# STUDY OF COMPETENCES

# POWER SECTOR

## FINAL RESEARCH REPORT

Center for Evaluation and Analysis of Public Policies
Interdisciplinary Centre for Organizational Research and Development
Jagiellonian University

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# SUMMARY

The report presents effects of research works carried out under the project: "Balance of competences" in the power industry sector. For the purpose of the study, the aforementioned sector is considered to be a **sector engaging in the processing, distribution and sales of electric power in forms suitable for feeding industrial processes and household equipment, and involved in the processing, distribution and sales of electric power from sustainable sources the exploitation of which does not imply shortages of supplies in a long-time perspective, that is such sources as wind energy, solar energy, biomass, geothermal energy and biogas.** The ambient of the definition of the sector also includes manufacturers of specialist equipment for the aforementioned businesses. For strategic reasons, the development of the sector should be considered one of the more important ones in the development of the city.

Within the framework of research works, and based on the analysis of job offers and in-depth interviews with opinion leaders and representatives of businesses, we identified 100 competences of various importance, which are required from the graduates of Kraków's universities. The competences were divided into five areas: **Specialist knowledge** (22 competences), **specialist skills** (29 competences), **business knowledge and skills** (15 competences), **soft skills** (16 competences) and **foreign languages and other requirements** (18 competences). At the next stages of research work, quantity analysis related to the demand for competences (20 sector companies employing more than 2500 employees in total), was compared with results related to the supply of competences (16 fields, more than 30 specialisations of studies, completed in total by more than 3000 students in 2014). The research method considerably modified as compared to that used in 2012 suits better the specific entities operating in the sector.

The demand analysis shows information related to the most important competences sought by employers, including **the ability to use 3D graphics design software, the ability to use office packets, coping with stress, English language, integrity and investment management**, as well as competences that will be demanded in a five-year perspective, including: **public procurement, energy audit calculations, ability to use simulation engineering applications, holistic perspective and innovation**. Competences that are most difficult to acquire on the market are related to **effective power management, oral communication skills, new trends, investment financing and investment management.** We also present key information related to the dynamics of employment in the sector, which – in case of the power sector – show a decreasing tendency. Most graduates now and in the five-year perspective will be offered employment on the basis of civil law contracts or self-employment. The report also contains information related to jobs/positions that are most frequently offered in recruitment processes.

The supply analysis shows information related to fields of studies the curricula of which, according to employers, offer the profile of education best fitting the needs of the sector. The analysis also present the assessment of educational results as seen by employers (the definitions of the competences were "translated" into educational results). Competences important for employers and learnt at universities are, inter alia, **law and legal regulations, ability to use MS Office, OpenOffice and Google Dosc, general technical knowledge, new trends and learning**. According to high-standard universities, the effects of education related, inter alia, **to low-voltage systems, ability to use simulation engineering applications, seismic and geophysical measurements and geological data interpretation** are obtained, but at a smaller number of studies.

Cooperation between universities and representatives of business is fairly intense and profitable to both parties. However, in case of a large number of businesses, particularly smaller ones, the range of cooperation is fairly limited, because universities cooperate mostly with large companies of national range.

The study of competences contains also diagrams in which difficulties in acquiring competences were juxtaposed with educational results. One may say that the image is generally highly positive, except that in case of certain competences, such as **effective power management, investment financing, solar energy and photovoltaic engineering and oral communication skills** certain shortages may be encountered.

An additional analysis is devoted to the opinions of employers and universities as to the responsibility of universities for teaching certain competences. The views of both parties as to **specialist knowledge and skills** are quite similar, but considerable differences occur in responsibility for teaching **business knowledge and skills as well as soft skills**.

The final part of the report presents conclusions derived from analysis along with proposed actions aimed at the development of universities and sector companies.

## CONTENTS

# BACKGROUND

In September 2012 the Study of Competences in BPO/SSC and ITO/IT in Kraków was published. In subsequent reports, while continuing our work and focus on the analysis of demand and supply in sectors of vital importance for the development of the city of Kraków, we are pleased to present the results of research work in the four sectors:

1. Passive houses and low-energy building sector
2. **Power sector**
3. Selected segments of the creative sector
4. Life science sector.

In reports focusing on each of the aforementioned sectors, we present the most important conclusions related to the demand of Kraków's companies for certain competences and the supply of such competences by Kraków's universities. The principal tasks that were assigned to the research team have not changed and are focused on a reply to key questions: what competences should possess graduates of Kraków's universities now and in the future, and to what extend the competences are taught at the universities. The reports also help to find an answer to the question: how businesses and universities perceive the role of the latter in teaching selected groups of competences and what consequences may have differences (if any) between these two perspectives. In the reports, interested Readers will also find information related to the state and development perspectives of and challenges faced by the sectors, as well as barriers related to cooperation between research institutions and businesses.

A large number of assumptions and guidelines related to the outcome presented herein are a result of research work carried out within the framework of the first edition of the study dedicated to the balance of competences. Accordingly, whenever it is possible or advisable, we will refer to materials previously developed and published. However, considering specific features of the sectors which are analysed in this year's reports and the necessity of adapting research methods, substantial changes have been made to the methods and described in details.

Conclusions presented in the reports were formulated on the basis of research questionnaires and several dozen interviews with sector experts and with the representatives of companies and universities. The subject matter of research was also a set of job offers and, to a lesser degree, documents related to university curricula of selected fields of university studies.

The project was commissioned by the Kraków City Hall and carried out in cooperation with the Centre for Evaluation and Analysis of Public Policies and the Interdisciplinary Centre for Organizational Research and Development at the Institute of Psychology of the Jagiellonian University. The execution of the project would not have been possible without the courtesy and professional assistance from the representatives of the Kraków City Hall, businesses and Kraków's universities. We would like to express our thanks to them, and declare that we, as the research teem, feel responsible for shortages and/or imperfections (if any) of the reports. Particular thanks are addressed to the following (in alphabetic order):

- Sector experts and persons who enabled us to understand the core of the operation of the said sectors in a broader context and submitted, often very critical remarks, which helped to improve the quality of tools and definitions applied by us: Adam Biernat (Regional Labour Office), Paweł Błachno (Jagiellonian Innovation Centre), Zuzanna Drożdzak (Centre for Evaluation and Analysis of Public Policies of the Jagiellonian University), Joanna Homa (Department of Evolutionary Immunology of the Jagiellonian University), Paweł Jastrzębski (Małopolska Energy and Environment Agency), Stanisław Just (11 bit studios), Paweł Kołodziej (xtech.pl sector Internet service), Dawid Kurdziel, Maria Leńczuk (Regional Labour

Office), Kazimierz Murzyn (Lifescience Cluster), Rafał Orlicki (Kraków Festival Office), Tomasz Pyszczek (Passive Architecture, Polish Institute of Passive and Low-Energy Building), Barbara Siorek (Career Office of the Academy of Fine Arts), Anna Szczucka (Centre for Evaluation and Analysis of Public Policies of the Jagiellonian University), Dariusz Szklarczyk (Centre for Evaluation and Analysis of Public Policies of the Jagiellonian University), Paweł Szlachta (INRET – Cluster of the Culture and Free Time Industries), Paweł Węgrzyn (Department of Games Technology of the Jagiellonian University), Michał Wojtulewicz (ASTOR), Ewelina Woźniak-Łyp (Creative Kraków Foundation), Katarzyna Wysocka (Kraków City Hall);

- representatives of power sector companies[1]: EC Systems, FMC Technologies, Geofizyka Kraków, Oil and Gas Institute, Itron Polska, Heat Energy Municipal Company, OBR GSCh "CHEMKOP", Optimum, SolarTech Invest, Techno Serwis, WSK Kraków;

- representatives of universities associated with the sector: AGH University of Science and Technology (Faculty of Metals Engineering and Industrial Computer Science, Faculty of Geology, Geophysics and Environmental Protection, Faculty of Mining Surveying and Environmental Engineering, Faculty of Mechanical Engineering and Robotics, Faculty of Drilling, Oil and Gas, Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering, Faculty of Non-ferrous Metals), Cracow University of Technology (Faculty of Civil Engineering, Faculty of Environmental Engineering), Jagiellonian University (Faculty of Physics, Astronomy and Applied Computer Science), University of Agriculture (Faculty of Production and Power Engineering)

We intended to develop the reports in such manner that – on the one hand – each report could be used independently from the other reports by employers, universities, public authorities or students and graduates, and – on the other hand – could help to built a bridge and a communication platform between the aforementioned groups. As it was shown by the discussion on the results of our previous research works, such a project, commissioned by the Kraków City Hall and unique in the country scale, may easily fulfil the aforementioned tasks.

[1] The list of companies covers only these entities that permitted their names to be published in the report. The list covers all universities and business institutions that filled up the research questionnaire, either in the whole, or in part, or participated in in-depth interviews.

## RESEARCH TEAM

*Leading experts:*

**Prof. Jarosław Górniak**, PhD., [prof. dr hab.], dean of the Faculty of Philosophy of the Jagiellonian University, director of Centre for Evaluation and Analysis of Public Policies, director of Department of the Sociology of Economy, Education and Research Methods at Institute of Sociology of the Jagiellonian University. A sociologist and an economist, an expert in social research methods and data analysis, evaluation methodology and analysis of public policies as well as the sociology of economy and organisation. Scientific patron of the systemic research project "Study of Human Capital in Poland" (BKL) and previously - director of multiple research projects and author of studies on the labour market and public policies. A member of the Consulting Council at the Presidium of Kraków.

**Prof. Małgorzata Kossowska,** PhD, [prof. dr hab.], deputy dean for educational issues at the Faculty of Philosophy of the Jagiellonian University, director of the Social Psychology Unit, president of the Polish Society of Social Psychology (2008-2011 and 2011-2013), President of the Management of the Interdisciplinary Centre for Organizational Research and Development at the Institute of Psychology of the Jagiellonian University (ICBRO). She conducts research connected with issues such as: individual differences, political approaches and beliefs, conditions for political beliefs, cognitive rigidity. Holder of multiple prestigious prizes and distinctions. Author of numerous books and articles.

*Team members*

**Piotr Prokopowicz**, holder of PhD title in liberal arts and sciences, graduate of sociology and psychology at the Jagiellonian University. Assistant of deputy dean for development at the Jagiellonian University, associate researcher at the Center for Evaluation and Analysis of Public Policies at the Jagiellonian University. Co-worker and lecturer at Cologne Business School and Jagiellonian University, Visiting Fellow at Saint Mary's University in Halifax. Specialist in organisation of research and data analysis. When working as a consultant for Great Place to Work Institute Europe in Copenhagen, he took part in preparing the list of 100 best employers in Europe and South America. Author and editor of many studies, books and articles about sociology and psychology of management.

**Grzegorz Żmuda**, psychologist and sociologist, Managing director, ICBRO, manager of a specialization path in organisational psychology at the Institute of Psychology of the Jagiellonian University. He specializes in psychology of management and organisation, in particular in psychological organisational diagnostics, participatory management and psychology of personnel. He is also working on creating innovative tools for organisational development. He is working on his PhD thesis concerning the preferences of management styles among the young entrepreneurs, he is the author of multiple publications and presentations about organisational psychology.

**Katarzyna Jaśko**, holder of a PhD title in liberal arts and sciences, a psychologist. She specializes in social and political psychology. She is working on the conditionality of beliefs about justice, in particular in the context of inter-group relations. She is also interested in psychology of purposes and motivation as well as in creativity. Author of multiple articles about motivation through compensation.

**Joanna Pyrkosz**, psychologist, managing director, ICBRO, manager of a specialization path in organisational psychology at the Institute of Psychology of the Jagiellonian University. She specializes in psychology of management and organisation, in particular in psychology of entrepreneurship and project management. Author and coordinator of many development projects for the University, with the support of the European Funds. She is working on her PhD

thesis concerning the impact of motivation factors of young entrepreneurs on their professional success. She holds a British certificate NVQ 3 issued to vocational counsellors.

**Karolina Dukała**, psychologist, a PhD student at Social Psychology Unit of the Institute of Psychology at the Jagiellonian University. She specializes in psychology of hearing and lies. Certified trainer in group training; leads training sessions mainly in personal development and application of soft skills in business, with particular focus on negotiations. President of the Jagiellonian University Society of PhD Students, engaged in the promotion of science and arts and involved in the development of a platform for co-operation between businessmen and Jagiellonian University scholars.

**Bartłomiej Baryła**, sociologist. He specializes in social psychology and behavioural economics, paying particular attention to the areas at the junction of psychology, sociology and economics. A scholarship holder of Central European University in Hungary and Antioch College in USA.

**Maciej Taraday**, psychologist, PhD student at the Experimental Psychology Unit of the Jagiellonian University. He participates in the PhD research project on educational measurement. Fields of interest: relationship between working memory and human intelligence, cognitive control, methodology of research and statistics. He is a holder of many awards and fellowships. He specialises in statistical analysis using R, SPSS, STATISTICA and AMOS programming environment.

**Marianna Król**, psychologist, a PhD student at Social Psychology Unit of the Institute of Psychology at the Jagiellonian University. As a coach and a trainer she specializes in holding development programmes for companies and organisations, which include trainings in soft skills necessary for effective acting in a complex business environment and individual coaching sessions focused on increasing efficiency and motivation among the employees.

## KEY UNDERLYING ASSUMPTIONS

Adapting the educational offer to the needs of the labour market continues to be one of the main topics of discussions concerning university education development directions, technology transfer and mutual relations between business and educational institutions. As the topic gets more and more exposed, the risk that the problem will be oversimplified or generalised is increasing, which obstructs cooperation instead of making it easier. One of the main goals of research works carried out within the framework of the balance of competences is to demythologise the problem of intellectual capital transfer from universities to business. Another goal is to create an objective description of expectations and perspectives adopted in the perception of the process of educating students.

The starting point for the study of competences are the needs of Kraków's businesses. It does not mean that the needs should be the only one factor defining the quality and nature of educational programmes. In this context, we want to emphasise clearly what we wrote in the previous report, i.e. that our views are far from sharing quite a common belief that universities must adapt their educational offer to the labour market regardless of what the market looks like. A view that problems related to cooperation between universities and business arise only from employers not being ready or being unable to use the potential offered by universities, in our opinion, cannot be upheld, either. Our goal is to present a perspective that will enable the main stakeholders – students, universities, employers and public authorities – to get to know better the relationships between demand for and supply of certain competences, and to develop solutions which will serve each of the interested milieus.

One of the already diagnosed problems related to cooperation between universities and businesses lies in that there is no common language and notions suitable for the description of human resources. There are several factors indicating that the said barrier will diminish when the guidelines provided by the National Qualification Framework (Krajowe Ramy Kwalifikacji) are implemented more efficiently by the universities and the educational results are used in a more professional manner. A detailed discussion of the problem is presented in last year's study[2], while this time we present only key information related to the meaning of core definitions.

In this report, as in that of the previous year, we define "competence" as: "a set of behaviours belonging to a common category, enabling effective realization of the purposes in an organisation and the tasks at the given position, determined by various psychological factors."

