of education and training services in the sector (e.g. *Altkom*, *COMARCH*, *Combidata*, *IT Media*, *Warsaw University of Technology*, *University of Warsaw*, *Vocational Training Institution in Warsaw*, *Microsoft*, *HP*), transnational corporations providing the most important commercial certificates in the IT sector (such as *Microsoft*, *Novell*, *Symantec*, *IBM*, *Red Hat*, *VMware*, *Pearson VUE*, etc.), industry organisations (e.g. *Polish Chamber of Information Technology and Telecommunications*, *PRO Polish Software Market Association*, *IPMA Polska – International Project Management Association Polska*, *Polish Information Processing Society*, *NTIE Scientific Society for Business Informatics*, *IEEE Institute of Electrical and Electronics Engineers Poland*, *ISOC Internet Society Poland*, etc.). The active involvement of these organisations in the implementation of the sectoral qualifications framework is required for the success of this endeavour. This is due to the structure of the IT market in Poland, which is very fragmented and lacks an organisation that is able to influence the entire sector. For this reason, it is recommended that SQF IT implementation be entrusted to an external institution to carry out the process with the cooperation and support of key IT stakeholders. An additional argument favouring SQF IT implementation is the current problem in the IT market of being able to properly assess the quality of offered education and training programmes and validation processes. For this reason, an additional argument supporting SQF IT implementation should be to highlight the issue of quality assurance, which can be used as an important element in promoting the use of the framework.

2. Overcoming barriers to the functioning of the SQF IT in the national qualifications system

The most important and, at the same time, most difficult barrier to overcome in the functioning of the SQF IT in the national qualifications system is the very high rate of change occurring in the IT market. As a result, IT qualifications and certificates are also rapidly changing. This situation makes the issue of standardising qualifications and competences less attractive in the IT sector, although it is possible to identify existing needs in this area. This raises a certain degree of mistrust among IT market entities about mechanisms proposing to standardise qualifications. By making the IT market aware of what essentially a sectoral qualifications framework is, this problem can effectively be overcome. It is particularly helpful to use pictorial and symbolic ways of conveying the idea of a qualifications framework. During the design work, using the idea of a library was suggested to describe the qualifications system (with the library as the equivalent of the qualifications register). In such a library, the shelves represent sectoral frameworks, and the books are the individual qualifications. In turn, the qualifications system is the whole library and its rules of use. This is a very visual comparison, allowing a person to understand the general idea of the qualifications system without going into details. Such a comparison could be used in a promotional campaign for the qualifications system. In this way, a person

could clearly see that the SQF IT is not an attempt to standardise qualifications, but a tool to unify the way qualifications are described and assigned a level. The emphasis should be placed on the educational and qualitative aspects of the functioning of the SQF IT, while at the same time, linking the tool to processes other than education and training or broader professional development should be avoided. It is also advisable to emphasise that the overarching aim of the sectoral qualifications framework is to bring order (participants in the verification study used the term "civilise") to the education and training market and to ensure the quality of the educational offer and validation processes.

3. The principles and conditions of using the SQF IT by the sectoral community

The first issue to signal in terms of recommendations on the principles and conditions of using the SQF IT is the previously indicated lack of a single unifying centre that could impose a specific solution for the entire sector. According to verification study participants, the principles and conditions of using the SQF IT should be proposed by an external institution in collaboration with key IT sector stakeholders. This institution should also be responsible for the implementation process and then administering and updating the SQF IT. However, study participants were unable to indicate which entity could act as this external institution. Given this situation, it seems that responsibility for managing the SQF IT should fall to either the institution designated to operate the Integrated Qualifications Register or another specialised entity, established specifically for this purpose.

4. Directions for the further development of the Sectoral Qualifications Framework for Information Technology (SQF IT)

Bearing in mind the universality of the developed tool, it is necessary to assume that any IT market stakeholder should be able to submit proposals for changes that he/she believes would improve the SQF IT. To this end, for example, establishing an online consultation platform is proposed, which should be part of a web portal dedicated to the sectoral qualifications framework. It is also recommended that the SQF IT be periodically reviewed in terms of changes that need to be made to successively adapt its entries to the changes occurring in the IT market. Taking into account the dynamics of the changes in the IT sector, such reviews should be required at least once every two years. The change process itself should take place with the broadest possible participation of stakeholders.

4. Presentation of the Sectoral Qualifications Framework for IT

4.1. SQF IT sectoral determinants

This chapter describes the sectoral qualifications framework for the information technology sector (SQF IT) and the premises underlying the development of the framework. The main premise for developing the SQF IT is its service to the sector throughout the country. For this reason, the framework is formulated in a general way, encompassing a variety of working and studying conditions in different regions of the country. The SQF IT must also cover the qualifications offered by all types of vocational education and training systems. Due to the broad scope of the IT industry, which is not uniform, among others, due to the diversity of its products, technologies and services, a functional approach was used in developing the SQF IT, in line with the logic, principles and structure of the European Qualifications Framework (EQF) and the Polish Qualifications Framework (PQF). While the EQF and PQF are very general in their descriptions of knowledge, skills and social competences, the SQF IT presents the learning outcomes characteristic for the IT industry.

The market context of IT qualifications

Computer science is a field that greatly influences the development of almost all areas of social life, the economy, science, administration, etc. According to data from the Ministry of Economy, in recent years, 9,000 companies were operating in this market sector, employing over 400,000 people. It should be noted, however, that IT qualifications coexist with others in many job positions in these companies. In practice, this means that in order to provide IT services, workers are required to have a variety of additional competences and qualifications from various fields and areas, such as: management and work organisation, legal regulations, graphics and media, etc. A good example of a job where IT is linked to other areas of business is the specialty of "business analytics", where competences in the fields of organisation and management are far more important than computer science skills.

On the other hand, a number of IT competences are becoming widespread and are used in many sectors, so they are no longer associated only with IT. The use of data in management, information exchange and retrieval, presentation graphics, as well as multimedia processing and presentation are no longer specialties reserved just for IT because of their universality. Also, the work of preparing user interface and methods of presenting information are now being perceived as more of a social science than a computer science.

It should also be noted that IT competences are an important supplement to the skills of other economic sectors for job positions requiring the autonomous use of IT tools or information technology.

This is why it is important to organise IT qualifications and to distinguish them from others that are related to or associated with the sector, but which do not belong in the category of IT qualifications. To do this, the IT sector and how it is understood in the context of developing a sectoral qualifications framework had to be precisely defined.

Defining the IT sector

For this process, the definition of the IT sector is understood as the area of activity within which information is acquired, transmitted, processed, analysed, stored and presented. This area is manifested through activities of varying degrees of complexity to analyse requirements, design, write, test, secure and implement software or administer the configuration, operation and updating of IT systems.

Because of the rapid and profound changes in technology, the IT sector, like no other, requires the practical application of the lifelong learning process, as this is the only way people working in IT are able to update and develop their professional competences. Only a small proportion of employees in this industry have been trained in their occupation by professionals through formal education. In addition, a significant and ever-increasing number of employees are intentionally changing the areas of their professional specialties, using non-formal and informal methods to acquire knowledge and skills, to become IT professionals. Vocational education and training, focused on the key competences for the industry, are therefore necessary in view of labour market needs and economic trends. Non-formal education plays a particularly important role here.

An analysis of the IT sector and its characteristic phenomena leads to the conclusion that, given such dynamics of change, it is essential to develop the SQF IT in such a way as to ensure that it does not lose its currency in a short period of time. It is also necessary to maintain the basic premise of the SQF, which is the ability to link sectoral qualifications to specific occupational tasks, business processes, as well as job positions.

Sectoral determinants

According to the definition accepted within the context of the SQF IT, the learning outcomes are categorised as knowledge, skills and social competence. The sectoral determinants are organised into two groups:

- software development (programming),
- attending to the equipment and the IT environment (administration).

Programming is the process of designing, developing, testing and maintaining the source code of computer programs or microprocessor devices (microcontrollers). The source code is written in a programming language using specified rules. It may modify an existing program or be something completely new. Programming requires much knowledge and experience in a variety of areas, such as application design, algorithmics, data structures, programming languages and tools,

knowledge of compilers and how computer components work. In software engineering, programming (implementation) is just one of the stages in developing a program. Computer scientists programming computers are called programmers. Programmers' tasks typically include: system requirements analysis, application specification, IT architecture, programming, software compilation, software testing, program documentation, software integration and servicing.