In this understanding, competences constitute sets of behaviours connected with characteristics expected at the given position. The following list includes the categories of factors, identified in the demand analysis:

- **Knowledge** - information acquired during learning process (e.g. knowledge related to heat circulation in buildings, graphic composition, etc.)
- **Skills** - acquired learnt actions within a given area (e.g. operation of MS Office, a foreign language, but also communication and social skills, etc.)
- **Abilities** - inborn predispositions within a given area (e.g. analytic abilities)
- **Other** - the qualities that cannot be attributed to the aforementioned categories (e.g. mobility, integrity, etc.)

[2] Balance of Competences in BPO and ITO in Kraków. http://www.krakow.pl/zalacznik/1165 Chapter: The premises behind the study of competences

In order to make the discourse clearer and simple, further in this study, the term "competence" will be used collectively to denote their behavioural manifestations in the aforementioned categories. This approach is compliant with both: the Polish research tradition and the commonly accepted international convention.

Competences, which constitute one of the key notions in businesses, find their counterpart at the universities in the notion of educational results. Kraśniewski[3] says that the essence of educational result may be found simply in "a statement (–) what the learner should know, understand and be able to do after a certain period (process) of education." In Poland, educational results are often classified in three categories: **knowledge, skills and social competences**. However, these categories often overlap. Within the framework of our study we made a simplifying translation of expectations related to competences into the code of educational results. As in the previous study, we decided to use a general catalogue of effects so that they may be easily specified in details and adapted to specific fields of study.

## RESEARCH METHOD

The research method applied for the purpose of this report has been considerably modified as compared to research related to BPO/SSC and ITO/IT sectors. The factors which made the modifications necessary, provide, as such, important information related to the analysed sectors and deserve to be briefly described here.

The first important factor is related to the technique of defining a sector. In case of four sectors analysed in this year's study, there occurred more substantial differences in opinions as to the criteria for the classification of a business to a given sector. In order to meet the challenge, in-depth also interviews with persons related to each sector were incorporated into the preparatory phase of the study. The interviews allowed, inter alia, to additionally precise definitions previously adopted and to identify companies and specialisations of university studies of vital importance to the sector. Exceptionally important remarks were provided by the Regional Labour Office. Another challenge that we faced was related to the defragmentation of the sectors analysed in this year's study, as compared to the BOP/SSC or IT/IT sectors. Of course, there are large companies in each sector, but most businesses may be classified into small and medium enterprises (SME). This fact made it impossible to cover the whole population of the representatives of the analysed sectors.

With view to the budget of and the number of personnel engaged in the project, the whole set of companies employing more than 9 employees, engaged in activities selected according to the Polish Classification of Economic Activities (PKD) was included into the survey pool, except the sector of passive and low-energy building and some PKD segments of the other sectors where PKD does not provide sufficient information on the profile of activities and its application appears impracticable. The pool was extended by a target sample from micro-enterprises, following recommendations of experts from a given sector and based on activities in the business space (participation in fairs and sector events, high recognition of the company). Although such approach directly implies that the overall assessment of the size of employment in a given sector (no random sample available) is impossible, it helped to improve the evaluation of market trends and anticipated dynamics of the demand for competences.

The previous report was criticised for the importance of specialist "hard" competences having been underestimated in it, whilst soft competences were given too much focus. As it occurred

[3] Cf: A. Kraśniewski (2011). Jak przygotować programy kształcenia zgodnie z wymaganiami Krajowych Ram Kwalifikacji dla Szkolnictwa Wyższego. [How to Prepare Curricula in Compliance with the Requirements of the National Qualification Framework for Universities.] Warszawa: MNiSW; E. Chmielecka (2010). Autonomia programowa uczelni. [Curriculum Autonomy of Universities] Ramy kwalifikacji dla szkolnictwa wyższego. [Qualification Framework for Universities] Warszawa: MNiSW; Rozporządzenie Ministra Nauki i Szkolnictwa Wyższego z dn. 02.11.2011 w sprawie Krajowych Ram Kwalifikacji dla Szkolnictwa Wyższego [On the National Qualification Framework for Universities]

later, such distribution of results was, to a considerable degree, caused by the specific features of outsourcing sectors and by the employers focusing mostly on the importance of competences missing in their sectors. In the event of all the sectors analysed in this year's study, exactly the same relationship was observed at the initial stage of research, save that the phenomenon was manifested to a smaller degree in the life science and in the passive and low-energy building sectors. The representatives of companies and experts attached the highest weight to soft competences and ability to use acquired knowledge in practice. In regard of the foregoing, the subject of the analysis was extended by job offers from the whole country, combined with the classification and categorisation of information on specialist knowledge and skills specific for the sector and/or jobs offered to university graduates (with maximum 1 year of experience).

The extension of the initial list of competences required that the research tools had to be modified so that their use would be less time-consuming. The time needed by the participants to take part in the project had to be reduced also with view to the relatively low interest of companies in the participation in the project, which fact was identified at the initial stage of the project. While the last year's research scheme provided that the supply questionnaire required 1.5h to 2h to be filled in, depending on the profile of the company, the time needed to fill-in this year's questionnaire required 30 minutes or 1 h, although the number of assessed competences was greater.

Within the framework of the research work, we decided that the analysis of demand for competences should be carried out at a more general level (in abstraction from specific jobs/positions). There were three reasons for such decision. Interviews with experts and employers indicated that the development of the *Strategic Human Resource Management* (SHRM) considerably varies from one company to another. We also noted a trend that there were no schemes for the creation of jobs/positions (defined as employment under labour contracts) and that the cooperation under another legal scheme (under civil law contracts, for instance) appeared more important and prevailing, which phenomena occurred quite common (particularly in the creative sector and in the passive and low-energy sector) and depends on the nature of actually performed projects. Entities subject to the study quite often indicated that their seeking of employees and collaborators depended on the winning (or failing to win) a certain project. With regard to the foregoing, the companies, although being capable of indicating clearly what competences are important for them now and will be such in the future, cannot or are reluctant to give a reply to the question how many employees and at which positions they will employ in a longer perspective of time.

All modifications adopted in our approach were also reflected in the tools applied for the purpose of the analysis of supply from Kraków's universities. The tools are presented in the appendix to this report. To summarise the foregoing, the research work consisted of the following steps:

1. **Initial phase**

    a. In-depth interviews with experts and persons related to a given sector and consultations with the Kraków City Hall and the Regional Labour Office, Kraków, purported to define more precisely the notion of a sector, as well as to recognise the context in which a given sector operates and, identify key players (on the part of businesses and universities). At the initial phase ca. 10 interviews and consultations were carried out in regard of each sector.

    b. The desk research of the sector and the analysis of job offers, purported mainly to identify key challenges faced by the sector, and to develop an initial list of competences sought by employers.

## 2. Analysis of the demand for competences

a. In-depth interviews with the representatives of selected companies, which gave insight into the sector experience related to recruitment procedures, selection and development of employees, as well as the assessment and completion of the list of competences sought (competence demand questionnaire).

b. The development and testing of the competence demand questionnaire as a research tool.

c. The development of the pool of companies, based on PKD items related to the power sector, desk research analysis as well as guidelines provided by experts and companies. After the list had been reviewed, in the course of which certain entities were removed from the list where they no longer existed, had moved their activities to other towns, or no longer carried out activities related to a given sector, or where they had declared that in the next five years they would not employ university graduates, the base survey sample counted 87 items.

d. Survey of sector companies with the use of questionnaires, which allowed to collect quantitative data on current and projected market requirements concerning the most important competences of the graduates of Kraków's universities, and to assess difficulties in acquiring such competences along with opinions on the responsibilities of universities for teaching the said competences. In addition, we collected information related to employment schemes (for 2014 and 2019), as well as information on competences required of graduates in order to get promoted in their companies, fields and specialisations of university studies the profiles of which, in the opinion of companies, fitted best the profile of their businesses (in the power sector, the survey covered 20 companies in total, employing more than 2500 employees, which makes 35% of the survey sample realization; 14% of companies refused to participate in the survey, whilst others declared their being ready to participated, but eventually failed to fill-in the questionnaires).

## 3. Analysis of the supply of competences

a. The development and testing of the competence supply questionnaire as a research tool.

b. The development of a survey sample for research of the fields and specialisations of university studies (based – in the power sector – on information provided by desk research analysis, guidelines provided by experts and companies, the initial list of field study invited to participate in the research work – total: 33)

c. Structured interviews combined with filling in the supply questionnaire, purported to obtain quantitative data on currently obtained educational results and projections of the number of future graduates, as well as to get insight into the context in which the field of study exists, challenges related to cooperation with businesses and expectations from companies and the Kraków City Hall.

d. Questionnaire on-line survey of the representatives of universities responsible for the profiles of the curricula of studies. The main purpose was to collect quantitative information on currently obtained educational results and on projections of the number of future graduates. In addition, we collected information on additional educational results that may be of significance to the sector and that are obtained at a given field of study. For the purpose of the power sector survey, the questionnaire was filled up by the representatives of 16 fields of studies (out of the total of 30, including post-graduate studies), to be completed by 3000 students in 2014, which makes 48% of the sample realisation.

## SECTOR DEFINITION

The definition of the power sector may be formulated in various manners, giving it a broadened or narrowed meaning. A broaden definition will cover, inter alia, the production, transmission, distribution and trade of electricity, gaseous fuels, heat energy extracted from steam, hot water or wind. In a narrow meaning, the power sector means the production and trade of electricity. Another important distinction is that the power sector consists of the professional and industrial industries (segments). The professional industry applies to companies whose basic activity consists in the production and/or distribution of power (e.g. power plants, heat power plants, transmission grids, etc.) The industrial power segment covers companies in which the production of power is a side effect of the main activity. The industrial sector generates power mostly for its own needs. Power surplus may be delivered to power grids, but it is not always so.

A business area in the power sector, which does not fall under the strict division into the professional and industrial segments, is prosumption. Prosumption is an activity that – for the time being – is of a marginal significance, but has a great potential and may play a significant role in the future. Prosumption means that power is produced and consumed by the same entity. In some sense, the area is close to the industrial power sector, but is applied mostly with regard to farms or family houses. As compared to the industrial power sector, prosumption is characteristic of a greater dispersion of and small production capacities[4].

For the purpose of the study, the aforementioned sector is considered to be a **sector engaging in the processing, distribution and sales of electric power in forms suitable for feeding industrial processes and household equipment, and involved in the processing, distribution and sales of electric power from sustainable sources the exploitation of which does not imply shortages of supplies in a long-time perspective, that is such sources as wind energy, solar energy, biomass, geothermal energy and biogas.. The array of the definition of the sector also includes manufacturers of specialist equipment for the aforementioned businesses.** The Polish Classification of Economic Activities [PKD] codes[5], that

[4] Wanat, L. (2012). SMART CITY versus DARK CITY? Perspektywa samorządowa dla nowej ustawy OZE [Perspectives of the New Law on Renewable Energy Sources from the Local Government View Point]. GlobEnergia 5/2012; Bukowski, M., Śniegocki, L. (2011). Mix energetyczny 2050 [Power Mix 2050]. Analiza scenariuszy dla Polski [An Analysis of Scenarios for Poland].

[5] In a number of cases, PKD codes do not allow to correctly identify entities that belong to a given sector. The list of codes is not exhaustive and companies operating in a given area may register another type activity as their main subject of activities. In such cases we used opinions provided by experts, sector companies and desk analysis of sector portals and Internet services.

identify entities belonging to the sector within the PKD meaning, are as follows: 06.10Z Extraction of crude petroleum, 06.20Z Extraction of natural gas, 09.10Z Support activities for petroleum and natural gas extraction, 35.11.Z Production of electricity, 35.13.Z Distribution of electricity, 35.14.Z Trade of electricity, 35.21.Z Manufacture of gas, 35.22.Z Distribution of gaseous fuels through mains, 35.30.Z Steam, hot water and air conditioning supply, 43.13.Z Drilling and boring, and 39.00.Z Remediation activities and other waste management services.

The following map shows the location of companies in Kraków's area, whose activity is linked with the power sector (based on the PKD data base).

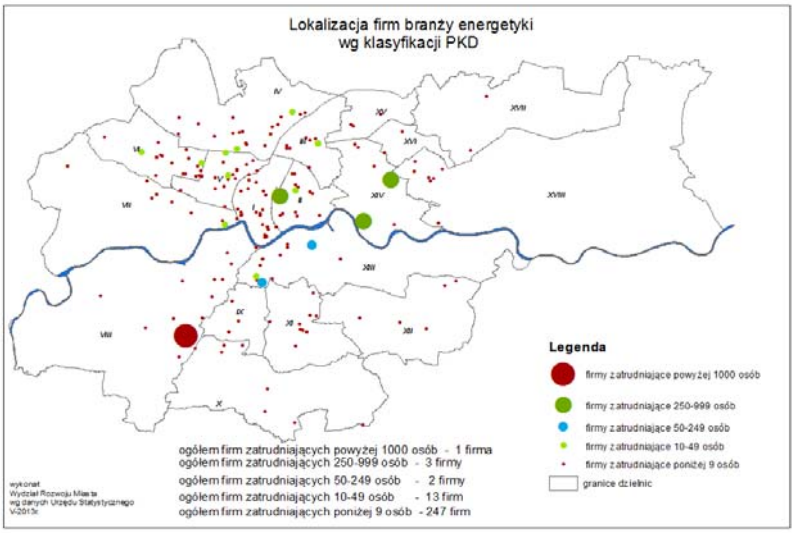


Fig. 1. Location of power sector companies in Kraków Source: Central Statistical Office (GUS). The graphics provided by the Kraków City Hall.

| | |
|---|---|
| Ogółem zatrudnionych powyżej 1000 osób – 1 firma | Total headcount above 1000 – 1 company |
| Ogółem zatrudnionych 250 – 999 osób – 3 firmy | Total headcount from 250 to 999 – 3 companies |
| Ogółem zatrudnionych 50 – 249 osób – 2 firmy | Total headcount from 50 to 299 – 2 companies |
| Ogółem zatrudnionych 10 – 49 osób – 13 firm | Total headcount from 10 to 49 – 13 companies |
| Ogółem zatrudnionych poniżej 9 osób – 247 firm | Total headcount below 9 – 247companies |
| Firmy zatrudniające powyżej 1000 osób | Companies with headcount above 1000 |
| Firmy zatrudniające 250 – 999 | Companies with headcount from 250 to 999 |
| Firmy zatrudniające 50 – 499 | Companies with headcount from 50 to 499 |
| Firmy zatrudniające 10 – 49 | Companies with headcount from 10 to 49 |
| Firmy zatrudniające poniżej 9 osób | Companies with headcount below 9 |
| Granice dzielnic | Borders of town districts |
| Wykonał Wydział Rozwoju Miasta wg danych Urzędu Statystycznego | Developed by the City Development Department on the basis of data provided by the Central Statistical Office |
| Lokalizacja firm branży energetyki wg klasyfikacji PKD | Location of power sector companies according to Polish Classification of Activities (PKD) |

## BASIC INFORMATION ABOUT THE SECTOR[6]

In the era of global and strong inter-regional competition, the key factor of economic growth is entrepreneurship and innovation. Modern economy, in spite of its constant efforts to save energy, is dependent on steady electricity supplies. The current situation in the power sector in the Małopolska Region is a barrier in the economic growth of the region. A number of areas located far from power plants suffer from periodic breaks in electricity supplies, which excludes these areas from modern market economy. According to the Report: „Perspektywa Technologiczna Kraków-Małopolska 2020 Wyzwania Rozwojowe [Technological Perspective Kraków – Małopolska][7]", the areas of key importance for the development of the region and the city are clean energy technologies and – related to them – smart power grids. These two technologies, combined with the aforementioned prosumption, constitute the bases for building a power sector based on dispersed energy sources. The dispersion of energy sources means not only their geographic location (local production of electricity that decreases transmission costs), but also the diversity of energy sources (which decreases dependency on coal). A modern state is so dependent on electricity that the decrease of the risk of shortages of electricity is the strategic goal of almost any government. Power sector based on dispersed energy sources allows to decrease losses related to electricity transmission and those related to environmental load, but – above all – to deceases the risk of recipients suffering from shortages of electricity supplies. The development of the power sector in a dispersed form may also ensure the increase of employment in the region. Another factor which is important for the development of the power sector in Kraków is support offered by huge research and technical resources which enable the development of renewable energy sources, smart power grids and clean coal technologies.