Administration involves managing a network or IT system to ensure its effective and continuous operation. The work may involve such issues as applications, databases, backups, LAN/WAN networks, and operating systems (servers). Administrators' typical tasks include overseeing the work of IT systems, managing accounts and user rights, configuring systems, installing and updating software, maintaining system and data security, monitoring, detecting and eliminating problems, assisting and working with external specialists in installation, configuration and repair work, maintaining order in the system, etc. It is also important to document changes made to the systems that directly affect its functionality. Due to the scope of responsibilities, the specialised knowledge of typical administrators requires more than just knowledge about administering the entrusted software or network, and pertains to related areas, such as electronics, knowledge of many different programming languages, cryptography and cryptanalysis. Due to their duties and access to sensitive data, administrators must follow ethical rules and applicable telecommunications regulations in their work.

The sectoral determinants were the starting point for working on the sectoral framework and the basis for developing the required learning outcomes that are specific and key to IT sector qualifications. The sectoral determinants reflect the foundation of IT activities and the functioning of information technology companies. They were developed as a tool to assist in designing the sectoral qualifications framework.

The specific learning outcomes derived from both determinants are present at each SQF IT level, ensuring that it is complete and encompasses the core business of the IT sector. Both sectoral determinants reflect in a synthetic form all of the learning outcomes incorporated in IT sector qualifications in Poland.

The distinguished sectoral determinants and their descriptive learning outcomes enabled the basic structure of the sectoral qualifications framework for IT to be established. The sectoral determinants were also the basis for deciding the two main specialty areas of the sector, which determined the distinction between the two groups of learning outcomes – for programming and administration.

The required knowledge, skills and social competence described for each sectoral determinant differ at each SQF level, just as they differ for various job positions. However, taken together, they represent all of the learning outcomes for the qualifications confirmed by the certification systems functioning in Poland's IT sector, and at the same time, are consistent with the structure of PQF and EQF levels.

It should be noted that the learning outcomes are integrated, i.e. a single outcome can refer to several determinants. The integration of learning outcomes intensifies with the progression to higher SQF IT levels. The adopted determinants can also be independent, indicating two relatively independent paths of development:

- in software development,
- in IT systems administration.

The essential principle of the SQF IT's structure is that if certain qualifications and competences are not included in the described levels for the above-mentioned sectoral determinants, then it was decided that they are not specific to the IT industry and are treated as not part of the sector. It is worth pointing out that sectoral determinants and their descriptions can be used, among others, for the purposes of:

- interpreting and updating SQF IT level descriptors;
- developing sectoral qualifications;
- developing and describing job positions, as well as qualifications and competence requirements for IT professionals;
- developing and reviewing IT education and training programmes.

Additional criteria used in the analysis to develop the SQF IT

Considering the fact that IT solutions are present in almost all areas of social and economic life, additional criteria were analysed in designing the SQF IT. These additional criteria were defined by sets of competences that are crucial for the tasks performed in the IT sector, but are not sector-specific[1]. The inclusion of these competences is primarily aimed at ensuring the consistency of the SQF IT descriptors with the economic nature of the business activities conducted in this sector. Also, these competences need to be taken into account in the proposed sectoral framework to ensure the completeness of the descriptors characterising each SQF IT level. Without them, the descriptors would be incomplete and would only encompass the technical dimension of IT tasks.

These competences are reflected in the learning outcomes for knowledge, skills and social competence of both sectoral determinants (programming and administration), and consist of:

1. Ensuring the quality of IT products and services

Both currently available and newly emerging software and hardware administration solutions are being provided to specific target groups. It is therefore important to ensure that their quality meets market demand, guaranteed at every level of product or service performance. Such an approach

[1] This means that these sets of competences are also required in sectors other than IT.

requires appropriate expertise, skills in the practical application of theoretical knowledge and relevant social competence. The scope of knowledge needed here, depending on specialty, can include: knowledge of the techniques and tools used in performing IT tasks, the design and construction of information systems and operating systems, knowledge about computer networks and distributed systems, graphics and multimedia systems, IT security, etc. It should be emphasised, however, that descriptors describing quality assurance should conform to market trends and the ability to apply them in particular IT specialties.

2. Ensuring congruity with IT market trends and developments

As pointed out earlier, the IT sector is subject to systematic, dynamic changes in the social, economic, technological and legal environments. All these factors directly affect the business of the sector and the competences that its employees must have. Examples of such competences in terms of knowledge include knowledge of the phenomena and processes of developing IT technologies and their impact on social and economic changes. An example of skills is the ability to take into account the development of IT technology in formulating plans and making decisions, or the ability to use IT for innovative and developmental business activities.

The pace of change in the IT world is very fast and keeping up with it is becoming increasingly difficult. As a result, the industry must also be appropriately dynamic and flexible to adapt to these changes, as well as to shape them. Rapid changes can also entail new and unforeseen ethical problems, as well as education and training challenges to keep pace with the technological innovations. Among the most important technological trends influencing the development of IT qualifications and competences are: the application of information technology in home appliances, large data sets, cloud computing, social tools and technologies, mobile technologies.

3. Ensuring economic efficiency

When acting in a dynamically changing market, it is important to ensure that the planned economic objectives are adequate to the production costs incurred to achieve them. In the category of social competence, an example can be the readiness to assess the quality of the products and services provided in terms of their substantive content and economics, and the willingness to be assessed in this way. An example in the category of skills is the ability to assess the economic value of the results of one's own work and the work of a subordinate team.

4. Observance of professional ethics

Achieving a set of economic goals should also be linked to observing the established ethical code or code of conduct and the regulatory practices in force in the IT industry. Competences in this area are extremely important and must be reflected in the descriptors formulated for individual SQF IT levels. An example of this in the category of skills is the ability to perform tasks in accordance with applicable quality standards, legal provisions (among others, intellectual property rights and personal data protection) and ethical standards. An example

in the category of social competence is to act in accordance with applicable laws, standards, and the principles of professional ethics.

4.2. SQF IT level descriptors

Referencing to the PQF

The division into SQF IT levels is in line with the PQF level descriptors for vocational education and training. As a result, there is no direct, simple translation between the level descriptors developed for the SQF IT and those for general education and higher education. SQF IT level 4 characterises the learning outcomes at a lower level than those anticipated for IT technicians, but they exceed the requirements of PQF level 3. The majority of these outcomes correspond to PQF level 4 descriptors. On the other hand, SQF IT level 7 descriptors describe learning outcomes that go beyond the requirements for a second-cycle computer science graduate, but they are at a lower level than those of PQF level 8 for vocational education and training. Consequently, SQF IT learning outcomes (for knowledge, skills and social competence) were defined for **levels 4 to 7**.

The hierarchy of competences

The established concept of the sectoral qualifications framework adopted the definition of PQF levels developed by the systemic project *The development of terms of reference for the implementation of the National Qualifications Framework and the National Qualifications Register for lifelong learning*. PQF levels have therefore been interpreted by the scale and complexity of the phenomenon for which the tasks are being performed, but it was also agreed that the complexity of interoperability, determined by the number of system components and the relationships among them, was more important than functional complexity.

In computer science, the scale of the complexity of a given problem determines the complexity of a system. The more complex the system, the more functions it will perform, and the greater the dependency between the various elements of the system. The complexity of the interactions between the different components of a system thus determines the degree of complexity and the level of competence required to develop and manage a given system. This way of formulating descriptors best reflects the hierarchy of competences needed to solve problems in information technology.

SQF level	Descriptors typical for vocational education and training	SQF IT
4	Is able to carry out moderately complex occupational tasks under routine conditions	Is able to design, produce and implement simple user software for a **single** personal or mobile **device**
5	Is able to carry out moderately complex occupational tasks under variable, predictable conditions	Is able to service a **network of devices** or program a **multilayered system**
6	Is able to carry out complex occupational tasks under variable and not fully predictable conditions	Is able to service a data **processing centre** or **program a distributed system**
7	Is able to carry out complex and non-routine occupational tasks under variable and unpredictable conditions	Is able to service a **data processing centre** or **program a distributed system in accordance with the enterprise architecture**

In order to clearly understand the entries of different SQF IT levels, definitions of the key terms from levels 6 and 7 are provided:

- **distributed system** (SQF IT level 6) is a collection of independent computers that is perceived by its users as a single, coherent system as the result of specially designed software;
- **data processing centre** (SQF IT level 6) is the hardware and software that enables the operation of one or more user systems and the organisational processes relating to their operation;
- **enterprise architecture** (SQF IT level 7) is a coherent organisation model that integrates strategic goals and objectives, business processes, and the information and technology needed for their achievement;
- **IT system designed and operating in accordance with the enterprise architecture** (SQF IT level 7) refers to a system operating according to the model described above and takes into account its requirements and evolution at the design, construction and operation stages.