Poland, as a member of the European Union, assumed the obligation to adapt more pro-ecological solutions based on renewable energy sources. With regard to EU regulations and with respect to geostrategic factors, Poland must implement the "power mix", i.e. solutions providing the reduction of the main sources combined with the spatial dispersion and diversification of primary energy sources[8]. Kraków and the Małopolska Region do not play a significant role on the national scene neither as a resource of potential energy sources, nor as an electricity recipient[9]. Kraków is not a candidate location for a nuclear power plant, not is its location suitable for wind or solar power plants. Kraków does not possess significant resources of mineral fuels. It is only the geothermal sector the characteristics of which is above the national average. Although Kraków is out-of-the-way, the implementation of diversified and dispersed energy sources must accompany the development of the renewable energy segment in Kraków in order to satisfy local needs. The development of renewable energy technologies will be an important area, determining the competitiveness of the Małopolska Region.

Today the Region of Małopolska imports electricity as the household and industry demand for electricity exceeds local production capacities. This is why, one of the challenges faced by the municipal and regional authorities is to secure energy safety (while demand for electricity will increase) by diversifying energy sources. Unfortunately Małopolska does not possess favourable

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6 This chapter was developed, based on the desk research analysis of documents and sector publications as well as information provided by experts, representatives of companies and universities, in the course of interviews.

7 Bendyk, E., Kisieliński, S. (red.)(2010). Perspektywa technologiczna Kraków – Małopolska 2020 [Technological Perspective Kraków – Małopolska 2020]. Development challenges

8 Bukowski, M., Śniegocki, L. (2011). Mix energetyczny 2050 [Power Mix 2050]. Analiza scenariuszy dla Polski [An Analysis of Scenarios for Poland].

9 Małopolska Agencja Energii i Środowiska [Małopolska Agency of Energy and Environment] (2011). Diagnoza stanu gospodarki energetycznej i założenia do Regionalnego Planu Energetycznego (RPE) dla województwa małopolskiego na lata 2012-2032. [Power Management Diagnosis and Assumptions for the Purpose of the Regional Energy Plan for 2012-2032 in the Małopolska Voivodship]

conditions for acquiring power from renewable sources. The area of the region has insolation higher than average, but it is not good enough to construct large and effective fotovoltaic plants. Windiness in Małopolska is lower than in other regions of Poland[10], which makes wind farms less profitable. In terms of renewable energy sources, Małopolska is distinctive because of renewable geothermal sources, but their exploitation is still low.

In the professional power segment, the main electricity producers in Kraków are the heat and power plant in Łęg and the power plant in Skawina. Kraków is characteristic of its SMEs sector and the presence of leading universities (AGH Technical University, Cracow University of Technology) educating specialists for the power sector. The universities also carry out research works related to the power sector. However, in the opinions of a number of experts, who we approached while preparing the report, there is no closer internal co-operation between faculties, nor is there any such co-operation between universities and business. One of the areas of the highest potential, which has been developed and tested at the Kraków's technical universities, is a smart power grid[11]. A smart power grid, in English often referred to as "smart grids", is a set of technical solutions that allows for a better control of electricity flows at each stage of electricity distribution. In a number of papers, the technology is mentioned as a key element of the effective "power mix", which also enables the development of presumption at a broader scale.

What is particularly characteristic for the power sector in Kraków, is that the AGH Technical University got engaged into the development of new initiatives. Within the framework of a long-term strategy for the development of alternative energy sources, AGH opened the Małopolskie Centrum Odnawialnych Źródeł i Poszanowania Energii [Małopolska Centre of Renewable Energy Sources and Energy Conservation] in Miękinia, in July 2013. The centre is located west of Kraków and according to prof. Wojciech Górecki, who co-ordinates the project, the centre is destined to be a leading research centre in Poland[12]. In the immediate vicinity of Kraków, in Niepołomice commune, another initiative related to the power sector is developed in co-operation with AGH. Public Energy Alternatives Project (PEAP) is intended to explore opportunities for the use of alternative energy sources in public utility buildings. Such initiatives not only build the marks of universities and offer modern and practical education to its students, but – first of all – perform the mission of the university consisting of research works and R&D activities.

The professional power sector has developed in Kraków in a very similar manner as it has in Poland and in Europe. The first electrification attempts started at the end of the 19th century, when each important building and institution had its own electricity generator. The municipal power plant was quickly founded and over decades has gradually increased its range and power, attaching new areas to its grid. The size of the plant increased with the increase of the urbanised area of the city. Until the 60s of the 20th century, the municipal power plant was the main producer and distributor of electricity in Kraków. In 1968–85 a heat and power plant was constructed in Łęg to become the main supplier of electricity in Kraków. The current power system is additionally supplied by the power plant in Skawina. The main companies of the power sector, operating in Kraków are Tauron Dystrybucja[13], EDF Kraków and Miejskie Przedsiębiorstwo Energetyki Cieplnej [Municipal Heat Energy Plant]. Other companies are small

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10 Małopolska Agencja Energii i Środowiska [Małopolska Agency of Energy and Environment] (2011).

11 Bendyk, E., Kisieliński, S. (red.)(2010). Perspektywa technologiczna Kraków – Małopolska 2020 [Technological Perspective Kraków – Małopolska 2020]. Development Challenges

12 Łazarczyk, G. (2013, 23 lipca). AGH bada odnawialne źródła energii w Miękini [AGH Researches Renewable Energy Sources in Miękinia]. http://krakow.gazeta.pl/krakow/1,44425,14326004,AGH_bada_odnawialne_zrodla_energii_w_Miekini.html

13 Noteworthy is that Tauron Ekoenergia, a company of the Tauron Group, operates two water power plants in Kraków (with 6 such plants operated by it in Małopolska). http://www.tauron-ekoenergia.pl/elektrownie/energia-wodna/zew-krakow/Strony/elektrownie.aspx

plants related to the photovoltaic or electric installation operated by a single person or a few persons or enterprises engaged into power attachment business. A market with such structure does not generate a large demand for graduates with specialist education, nor does it stimulate demand for prototype solutions developed by universities. However, the development of prosumption business and renewable energy sources may change the status quo.

## BUSINESS AND SCIENCE

Quantitative analysis showed that the main advantage for the power sector in Kraków is access to a large group of qualified technical specialists. Kraków's technical universities have been in the group of leading universities in Poland for years. Their research concerning the implementation of smart power grids, new technologies in nuclear power technology and clean coal technologies have a potential to become remedies to challenges faced by the power sector. AGH performs various pilot projects related to the power sector. For Instance the Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering, in co-operation with the Regional Marshall Office [Head of the Regional Local Government] and General Electric carries out the Green AGH Campus Project[14]. The project is an attempt to implement the principles of smart power grids at a limited stale. The project is performed in the area of the AGH Student Campus, where renewable energy sources, lighting automation systems and electricity storing devices are going to be integrated with each other. All elements will be subject to detailed measurement procedures and the whole unit will be controlled by an IT system. The project is intended to be a testing ground for implementations at larger scales. Another example of implementation projects is the activity of Katedra Informatyki Stosowanej AGH [AGH Unit of Applied Computer Science], which co-ordinates a prototype solution of a smart lighting system. The unit also has a laboratory of electric systems which is used to monitor the effectiveness of green energy sources in the Małopolska Region. Within the scheme of educational and research activities, the unit carries out the "Smart Grid", a technological platform organising seminars and conferences. The platform also serves as an information desk for students and researches engaged in the problems of smart power grids. AGH is the leader in the development of new undertakings related to the power sector at a supra-regional level, as well. The Małopolska and Podkarpacie Clean Energy Cluster, which is an organisation established in 2006, is operated by AGH with the goal of "establishing a platform for knowledge and information exchange between researchers, industry and local self-government organisations". The project of Centrum Energetyki AGH [AGH Power Centre] is scheduled to be completed in 2014. It will consist of 38 specialist laboratories for researching of various aspects of electricity generating, storing and distributing. The image of AGH is completed with the aforementioned initiatives: Małopolska Centre of Renewable Energy Sources and Energy Conservation and the project of Public Energy Alternatives

Co-operation between business and universities is quite intense, although these are mainly large companies, often domiciled outside Kraków, that are involved in it. Kraków's universities cannot be accused of co-operating with the largest companies in Poland. Just opposite, it is a desired situation to a considerable degree determined by the structure of the sector. This fact gives rise to challenges and sets barriers for smaller businesses operating at a more local scale. To create conditions for establishing co-operation with them is a task worth effort. Within the framework of poll interviews, the representatives of companies have indicated huge benefits derived from close co-operation with universities. One of such benefits is that such co-operation facilities recruiting of good candidates to jobs offered.

The market situation is particularly difficult for small businesses which would like to introduce innovative solutions to the market. Small businesses in the power sector could enjoy preferential conditions in the first years of their activity, provided that they meet certain

[14] Kotulski, L. (2013). AGH Green Campus. Presentation: www.forumees.pl/gfx/ees/userfiles/files/37_forum/kotulski.pdf

conditions (renewable energy sources, proper labour efficiency increase). The involvement of the city authorities could take a form of assistance in formal matters, by reducing procedural barriers and creating additional outlets to serve citizens. A number of real property owners, particularly housing co-operatives do a lot to increase energy conservation (for instance, building insulations or tightening window frames) or to diversify energy sources (solar panel installations). In order to use the potential, a more substantial support from the Kraków City Office is needed. In this area, the power sector could merge its potential with the passive and low-energy sector. A proper municipal programme could reduce formal and legal barriers and raise the awareness and pro-ecological approach in the society. Such initiatives would additionally increase demand for services and solutions related to renewable energy sources.

Experts are of the opinion that in order to strengthen business potential of universities the burden of educational activities could be lifted from researchers engaged in business projects. This would make it possible for them to increases their engagement in innovative projects. In the context of co-operation between science and business in Kraków, we should also remember the establishing of the Małopolska Agency of Energy and Environment, the goals of which are: "supporting the sustained development of local governments and enterprises by implementing modern technical and organisational solutions, with particular focus on the improvement of the state of natural environment. The agency could act as an agent and broker of information exchange between parties in order to merge sector demand with projects carried out by universities.

## SECTOR DEVELOPMENT OUTLOOK

Challenges faced by the power sector in Kraków may be divided into local and global ones. In the global perspective, the power sector enters the period of fundamental changes which affect all aspects of the process from acquiring electricity, through production, storing, up to the distribution and consumption of electricity. From the local perspective, the challenge comes mainly form the diversification of energy sources from which electricity is acquired.

The largest challenge faced by the power sector in Poland is its dependence on coal resources. 90% of Polish power installations use hard coal or brown coal. The combustion of coal has a number of adverse environmental effects and adversely affects human beings[15]. As we already emphasised, power sector is a strategic one as it affects almost all sectors of economy. While Poland depends on supplies of gas and oil from abroad, coal – in a short-time perspective – will be the only one alternative. Governments, in the last dozen or so years proposed a change, but budget limitations and relatively low revenues of private businesses resulted in the conservation of status quo. The construction of a nuclear plant implies huge financial costs and increased ecological risks. The construction of relatively inexpensive gas-driven power plants will increase the dependence of Poland on supplies from Russia. Costs of investment in renewal energy technologies are high and the prices of electricity from such sources are still considerably higher than those from non-renewal sources. Another factor that makes it difficult to abandon coal-based technologies is the social obstruction from trade unions. For the aforementioned reasons, the abandonment of coal-based technology implies strong resistance in the sphere of social life, politics and economy. As a result of the foregoing more environmental-friendly solutions have been adapted in Poland at a slower pace than in other countries.

The perspective of the sector in Kraków is related, first of all, with changes on the European and global scene. A change affecting the safety of power supplies or environmental protection are the key priorities of the Energy Policy for the European Union[16]. The directive is implemented in

[15] Bukowski, M., Śniegocki, L. (2011). Mix energetyczny 2050 [Power mix 2050]. Analiza scenariuszy dla Polski [An analysis of Scenarios for Poland].

[16] European Community Commission (2007) Communication of Commission to the European Council and Parliament; Energy Policy for the European Union.

Poland within the framework of the Energy Policy for Poland 2030[17]. If global situation or a change in technologies results in a change in the priorities provided by the aforementioned documents, the situation of the sector will also change. The most likely scenario is that the importance of renewable energy sources and of the modernisation of distribution grids will constantly increase. Legal situation in Poland, particularly that concerning renewable energy sources, definitely does not streamline the operation of businesses and obstructs their development.

The ecological awareness of Polish people will play an important role in the process of change. Individual recipients are the most "expensive" element of the power system. Savings in this segment may be translated into a greater stability of the power system and considerable savings in electricity consumption. Education resulting in better energy conservation as well as promotional and modernisation actions (for instance, installations of solar and photovoltaic panels on public utility buildings) may rise the risk of electricity prices going higher. The risk will be lower particularly when the increase will be balanced by the reduced dependency on foreign suppliers and lower environmental costs. Readiness to bear higher expenses will be translated also into a revival of electricity production from renewable sources.

One of the key factor that will determine the future of the sector is the progress in power grid and its networks convergence. The, so called, smart power grids are a priority in the EU long-term development plans. In countries where such solution has been implemented, energy consumption dropped. Benefits offered by smart measurement systems include an option to adjust tariffs on an individual basis to specific groups of recipients, reduction of energy consumption and more effective consumption due to a better adjustment of demand for energy and its supply. An additional benefit from such solution is that barriers related to the change of the operator are reduced, the quality of electricity supplied is higher and breaks in the system may be fixed faster[18]. Kraków's universities have been carrying out research on such type of grids for years, hence in the perspective of ongoing changes, their position is good.

In addition to the aforementioned benefits, the implementation of smart power grids technology may result in the development of a new electricity production sector, i.e. prosumption, already mentioned above. A better control of the electricity distribution process enables a quicker response to changes in demand for energy and streamlines transmission of generated electricity to a distribution grid. In order to enable prosuments to play a significant role in the power sector in the future, it is necessary to have the infrastructure reconstructed from the ground and to adjust regulatory provisions. Individual attachments to the power system is now of a marginal significance, but a number of strategic and sector documents indicate that individual attachments constitute one of the most important trends in the sector[19]. According to experts, the development of the segment may result in a huge revival of economic activities purported to serve thousands of small prosuments, offering them necessary tools, equipment, maintenance services as well as consultations and production optimisation. The settlement of the interests of the professional power segment and those of prosuments may be a problem in the sphere of infrastructure and legal regulations. The most recent amendment to the Energy Law obstructs the development of the prosument market. According to the Institute of Renewable Energy[20]

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17 Ministry of Economy (2009). Polityka energetyczna Polski do 2030 roku. [Energy Policy for Poland 2030]. Schedule to Resolution No. 202/2009 of the Council of Ministers of 10 November 2009.