The links between the SQF IT levels

When analysing individual SQF IT qualifications framework levels, it is important to note that they are complementary (the lower level complements the higher one) because they are progressive and cumulative. This means that the descriptors of learning outcomes for knowledge, skills and social competence at a given level also include the descriptors from the lower levels.

The SQF IT structure was divided into two basic areas: **programming and administration**, in line with the adopted sectoral determinants. In addition to separate learning outcomes, these two areas also share common learning outcomes in the areas of knowledge and skills. Descriptors for social competence include criteria relating to management, scope of responsibility, complexity of the task to be performed, the frequency and the form of supervision (employees can be subject to supervision or they may be responsible for supervising others), as well as the achievement of designated results.

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Annex 1

Sectoral Qualifications Framework for Information Technology (SQF IT)

Level 4

A person with sectoral qualifications at SQF IT level 4:

KNOWS AND UNDERSTANDS:

- The dependencies between the structure and architecture of personal IT hardware elements and their efficiency
- The basic standards of quality, legal regulations, and ethical standards required of the occupational tasks being performed
- The rules of occupational health and safety (OHS) of the occupational tasks being performed
- The differences between the most popular operating systems and user software

Administration

- The general theoretical basis of the operation of digital technologies, hardware, computer networks and peripherals
- The principles of operating mobile and personal IT hardware, including processors, memory, interfaces, and peripherals

Programming

- The general theoretical basis of the operation of software, the computing and processing of data using computer hardware
- The basic principles of mathematics and IT needed to understand the functioning of algorithms, as well as the languages and principles of programming

IS ABLE TO:

- Secure the data, hardware and software of a single personal or mobile device
- Find and apply information on the IT technologies used and follow the innovations emerging in this area during the performance of occupational tasks
- Identify the economic aspects of performed occupational tasks
- Communicate in an open and effective way with the use of appropriate concepts and vocabulary
- Document completed tasks and effectively explain the results of the performed work

Administration

- Configure and manage hardware, operating and user software for personal or mobile LAN or Wi-Fi devices, and is especially able to:
  - configure mobile and personal devices for operation in wired and wireless networks;
  - select, exchange and configure the elements of various mobile and personal devices and to solve documented problems in their operation;
  - install and manage selected mobile and personal device operating systems and use documented solutions to resolve problems in their operation;
  - use script language

Programming

- Design, produce and implement simple user software for a single personal or mobile device, and is especially able to:
  - formulate and appropriately apply simple algorithms;
  - build and use simple databases;
  - build, adapt and manage simple user interfaces for IT systems;
  - autonomously design, write and launch simple software operating either independently or as part of a complex system, and resolve the problems arising in the performance of such tasks;
  - test simple software or develop the elements for testing a complex system

IS READY TO:

- Act in accordance with applicable laws, standards, procedures, and principles of professional ethics
- Function in a team with an awareness of the importance of respecting diverse views and cultures in teamwork, as well as of the impact of one's completed tasks on the results of the team's work
- Assess the quality of the products and services one is delivering in terms of their substantive content and economics, and also be willing to undergo such assessments

Polish Qualifications Framework level 4 descriptors

A PERSON KNOWS AND UNDERSTANDS:

- a broadened set of basic facts, moderately complex concepts and theories and the dependencies between selected natural and social phenomena and the products of human thought; furthermore, a broader scope of facts, moderately complex concepts and theories from specific fields and the dependencies between them
- the basic conditions of conducted activities

A PERSON IS ABLE TO:

- complete moderately complex tasks, partially without instructions, often under variable conditions
- solve moderately complex and somewhat non-routine problems often under variable conditions
- learn autonomously in a structured form
- understand complex statements, formulate moderately complex statements on a broad range of issues
- understand and formulate simple statements in a foreign language

A PERSON IS READY TO:

- assume responsibility for participating in various communities and functioning in various social roles
- act and cooperate with others autonomously under structured conditions
- evaluate one's own actions and those of the persons one is directing; take responsibility for the results of one's own actions as well as those of the persons one directs

Level 5

A person with sectoral qualifications at SQF IT level 5:

KNOWS AND UNDERSTANDS:

- The concepts of mathematics, physics and the technical sciences required to understand the theoretical basis of the functioning of hardware, computer networks, peripherals and digital techniques
- The changes occurring in IT technology relating to occupational activities
- The required standards of quality, legal regulations and ethical standards for the IT area in which one is working
- Cybercrime threats
- OHS rules required of the IT sector
- The significance of the economic effects of one's own work