18 DGA (2008). Analiza końcowa [Final Analysis]. Studium wykonalności instalacji elektronicznych urządzeń pomiarowych w Polsce [Feasibility Study of the Installation of Electronic Measurement Instruments in Poland]

19 Bil, J., Gąsiorowska, E., Graczyk, W., Guzik, R., Maciuk-Grochowska, A., Malec, A., Smoleń, P. (2010). Analiza trendów rozwoju branży energetycznej [Analysis of Development Trends in the Power Sector]. Polska Konfederacja Pracodawców Prywatnych Lewiatan [Leviatan, Polish Confederation of Private Employers]

20 IEO, (2013). O błędnym rozumieniu istoty działalności prosumenciej. [About a Misconception of the Core of Prosument Activities. Comments by the Institute of Renewable Energy, concerning the "prosument" amendment to the Energy Law adopted by the Senate: http://www.ieo.pl/pl/poprawka-pe.html

energy re-purchase prices adopted in the act are several times lower than the production profitability threshold. This results in prosuments being discouraged from selling electricity produced by them and from investing in the increase of production capacities.

In the context of changes in the power sector in Kraków, we cannot overlook an important factor, specific for the city, which is high condensation of dust and smog. Several steps have been undertaken in 2013 in order to solve the problem. Kraków's Smog Alert social grass-root initiative emerged and highlights the Kraków's air quality problem, lobbying for regulatory changes. Many residential houses in the city centre are not attached to the municipal central heating system. The citizens heat their apartments using coal stoves, which generate pollution and are used as a means to utilize trash and waste materials. When more citizen households are attached to the central heating system, the consumption of energy will be more effective and the emission of dust – reduced. The necessary replacement of heating installations and the extension/expansion of the municipal central heating system will result in the growth of investments into the municipal power and heat plant and stimulate the development of the sector. The programme of subsidising owners of real estates who decide to change coal-heated stoves to a more pro-ecological solution has been carried out in Kraków for years[21]. Currently, when social awareness is increasing the pace of the implementation of the programme may increase.

An important element of the power sector in the world are fundamental changes in the way of thinking about energy sources. Researches on renewable energy sources increasingly refer to biotechnology, including bacteria and micro-organisms, that may generate electricity, speed up photosynthesis or generate huge quantities of gases. These are still preliminary researches, but in the next few years prosuments may be offered yet another option of power generation. Researches on bacteria is only an illustration of many research efforts into which the world invests its resources. Research centres, both – private and public – work on alternative forms of acquiring energy[22] which considerably vary from solutions known so far. They may give rise to new challenges to be faced by the power sector and prosuments. The most important aspect of this direction of research in Kraków is the presence of the biotechnological sector in the city. Convergence of biotechnology and the power sector may occur a promising niche for Kraków and the region.

One of the most important trends related to the activities of the sector is the subordination of energy-oriented thinking to thinking in terms of environmental protection. It is a result of the increase of citizen's awareness of the exhaustiveness of mineral fuels and observed effects of the emission of the mineral fuel combustion products to air at a greater scale. The range of ecological disasters is no longer the question of an individual opinion. The issue has become a subject of public economic debate. An increasing ecological public awareness has been observed in Western Europe and the USA since the 60s of the 19th century and the same phenomenon is currently observed in Poland.

## PESTER AND SWOT ANALYSES

PESTER, i.e. the analysis of the external environment (political and legal, economic, socio-cultural, technological, environmental and regulatory environments).

a) Political and legal environment

The power sector is subject to many regulations and it is very susceptible to political decisions. Market mechanisms as such cannot handle the external effects of electricity production, i.e. air and water pollution. If the legal regime of laws regulating energy market is weakened or the

[21] http://www.krakow.pl/get_html.php?dok_id=4870

[22] Hylton, W. (2012). Craig Venter's Bugs Might Save the World. http://www.nytimes.com/2012/06/03/magazine/craig-venters-bugs-might-save-the-world.html?pagewanted=all&_r=0

political will to implement changes into the power sector is changed, the sector will move away from renewable energy sources. The political crisis in the European Union might result in such changes that would make incentives for expensive modernisation less attractive. On the other hand, if the current trend is upheld and the political will is not weakened, the power sector awaits fundamental changes in almost each area of its activity.

What is also noteworthy in the political and legal area, is that there is a strong lobby associated with mineral fuels that slows down the implementation of pro-ecological solutions. It is in the interest of Polish coal companies and/or natural gas suppliers that the energy mix is put forward and that the application of technologies based on renewable energy sources is slow.

b) Economic environment

Economic environment has a strong influence on the activity of the power sector. As the economic situation improves, demand for power and investments in the generation of electricity grow. On the other hand, when the economic situation worsens, the sector sees considerable drops. The prolonging economic crises may result in the outflow of technical specialists and managers and the decrease of public investments which – otherwise – constitute sector development basis.

c) Socio-cultural environment

The present sector development direction is most strongly threatened by the decrease of public ecological awareness and the rise of anti-ecological sentiments. This is not a likely scenario, but same symptoms of ignoring ecological threats are visible. The raise of such sentiments could challenge reasons for additional investments into pro-ecological projects. If the present trend related to the increasing importance of ecological values continues, it may result in the drop of demand for electricity from households and subsequently – lift some burden from power grids. Consumer's increasing awareness may also have a positive impact on the development of the prosumer market.

d) Technical environment

The power sector is considerably dependent on the development of production, storing and transmission methods. The introduction of an inexpensive and reliable methods for energy generation may result in a decentralisation and subsequently decrease the exploitation of power grids. A similar effect may have innovations in the effective energy storing technologies. The development of lossless electricity transmission methods may cause that the diversification trend is reversed and electricity production will be again concentrated in huge power plants.

The increase of the effectiveness of technologies for electricity storing and the drop of prices of such technologies will stimulate the decentralisation of electricity production and more individual households will detach from power grids.

An inexpensive and highly effective method for catching and storing carbon dioxide which may reduce negative ecological impact of coal-based electricity production, may also have a breaking point effect.

e) Natural environment

The power sector is highly susceptible to climatic changes. Abrupt weather changes, strong winds and icing of wires result in damages of power grids. This fact may stimulate the development of the prosument market. Environmental pollution, being a side effect of coal-based electricity generation may weaken political resistance against abandoning such source of energy and acceptance of renewable energy sources.

On the other hand, the same abrupt weather changes may result in damage in household solar and wind installations resulting in the increase of costs related to the maintenance of such installations and – eventually – decrease the demand for such solutions.

f) Regulatory environment

The pro-development policy of the European Union puts forward a target being the increased competitiveness of all markets of goods. Power market is one of the strategic markets, where prise competition is secondary to stability of supplies, reduction of transmission losses and environmental issues many times mentioned above. The power market is highly regulated and national governments play an important role in it. As the dependence on external sources will decrease and the effectiveness of renewable energy sources increase, the level of regulation should also decrease. A deregulation process will result in higher competition on the energy market.

Changes in the system of subsidies for pro-ecological solutions (solar panels, replacement of coal heated stoves), which are offered within the framework of municipal programmes and by the National Environmental and Water Management Fund may have a substantial impact on organisations operating in the sector. More favourable criteria for granting subsidies and the increase of subsidy funds may result in quick adoption of such solutions and revive the market of renewable energy sources.

SWOT analysis is a summary of strengths and weaknesses of the sector and as well as opportunities and threats in the surrounding environment.

Strengths of the power sector in the region:

- Recognisable technical universities
- Research on smart power grids
- Research on technologies for generating energy from solar radiation and on clean coal technologies.
- Pilot projects for testing the usability of innovative solutions.
- Political support for sector development

Weaknesses of the power sector in the region:

- Weak co-operation between universities and smallest businesses.
- To few innovative enterprises.

Opportunities of the power sector in the region:

- Practical application of solutions developed at universities.
- Development of pro-prosumer solutions.

Threats to the power sector in the region:

- Shortage of investment capital
- Competition struggle with other regions for funds and personnel.

To sum up, the power sector in Kraków is characteristic of high concentration of the professional power sector organisation, a huge dispersion of installation businesses and services offered to electricity consumers. Kraków and the Małopolska Region do not play an important role on the national scene of the power sector because of a considerable lack of mineral fuel beds and unfavourable conditions for generating energy from renewable sources. The advantage of

Kraków is its significant scientific potential. The core of research in the area of electric power in Kraków is constituted by research on smart power grids which open a communication channel from the recipient to the distributor of electricity and enable a lower power consumption level along with the development of the prosumer sector. The sector in Kraków will follow paths determined by international decisions concerning environmental protection and power supply safety, but it is hard to believe that the present trend for the increase of the importance of renewable energy sources could be reversed.

# DEMAND ANALYSIS
# SECTOR DEMAND FOR COMPETENCES

An overview of findings as regards the demand for competences in the sector begins with a presentation of a list of jobs/positions that are most frequently offered in recruitment processes in the sector. An important remark relates to various recruitment strategies elected by companies. On the market there are companies that employ graduates directly at independent positions, which makes the sector similar to that of passive and low-energy building. There are also companies in which such policy is unreal and recruitment procedures refer to support positions at which promotion is offered after 2 – 3 years, when the employee gains required experience.

| **List of jobs most often offered to graduates in the power sector** |
|---|
| Designer engineer, junior designer engineer, assistant to designer engineer |
| Engineer of sales, commercial engineer, salesman |
| Designer, designer assistant, designer of renewable energy sources |
| Construction engineer, assistant to construction engineer |
| Wireman, assembler |
| Technical counsel, technician, technologist |
| Technical and commercial counsel |
| Sales manager |
| Public procurement specialist |
| Specialist for UE projects |
| Marketer |
| Power engineer |
| Automation engineer |
| Plumber |
| Project manager |
| Specialist for operations |
| Project engineer |
| Geophysics engineer |
| Operator of geophysical equipment |
| Estimator |
| Service person |
| Accountant |

Table 1 List of jobs offered to graduates in the power sector.

Employment plans for 2014 and 2019 do not seem very optimistic. While the companies intend to employ graduates in 2014 in a number equal to their 6% labour force (which is to same degree a result of development plans or retirement plans of currently employed personnel), then the five-year perspective is covered by absolute uncertainty. A few surveyed companies declared that they might plan employment of graduates in years to come. This does not mean, of course, that no recruitment procedures will be carried out, but employers are very conservative as to provide any prognosis for the future. Dynamics of the employment of graduates is as follows

| Employment of graduates in 2014 | Employment of graduates in 2019 |
|---|---|
| **5.7%** | **1.2%** |
| Decrease in dynamics of employment of graduates | |

Table 2 Dynamics of employment in the power sector

* graduates to be employed in 2014 and in 2019 as a percentage of current employment level (accounting for all legal forms of employment)

90% of the employees of companies that participated in the research are employed under contracts of employment, and 10% - under civil-law contracts (Fig. 2).

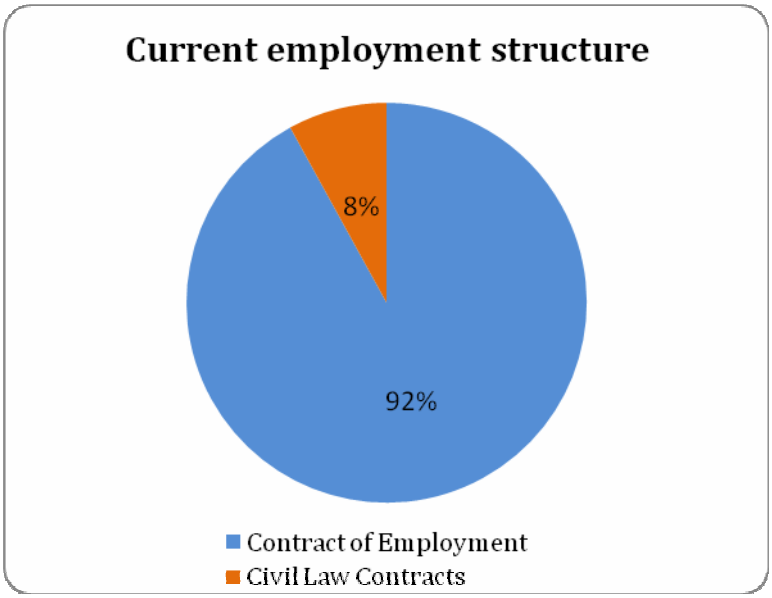


Fig. 2. Structure of employment in the power sector by contract type

A reverse situation is observed in the case of planned employment among graduates. In 2014, as much as 2/3rds of all graduates will be employed under civil law contracts (Fig. 3). It should be emphasised that these are mere estimates rather than plans, which is a result of uncertainty as to the situation of the sector in the future.

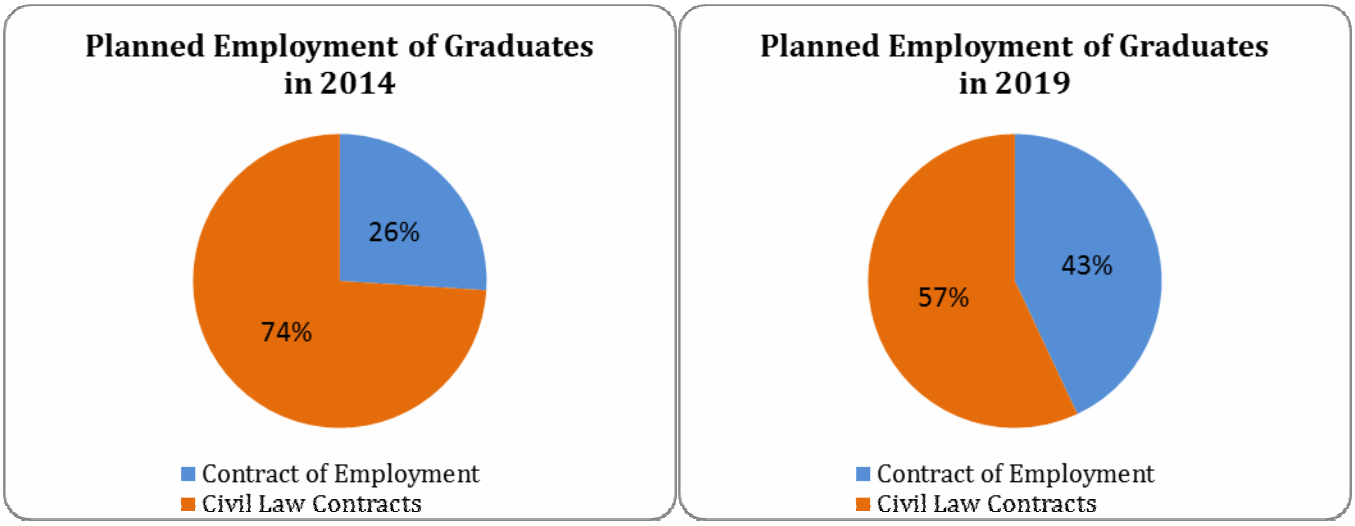


Fig. 3. Structure of planned employment of university graduates in the power sector by contract type in 2014 and 2019.