Administration

- The theoretical basis of the operation of digital technologies, hardware, computer networks and peripherals
- The dependencies between the structure and architecture of IT systems and their efficiency
- The methods, techniques and tools used in designing, building and monitoring computer network operations
- The structure and principles of building computer networks, network protocols and their layered architecture

Programming

- The theoretical basis of the operation of software, computing and data processing using computer hardware
- The issues pertaining to software architecture, software layers and components, and the dependencies between software and the architecture of a computer
- The methods, techniques and tools used in designing, producing, testing and launching complex software

IS ABLE TO:

- Use IT system documentation or specifications relating to hardware, software and their required functionalities
- Autonomously obtain information on IT developments using the literature and other sources of knowledge, interpret such information, draw one's own conclusions and apply them in practice
- Perform tasks in compliance with the required standards of quality, legal regulations (including those relating to the protection of intellectual property and personal data) and ethical standards
- Prepare a work plan and direct a small team established to complete a specific task, monitor progress in completing the task, and introduce appropriate changes as required by circumstances

Administration

- Configure and manage a system consisting of hardware, operating and user software, as well as connected personal or mobile devices, and is especially able to:
  - configure and service wired and wireless networks;
  - select and monitor operations, replace and configure various elements of LAN and WAN computer networks, and resolve their operating problems;
  - use external telecommunications and virtual IT services;
  - use a virtual work environment to store and process data;
  - secure the operation of hardware and network systems at the required level

Programming

- Design, produce and implement user software for single personal or mobile devices using multiple components, software layers and network communications, and is especially is able to:
  - formulate and appropriately implement complex algorithms;
  - build and implement the software representation of object-oriented models of systems and processes;
  - analyse the requirements of a simple multilayered application or component of an IT system;
  - model and use databases;
  - use basic computer graphic tools to design and build the graphic and multimedia elements of user applications

IS READY TO:

- Assume responsibility for the results of occupational activities with an awareness of their social and economic impact and legal consequences
- Work autonomously under variable, predictable conditions, cooperate well in a team or direct a small team to perform a specific task
- Autonomously search for solutions to improve the effectiveness and quality of one's work

Polish Qualifications Framework level 5 descriptors

A PERSON KNOWS AND UNDERSTANDS:

- a broad scope of facts, theories, methods and the dependencies between them
- the diverse conditions of conducted activities

A PERSON IS ABLE TO:

- complete tasks without instructions under variable, predictable conditions
- solve moderately complex and non-routine problems under variable, predictable conditions
- learn autonomously
- understand moderately complex statements, formulate moderately complex statements using specialised terminology
- understand and formulate very simple statements in a foreign language using specialised terminology

A PERSON IS READY TO:

- assume basic professional and social responsibilities, evaluate and interpret them
- independently act and cooperate with others under structured conditions, direct a small team under structured conditions
- evaluate one's own actions and those of others and the teams one directs; assume responsibility for the results of those actions

Level 6

A person with sectoral qualifications at SQF IT level 6:

KNOWS AND UNDERSTANDS:

- The mutual impact of IT technology and social and economic changes
- An advanced level of the required standards of quality, legal regulations and ethical standards of the IT area in which one is working, enabling critical assessments to be made of performed work and the verification of assigned tasks
- Management processes, including the quality management of IT services

Administration

- Advanced theories forming the basis for the operation of digital technologies, hardware, computer networks and peripherals
- The operating principles of complex information processing systems

Programming

- Advanced theories forming the basis for software programming, computing and data processing with the use of computers
- Advanced methods of using selected programming languages

IS ABLE TO:

- Obtain, exchange and distribute information on IT technologies from the literature and other sources of knowledge, maintaining in this way a relationship with the professional community
- Prepare a plan of implementing assigned tasks, taking into account variable conditions
- Assess whether or not a specific product, service or technology is adapted to the required specifications or needs of the customer
- Direct a small team implementing a project or operating a continuous process under variable conditions
- Assess the economic significance of one's work and the work of a subordinate team

Administration

- Configure and manage a system consisting of hardware, operating and user software, computer networks, together with distributed processing systems and connected personal and mobile devices, and is especially able to:
  - install and manage selected operating and user systems for servers and central data processing equipment and to resolve problems in their operation;
  - plan the efficient operation and safe use of virtual work environments for data storage and processing;
  - configure and manage selected database systems;
  - plan the efficient operation of servers and central data processing equipment and ensure their continued operation