## THE COMPETENCES OF TODAY AND THE COMPETENCES OF TOMORROW

Before we present results of research works related the importance of given competences for the power sector, it is necessary to make certain reservations.

The competences were identified on the basis of the interviews with opinion leaders, companies and the analysis of job offers. For better clarity of the report, the competences were broken down into 5 groups: specialist (professional) knowledge, specialist (professional) skills, business knowledge and skills, soft skills, foreign languages and other requirements. **As extensive as the list of competences is, it is not necessarily exhaustive.** Of course, there are many companies that operate on the market and that need other competences – often very specific or exceptional.

Within the framework of preparatory works, we attempted to set all sought competences at the same level of generality. Not always was it possible or desirable, though. That is why **competences will vary as to their level of precision**.

The companies participating in the survey replied to questions related to the importance of each competence today and in the future. Although the sector is generally homogeneous, there are naturally considerable differences in the importance of competences, depending on the profile of activities and specialisation of the entity. **We adopted a sector perspective where the point of reference is the whole graduates labour market.** While interpreting the results, the following should be taken into consideration. For instance, the impotence of geophysical knowledge has been given low position. This does not mean that there are not companies, for which this competence is of key importance. However, from the total number of graduates to be employed in the future, the weight of this competence is respectively lower.

Presented **data reflect opinions of persons who are responsible for human resources policies or the management of companies operating in the sector. Hence, the said data have not a prescriptive nature.** In other words, we present the views of persons who manage companies, and we refrain from judging whether such views are correct, or not, and whether strategies based on these views are good.

Table 3 contains a list of 20 most important competences (requirements) in 2014 and 2019 estimates. The most important – from the perspective of the labour market in the power sector – are the following competences: **operation of 3D designing applications, operation of office packet software, driving licence, coping with stress and English language**[23]**.** The five competences that will become the most important in more distant future are: **operation of 3D designing applications, learning, knowledge about investment financing, knowledge about public procurements and effective power management**. It is also noteworthy that the importance of the following competences is increasing, namely: **innovation, energy audit calculations.** The profile list of the most important competences in the sector clearly indicates that field work is a necessary component of work and that the surveyed companies are strongly focused on trade and sales. On the other hand the increase of such competences as: **innovation, new trends or holistic perspective** imply that the sector in Kraków may develop into another direction in the future.

| 20 most important competences (requirements) today | Importance in 2014 |
|---|---|
| Operation of 3D designing applications | 4.88 |
| Ability to use MS Office, Open Office or Google Docs applications | 4.82 |
| Driving license | 4.80 |

| 20 most important competences (requirements) today | Importance in 2019 |
|---|---|
| Operation of 3D designing applications | 4.88 |
| Learning | 4.78 |
| Investment financing | 4.71 |

[23] Precise definitions of these and other skills are provided in the Glossary in Appendix No.1.

| 20 most important competences (requirements) today | Importance in 2014 |
|---|---|
| Coping with stress | 4.70 |
| English | 4.67 |
| Integrity | 4.67 |
| Investment management | 4.60 |
| Oral communication | 4.60 |
| Learning | 4.60 |
| General technical knowledge | 4.58 |
| Technical English | 4.58 |
| Law and legal regulations | 4.56 |
| Customer-focused | 4.56 |
| Commitment | 4.56 |
| Analytical skills | 4.56 |
| Focus on development | 4.55 |
| Effective power management | 4.50 |
| Designing of power installations | 4.50 |
| Being concerned about quality | 4.50 |
| Knowledge about the sector | 4.44 |

| 20 most important competences (requirements) today | Importance in 2019 |
|---|---|
| Public procurement | 4.71 |
| Effective power management | 4.70 |
| English | 4.67 |
| Ability to use MS Office, Open Office or Google Docs applications | 4.64 |
| Innovation | 4.60 |
| Holistic perspective | 4.60 |
| Integrity | 4.57 |
| Coping with stress | 4.56 |
| Law and legal regulations | 4.56 |
| Customer-focused | 4.56 |
| Knowledge about the sector | 4.56 |
| New trends | 4.56 |
| Commitment | 4.50 |
| Focus on development | 4.50 |
| Project management | 4.50 |
| Business offers | 4.50 |
| Energy audit calculations | 4.50 |

Table 3 Competences of today (perceived as important in 2014) and competences of tomorrow (perceived as important in 2019). Orange fields denote competences that within five years will no longer be included in top 20. Green fields denote competences which within five years will enter top 20.

## GROUPS OF COMPETENCES

The charts below present detailed results concerning the importance of competences in individual groups discussed in the report (specialist knowledge, specialist skills, business knowledge and skills, languages and other requirements), in a comparison of the present situation with that in 5-year perspective.

In the case of specialist knowledge, the importance of individual competences in the coming years should remain more or less the same (Fig. 4). **General technical and engineering knowledge, knowledge about effective power management and automation of installations** will continue to be most important. The importance **of knowledge about renewable energy source installations, electronics and electrical engineering, heating installations as well as air-conditioning and ventilation installations** will somewhat increase**.**

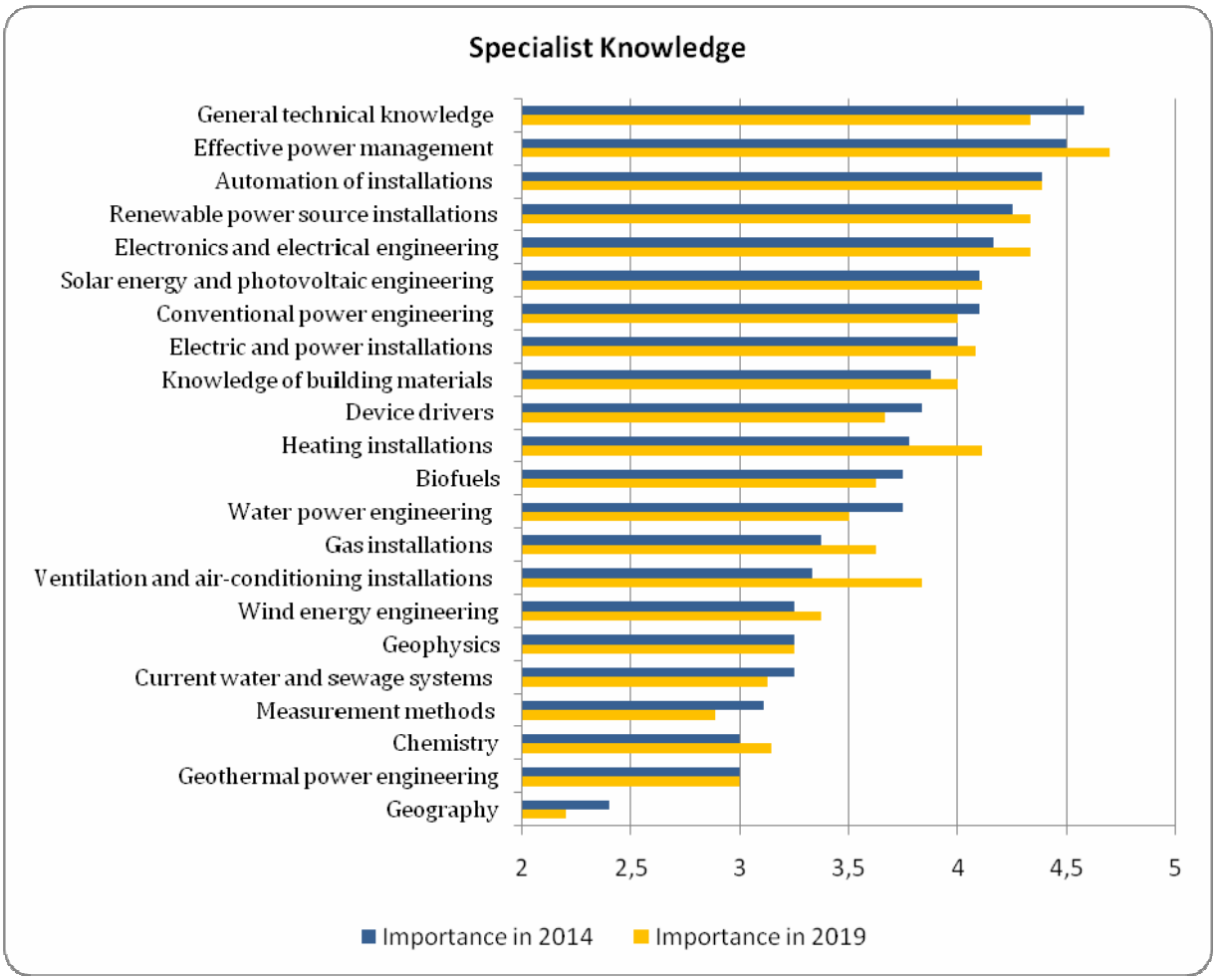

Fig. 4. Expected importance of individual competences in the area of "Specialist Knowledge" as perceived by employers in 2014 and 2019.

As regard specialist skills the most important is and in the next years will be the **operation of 3D designing software**. The importance of the **operation of simulating engineering applications and energy audit calculations** will considerably increase. (Fig 5.)

In the group of business knowledge and skills the importance **public procurement and investment financing** will considerably increase. The following competences will continue to be important: **investment management, knowledge about laws and legal regulations, new trends and knowledge about the activities of the sector** (Fig. 6).

As regards soft skills (Fig. 7) noteworthy is that the increase of **learning and innovation** considerable increases. The phenomenon is most likely related to the uncertainty affecting sector development directions in the future, when the aforementioned competences increase chances of adaptation to new conditions. In the language group, the most important is **the English language and the technical English language**. In the future, the importance of other languages (except for Italian) will also increase (Fig. 8).

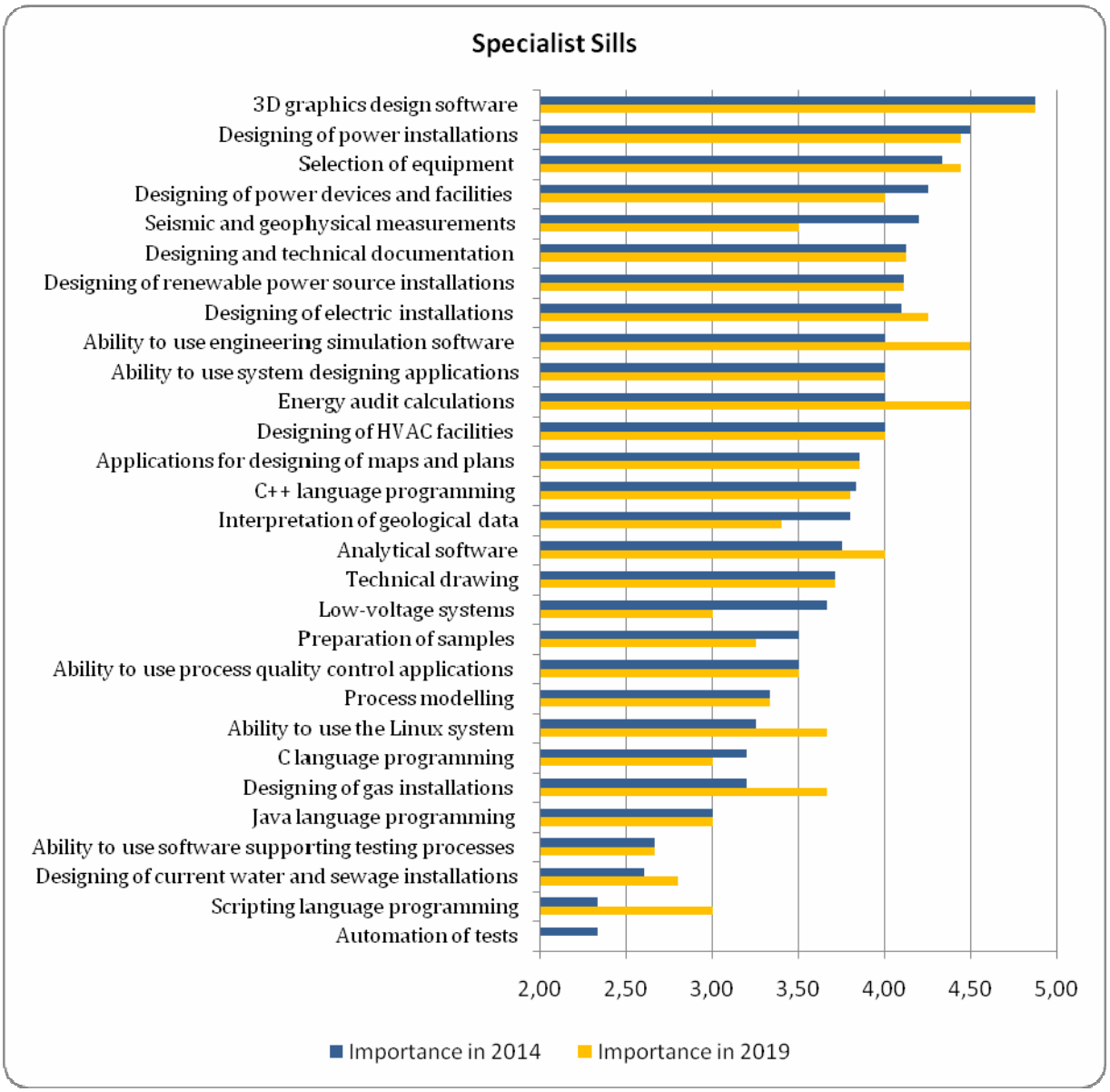

Fig. 5. Expected importance of individual competences in the area of "Specialist Sills" as perceived by employers in 2014 and 2019.