Programming

- Design, produce and implement IT system software using various components and distributed processing, and is especially able to:
  - use mathematical and IT knowledge to describe and simulate processes, develop models, write algorithms and perform other related activities;
  - fulfil the role of an expert in selected programming languages and tools;
  - use the appropriate tools for analysis, evaluation and validation in assessing IT systems, technologies and tasks;
  - assess the software complexity of tests and carry out a test plan;
  - model and use multilayered distributed systems

IS READY TO:

- Promote the ethical standards and organisational culture of quality assurance, acting as a role model for co-workers in these areas
- Direct a team and ensure the development and appropriate attitudes of subordinate employees

Polish Qualifications Framework level 6 descriptors

A PERSON KNOWS AND UNDERSTANDS:

- an advanced level of facts, theories, methods and the complex dependencies between them
- the diverse, complex conditions of conducted activities

A PERSON IS ABLE TO:

- innovatively complete tasks and resolve complex and non-routine problems under variable and not fully predictable conditions
- autonomously plan one's lifelong learning
- communicate in one's environment, substantiate one's position

A PERSON IS READY TO:

- cultivate and disseminate models of good practice in the workplace and beyond
- make decisions independently; critically evaluate one's own actions, those of the team one directs and the organisations in which one participates; assume responsibility for the results of those actions

Level 7

A person with sectoral qualifications at SQF IT level 7:

KNOWS AND UNDERSTANDS:

- The life cycle related issues of IT systems
- The scope of organisational and business solution changes resulting from the application of IT technologies and their social and economic impacts
- The types of risks to security and the continuous operation of IT systems

Administration

- Advanced concepts in mathematics, physics, technical sciences and social issues required to analyse and anticipate the development and changes in the functioning of digital technologies, hardware, computer networks and peripherals

Programming

- Advanced concepts in mathematics, physics, technical sciences and social issues required to analyse and anticipate the development and changes in the functioning of software programming, computing and data processing with the use of computers

IS ABLE TO:

- Design and implement an IT solution in accordance with the enterprise architecture and meet the relevant standards of this architecture
- Take into account the development of IT technologies in formulating plans and making strategic decisions
- Design and implement a solution on the basis of an obtained, formalised needs analysis or perform such an analysis using the required tools
- Manage large and diverse teams using a known project or process management method, taking into account risk management, the search for new solutions, as well as the quality and economic efficiency of the performed work; provide high-level data and systems security in accordance with economic and legal requirements, expected risks and available technologies

Administration

- Manage and economically substantiate the development of a system consisting of hardware, operating and user software, which is designed and operating in accordance with the enterprise architecture, and is especially able to:
  - plan computational complexity, design and implement a plan of tests, optimise algorithms and their applications, optimise the configuration of hardware, operating system software and database software;
  - plan the implementation of an IT system with the use of change management skills or plan the work of a data processing centre or IT service centre, taking into account security, efficiency and customer service, using selected management methods

Programming

- Design, implement and economically substantiate the development of IT system software using distributed processing in accordance with the enterprise architecture, and is especially able to:
  - manage the processes of requirement analysis, designing, writing and implementing IT solutions with the use of appropriate methodologies or supervise the performance of these technological processes;
  - lead IT projects or organise the work of software development teams

IS READY TO:

- Take initiatives and assume responsibility for the impact of the applied IT technologies on changes in business processes and for the economic effects of such changes
- Assume the role of a team leader and be a role model for subordinate workers
- Develop an organisational culture based on cooperation, respect for the individual, as well as team and individual development

Polish Qualifications Framework level 7 descriptors

A PERSON KNOWS AND UNDERSTANDS:

- an in-depth level of selected facts, theories, methods and the complex dependencies between them, also in relationship to other fields
- the diverse, complex conditions and axiological context of conducted activities

A PERSON IS ABLE TO:

- complete tasks as well as formulate and solve problems with the use of new knowledge, also from other fields
- independently plan one's own lifelong learning and direct others in this area
- communicate with various target groups, appropriately substantiate one's position

A PERSON IS READY TO:

- establish and develop models of good practice in the environments of work and life
- initiate actions, critically assess oneself as well as the teams and organisations in which one participates; lead a group and take responsibility for it

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