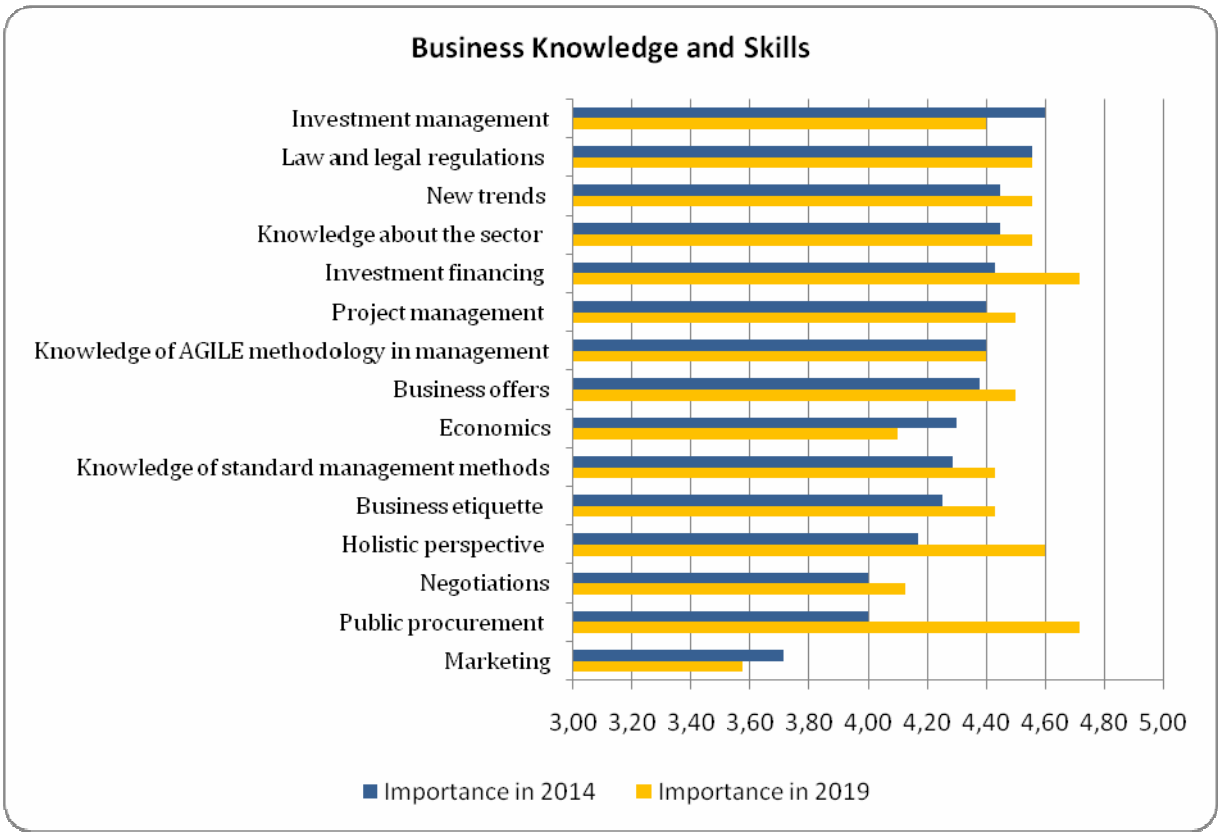


Fig. 6. Expected importance of individual competences in the area of "Business knowledge and skills" as perceived by employers in 2014 and 2019.

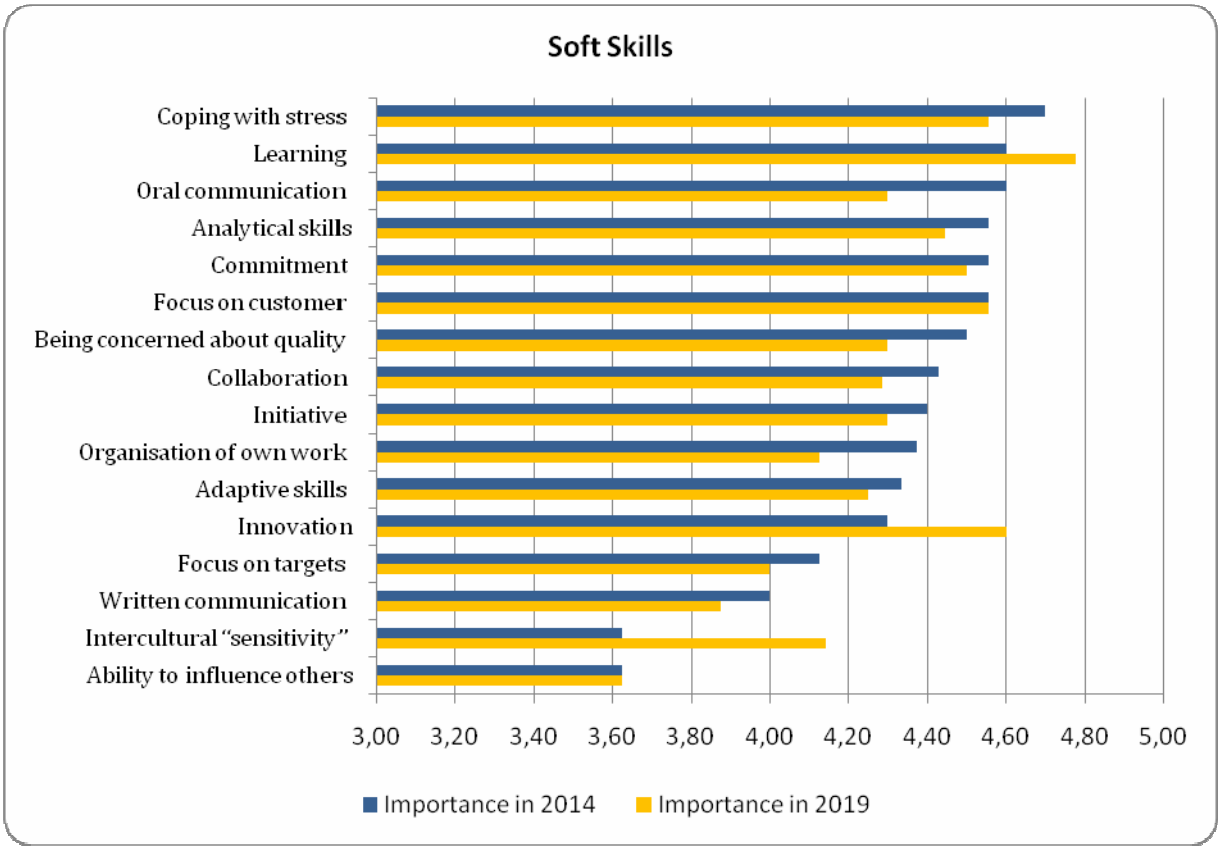


Fig. 7. Expected importance of individual competences in the area of "Soft skills" as perceived by employers in 2014 and 2019.

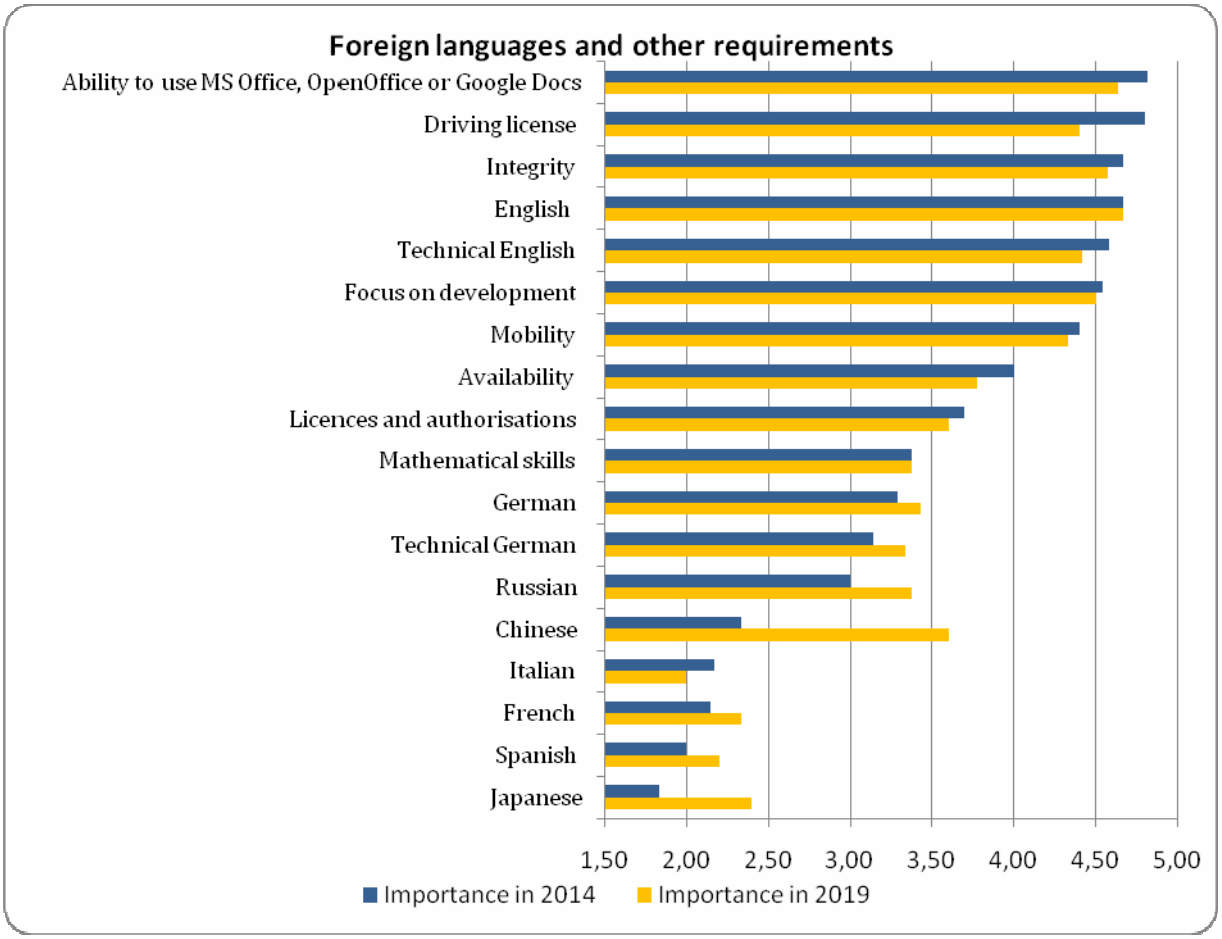


Fig. 8. Expected importance of individual competences in the area of "Foreign languages and other requirements" as perceived by employers in 2014 and 2019.

We asked employers to indicate competences which are of key importance in the context of professional promotion. The list of these competences is presented in table below.

| **List of competences / requirements of key importance in the context of promotion at work** |
|---|
| Self-reliance |
| Group work |
| Organisation of work, organisation talents |
| Quick learning, learning |
| Professional competences |
| Creativity |
| Initiative |
| Post-graduate study certificate |
| Experience |
| Pro-creativity |
| Foreign of foreign languages |
| IT competences |
| Reliability |
| Commitment |
| Coping with difficult situations |
| Effectiveness at work, performance of targets assigned to the position |
| Good manners, |
| Analytical abilities |
| Focus on targets and tasks |
| Individual professional development |

| List of competences / requirements of key importance in the context of promotion at work |
|---|
| Innovation of research works conducted, scientific development |

Table 4 List of competences of key importance for graduates in the context of promotion at work

The competences mentioned in the context of promotion of an employee are soft skills and the desired approach. This information is important because it indicates the role of the aforementioned characteristics for the career development of graduates.

## SECTOR CORE COMPETENCES

One of the most important indicator of the perception of the education market from the employers' point of view is the juxtaposition of the importance of certain competences with the difficulty in acquiring them. Data in Table 5 show that amongst 20 most important competences there are those that are easily acquired (marked in green colour) as well as those that are difficult to acquire (marked in red colour). Following this line of thinking, competences that from the demand and supply point of view may be considered to be core competences are those that the representatives of the sector consider important and hard to acquire like a painfully missing and particularly hardly-available good. Therefore, on the basis of Table 5, one may find that the core competences are as follows: **effective power management, oral communication, investment management, concern about quality and sector knowledge**. It is noticeable that employers do not report considerable difficulties in acquiring core competences from the market.

| 20 most important competences (requirements) today | Importance | Difficulties in acquiring |
|---|---|---|
| Ability to use 3D designing applications | 4.88 | 3.38 |
| Ability to use MS Office, Open Office or Google Docs applications | 4.82 | 2.18 |
| Driving license | 4.80 | 2.25 |
| Coping with stress | 4.70 | 3.44 |
| English | 4.67 | 2.91 |
| Integrity | 4.67 | 3.50 |
| Investment management | 4.60 | 3.80 |
| Oral communication | 4.60 | 3.89 |
| Learning | 4.60 | 3.44 |
| General technical knowledge | 4.58 | 3.18 |
| Technical English | 4.58 | 3.50 |
| Law and legal regulations | 4.56 | 3.56 |
| Customer-focused | 4.56 | 3.50 |
| Commitment | 4.56 | 3.57 |
| Analytical skills | 4.56 | 3.22 |
| Focus on development | 4.55 | 3.30 |
| Effective power management | 4.50 | 4.20 |
| Designing of power installations | 4.50 | 3.38 |
| Being concerned about quality | 4.50 | 3.70 |
| Knowledge about the sector | 4.44 | 3.78 |

Table 5 20 most important competences in the power sector and difficulties in acquiring them Competences that are most easily available on the market were marked with the green background of the field, whilst those that are most difficult to acquire – with the red one.

We present below diagrams that show the importance and difficulties in acquiring each competence in 5 major groups (specialist knowledge, specialist skills, business knowledge and skills, soft skills, foreign languages and other requirements).

Out of the most important competences in the group of specialist knowledge (Fig. 9), the most difficult to acquire are competences related **to the knowledge about effective power management, solar energy and photovoltaic technologies as well as renewable energy source installations**. Competences less important from the point of view of the whole sector, but likely to be important for selected businesses, the most difficult to acquire are: **knowledge about water energy and wind energy engineering, as well as biofuels and geography**.

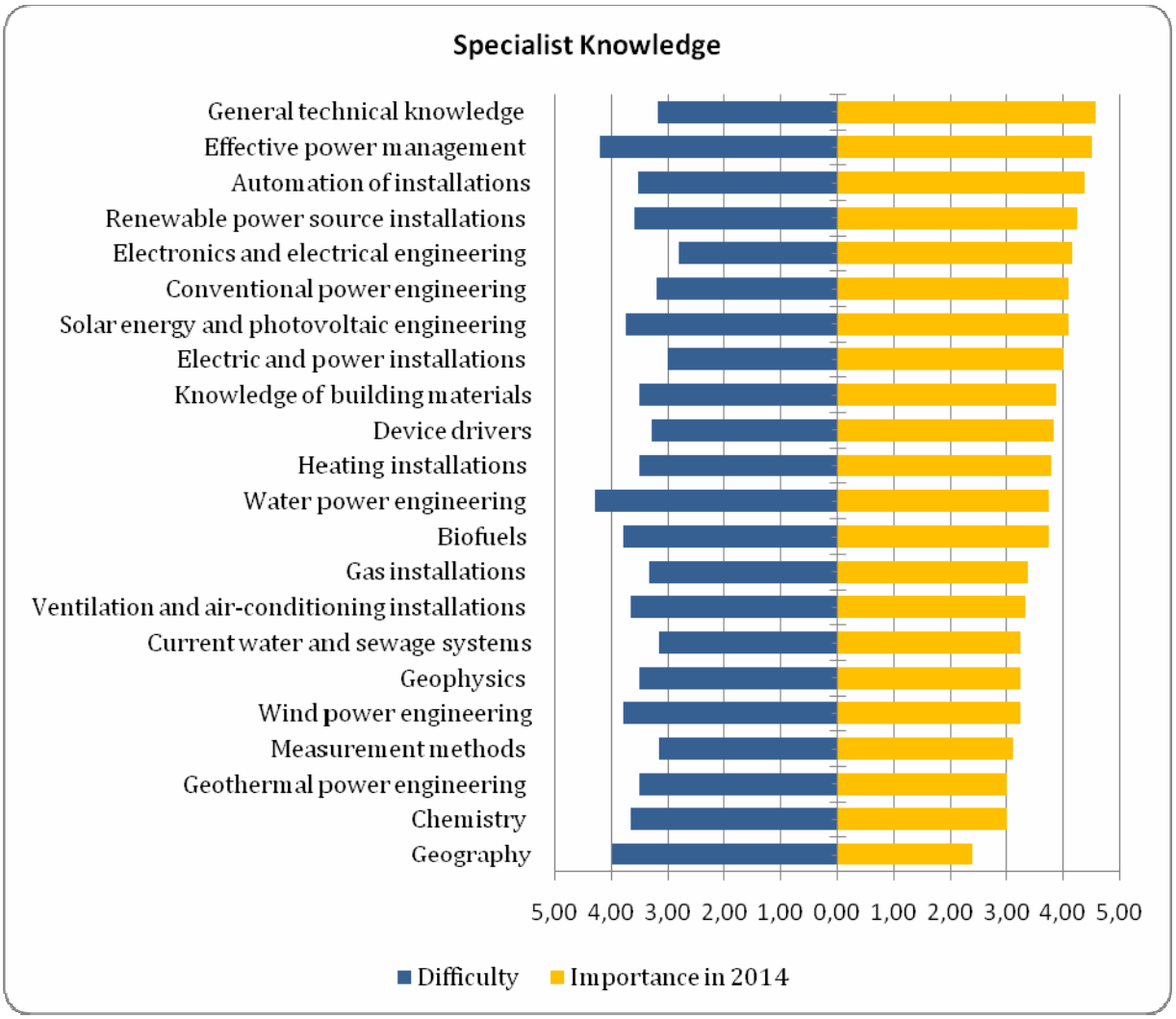


Fig. 9. Importance of and difficulty in acquiring individual competences in the area of "Specialist knowledge" as perceived by employers.

As regards specialist skills (Fig. 10), the most important competences are relatively easy to acquire (e.g. **operation of 3D designing software, designing of electric installations**). The most difficult specialist skills to acquire are, according to employers: **designing of HVAC installations, operation of simulating engineering software, analytical software and quality control software as well as geological data interpretation.**

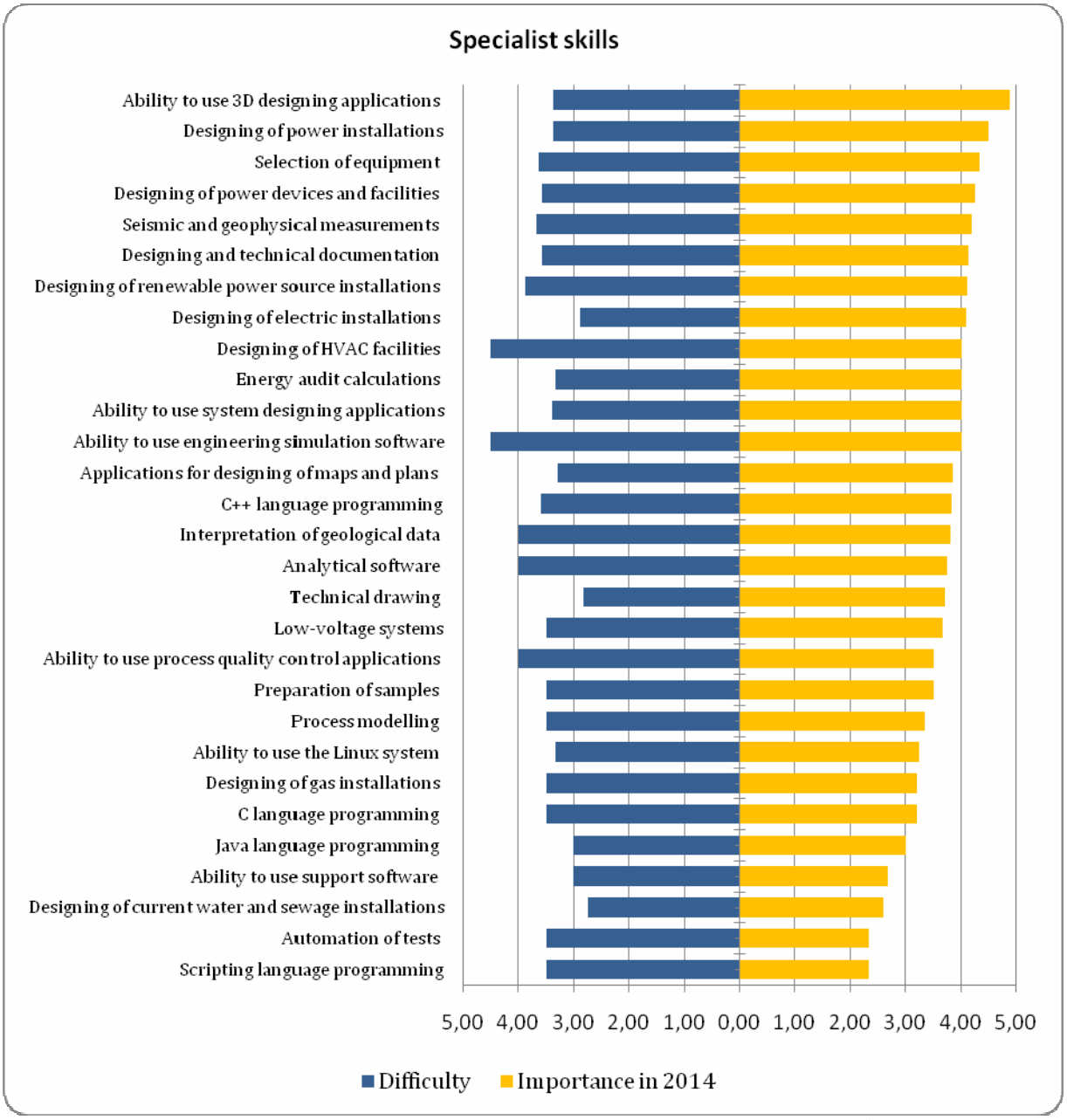

Fig. 10. Importance of and difficulty in acquiring individual competences in the area of "Specialist skills" as perceived by employers.

Competences from the group of business knowledge and skills that graduates are said to be missing are: **investment management, Knowledge of standard investment management methods and AGILE methodology.** Difficult to acquire are also **knowledge about sector and knowledge of newest trends as well as investment management** (Fig. 11)

Out of soft skills the most difficult to acquire **are initiative, innovation and oral communication** (Fig. 12).

AS regard other requirements (Fig. 13), the employers emphasises that the situation related to the command of the **English language** has been improving. One of the requirements scored amongst the most important requirements **is integrity**, a characteristics that is relatively easily acquired on the labour market. The competences most difficult to acquire (which is quite understandable) are competences related to less popular languages.

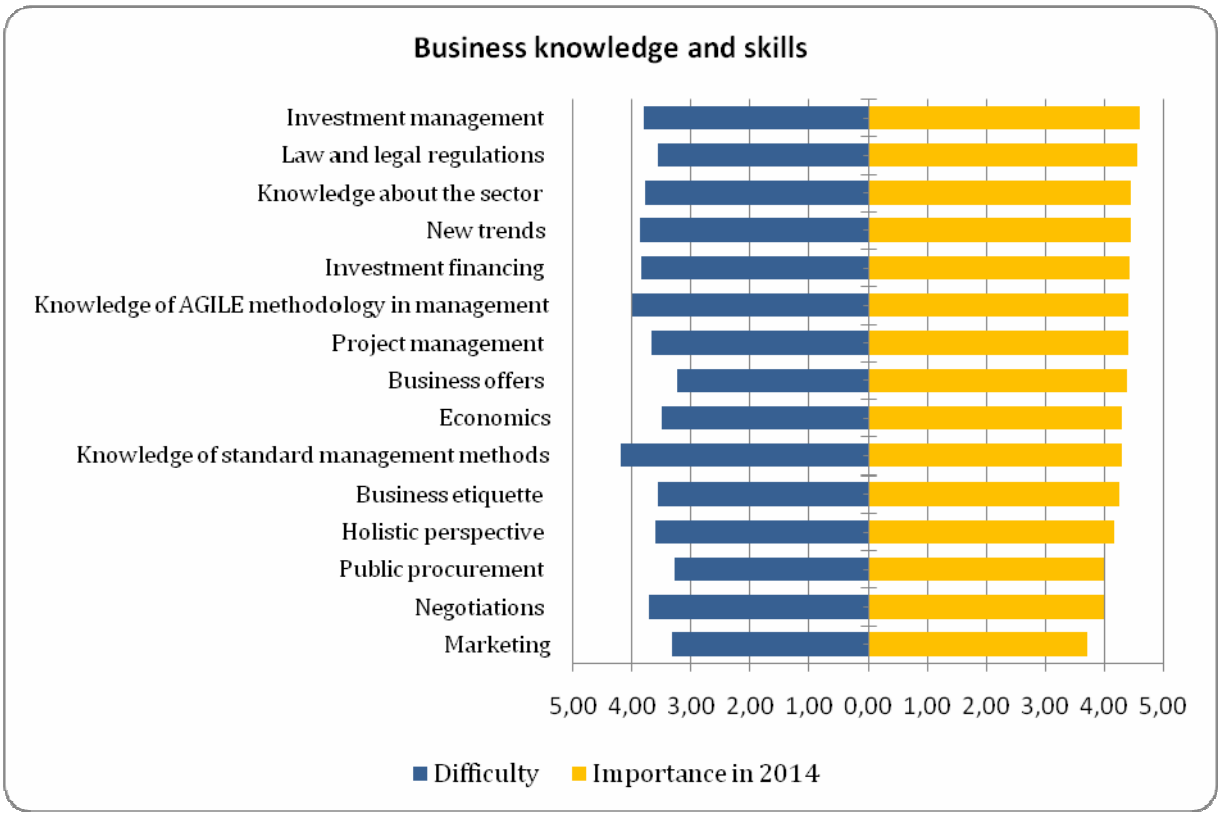


Fig. 11. Importance of and difficulty in acquiring individual competences in the area of "Business knowledge and skills" as perceived by employers.

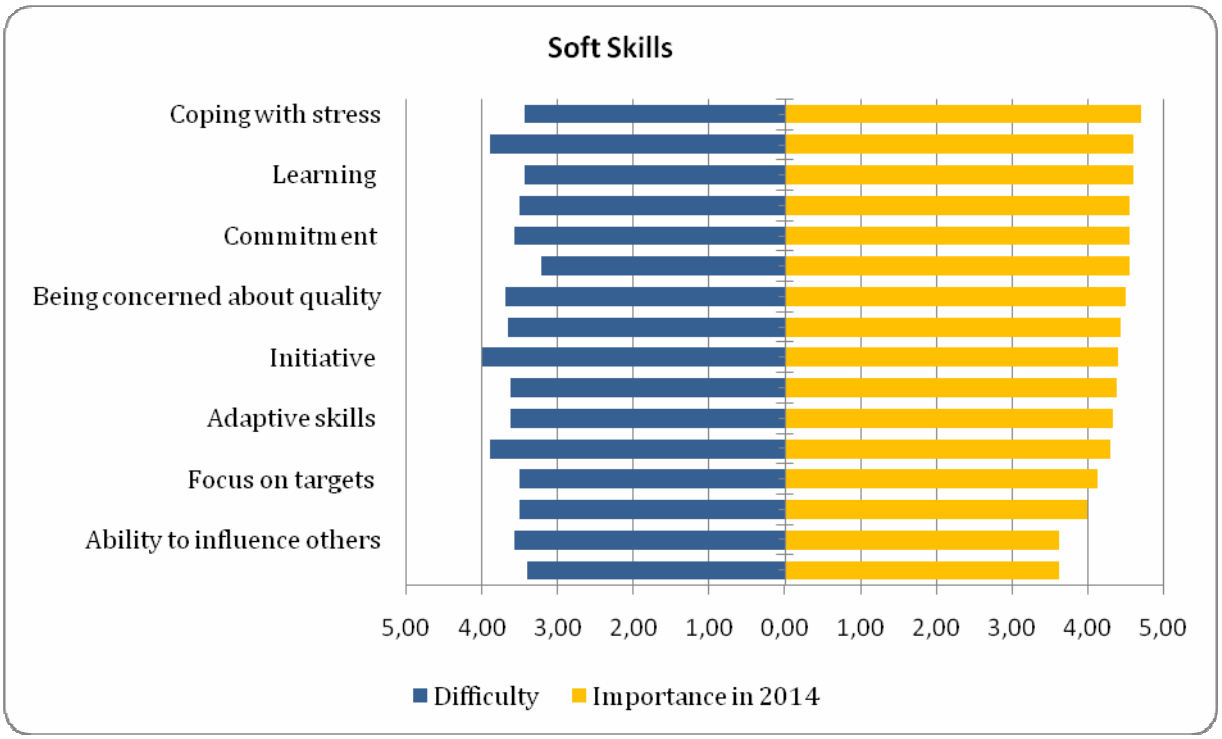


Fig. 12. Importance of and difficulty in acquiring individual competences in the area of "Soft skills" as perceived by employers.

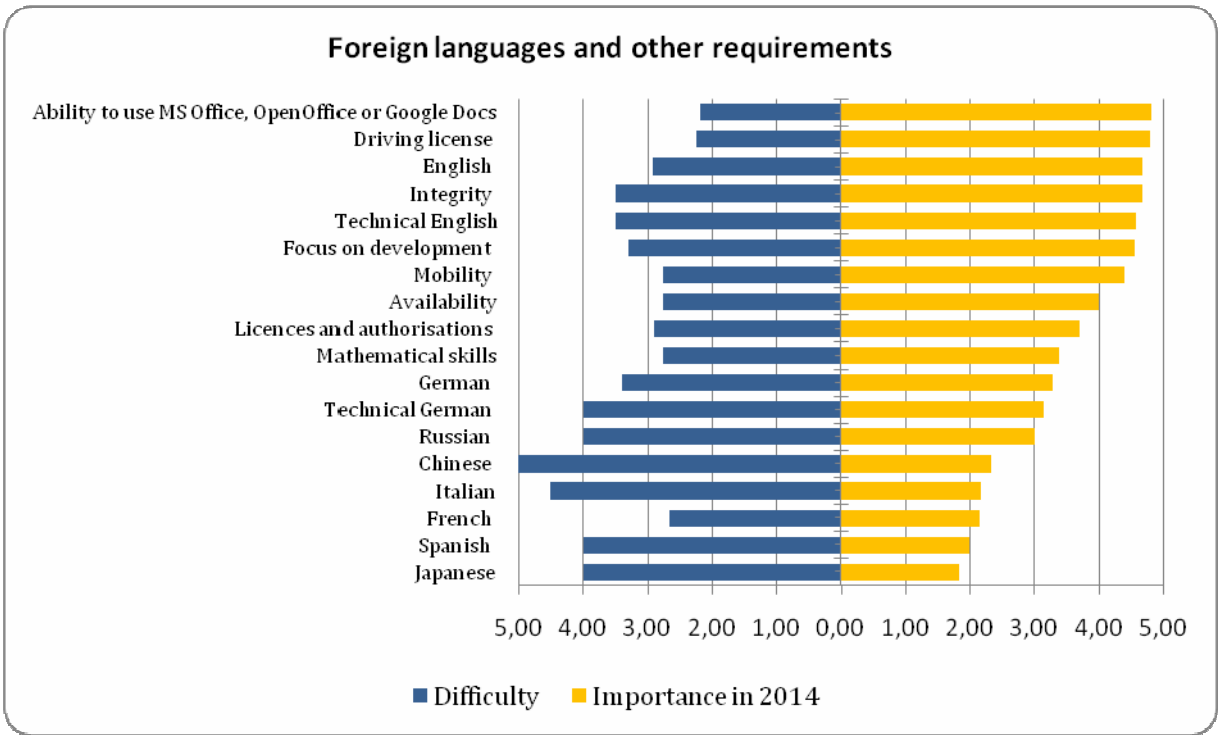

Fig. 13. Importance of and difficulty in acquiring individual competences in the area of "Foreign languages and other requirements" as perceived by employers.

In replies concerning additional competences not included in the list, there were only thee competences mentioned**: motivation, licences in the heat energy engineering and AutoCAD**, which indicates that the original list of competences has an exhaustive nature.

## SUPPLY ANALYSIS
## EDUCATIONAL RESULTS IMPORTANT FOR THE SECTOR

The analysis of educational results achieved in fields of study related to the sector has a complex nature. Educational results, ex definition, relate to an average student, which means that amongst the graduates are those with a much higher level of professional preparation, as well those with a level of professional preparation being lower than average.

According to the representatives of universities, the number of students attending university courses related to the power sector in the next years will considerably decrease (averagely by 20%). The reduction will affect studies offered in a system other than the full-course study, as the other forms of studies became unprofitable for universities because teaching activities generate a considerable load. This fact does not necessarily mean that the availability of competences required by the market will also drop. The decrease of the number of students may result in the increase of the education quality, eventually resulting in the increase of the availability of competences which are important for the sector.

The table below presents the titles of university courses that were indicated by the representatives of the companies as those whose profiles best fit the expectations of businesses.

| Fields/specialisations/profiles of study[24] most often mentioned by sector companies as best meeting their expectations |
|---|
| Electrical technology |
| Automation and robotics |
| Power engineering, heat engineering |
| Hating and air-conditioning systems |
| Geophysics |
| Geology |
| Electronics |
| Mathematics and physics |
| Drilling engineering |
| Heat and sanitary equipment engineering |
| Chemical technology |
| Ceramics |
| Electrical engineering |
| Mechanics and robotics |
| Renewable energy sources engineering |
| Industrial control systems |
| Environmental engineering |
| Building and Construction |

Table 6 List of courses, specialisations, and profiles of study most often mentioned by employers as teaching students in areas needed in the power sector.

Educational results obtained in each of the five competence groups will be presented in a number of diagrams below. Data presented in them are not the averaged replies as it was the case of the demand for competences, but a percent of fields of study in which the educational result is obtained at least at the average level. Such approach corresponds to the fact that, except a number of post-graduate studies and very few specialist fields of study, only rarely are competences most important for the sector being taught at a given field of study. On the other hand, there are educational results that for a given sector are rather irrelevant. (This is likely to be a source of unfair judgments often made by business people that graduates possess a lot of useless knowledge as the knowledge they refer to may be useful in other sectors). Should we use means or weighted means, the result would be artificially lowered and would not present the full image of the supply of competences.

The following educational results related to the sector are most often achieved as a result of teaching within the framework of researched curricula of fields of study: **General technical and engineering knowledge, knowledge about effective power management, conventional power engineering, electronic and electrical engineering.** The following areas are most rarely included into the curriculum of study: **geophysics, measurement methods** as well as **gas installations, current water and sewage systems and geography** (Fig. 14).

[24] The original names given by entrepreneurs are preserved; individual categories do not always constitute a separate area. Results supplemented by desk research analysis.

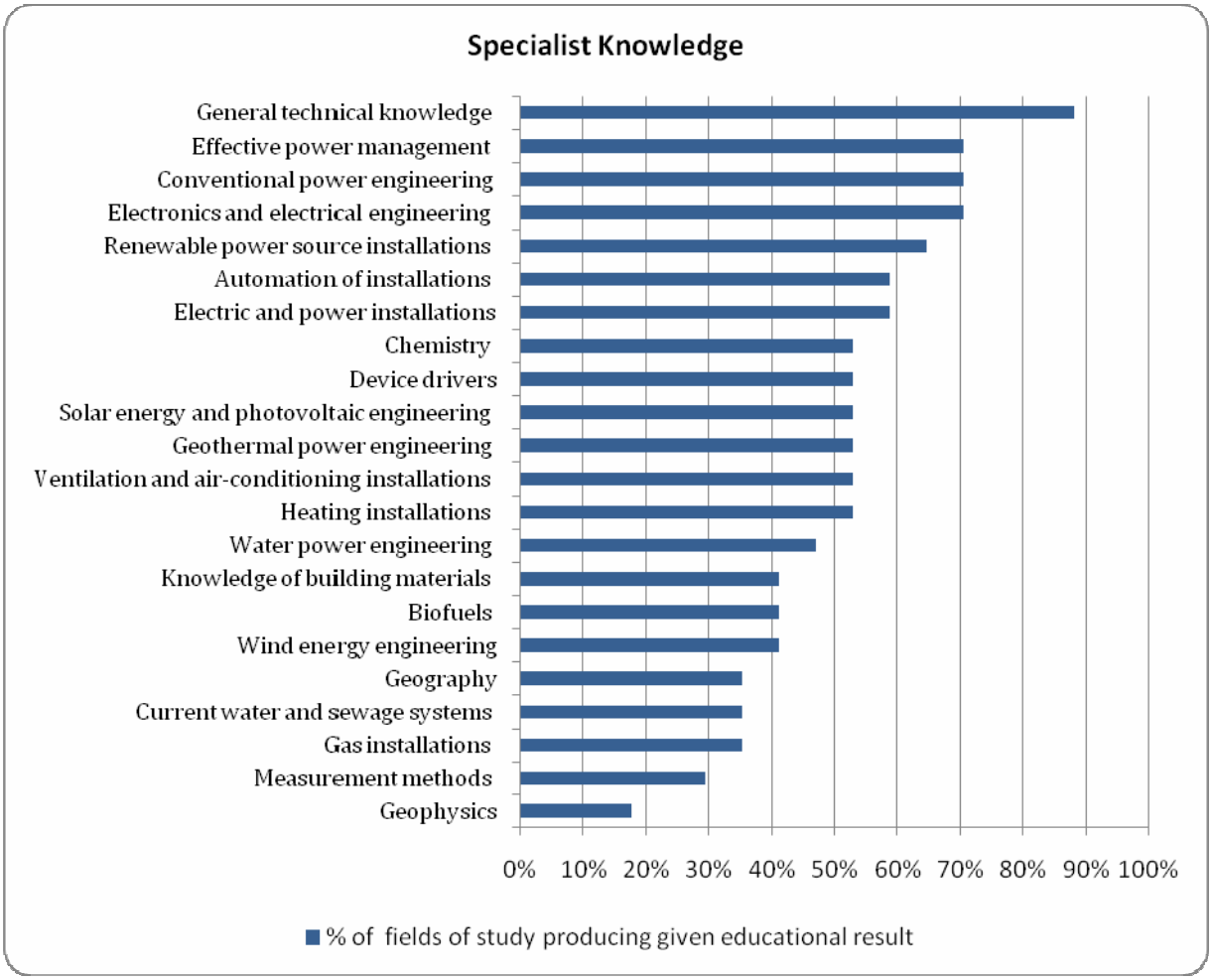

Fig. 14. Percentage of courses and specialisations producing at least medium level educational results in the area of "Specialist Knowledge" (universities' perspective).

As regards educational results in the area of specialist skills (Fig. 15), they are generally less frequently achieved by universities than those related to specialist knowledge. The following skills are taught at ca 3/4 of the courses**: technical drawing, operation of 3D designing software, developing of project documentation and selection of equipment**. Educational results related to **operation of software supporting testing processes and testing automation skills and ability to automate testing processes** are achieved at the smallest number of courses are.

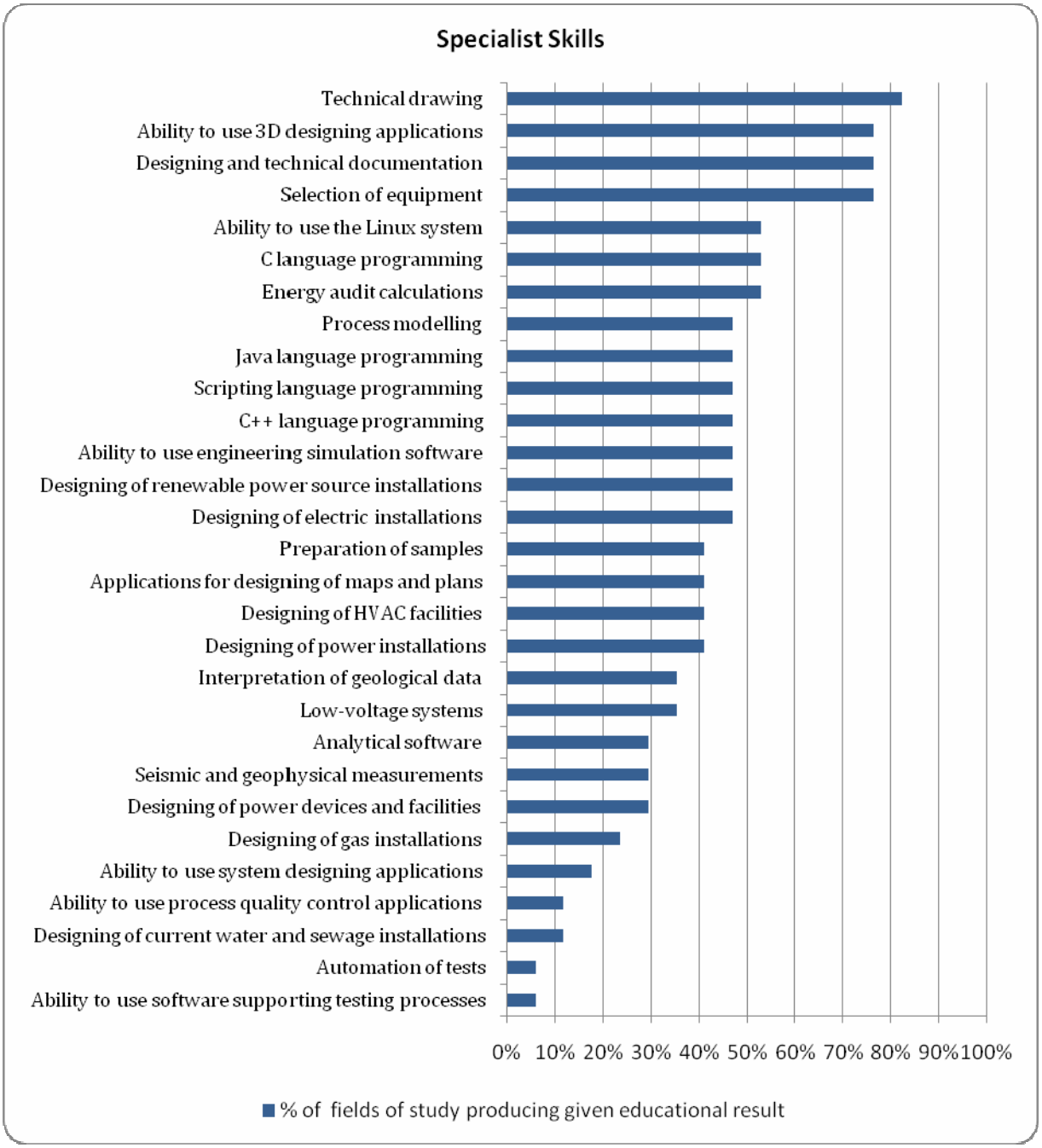

Fig. 15. Percentage of courses and specialisations producing at least medium level educational results in the area of "Specialist Skills" (universities' perspective).

As regards business knowledge and skills (Fig.16) the image is strongly diversified. On the one hand, students of most fields of study achieve knowledge related **to newest trends, law and regulations, economics of investments and general knowledge about the sector**. On the other hand, very few students are taught **knowledge and skills related to investment management and public procurement.**

As regard soft skills (Fig. 17) in most cases soft skills are acquired at least at a medium level at half of the fields of study. The skills related to **learning, innovation and focus on targets** (or target orientation) are acquired at most fields of study.

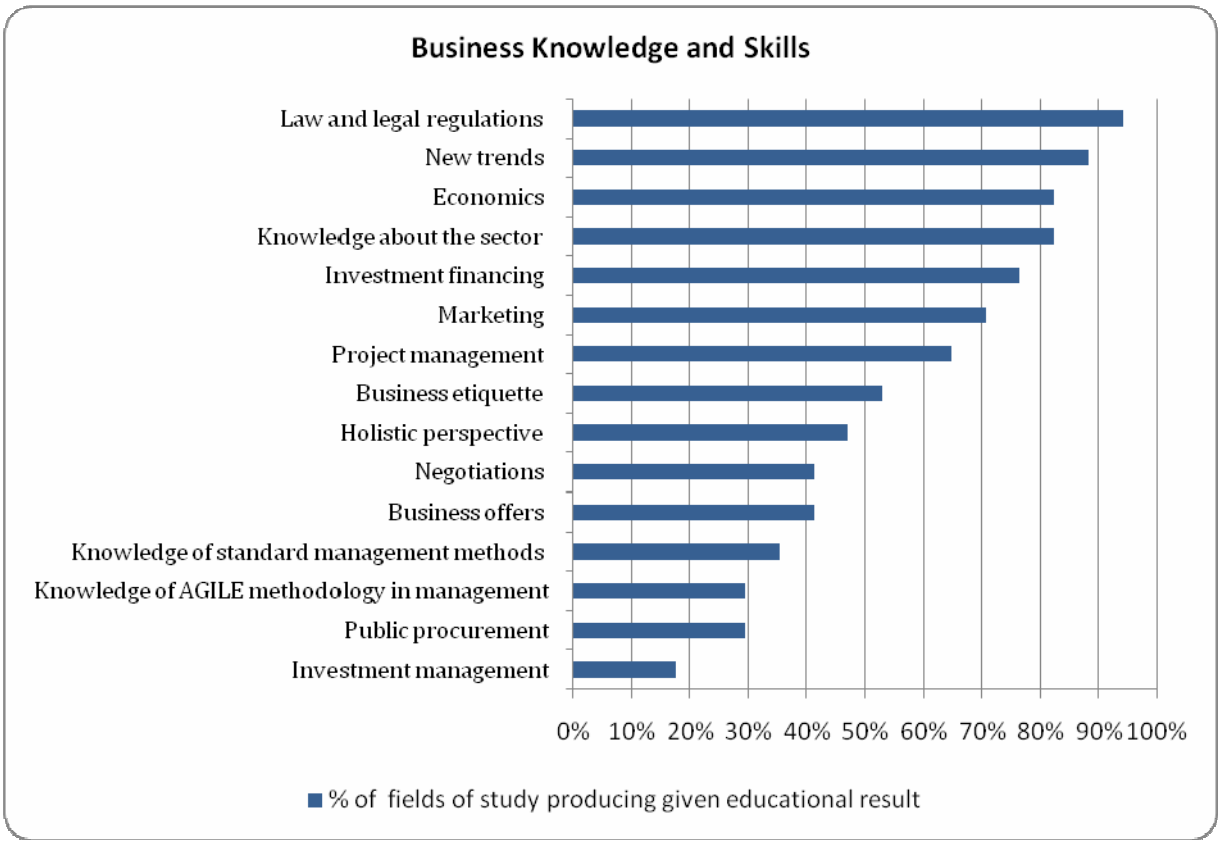


Fig. 16. Percentage of courses and specialisations producing at least medium level educational results in the area of "Business Knowledge and Skills" (universities' perspective).

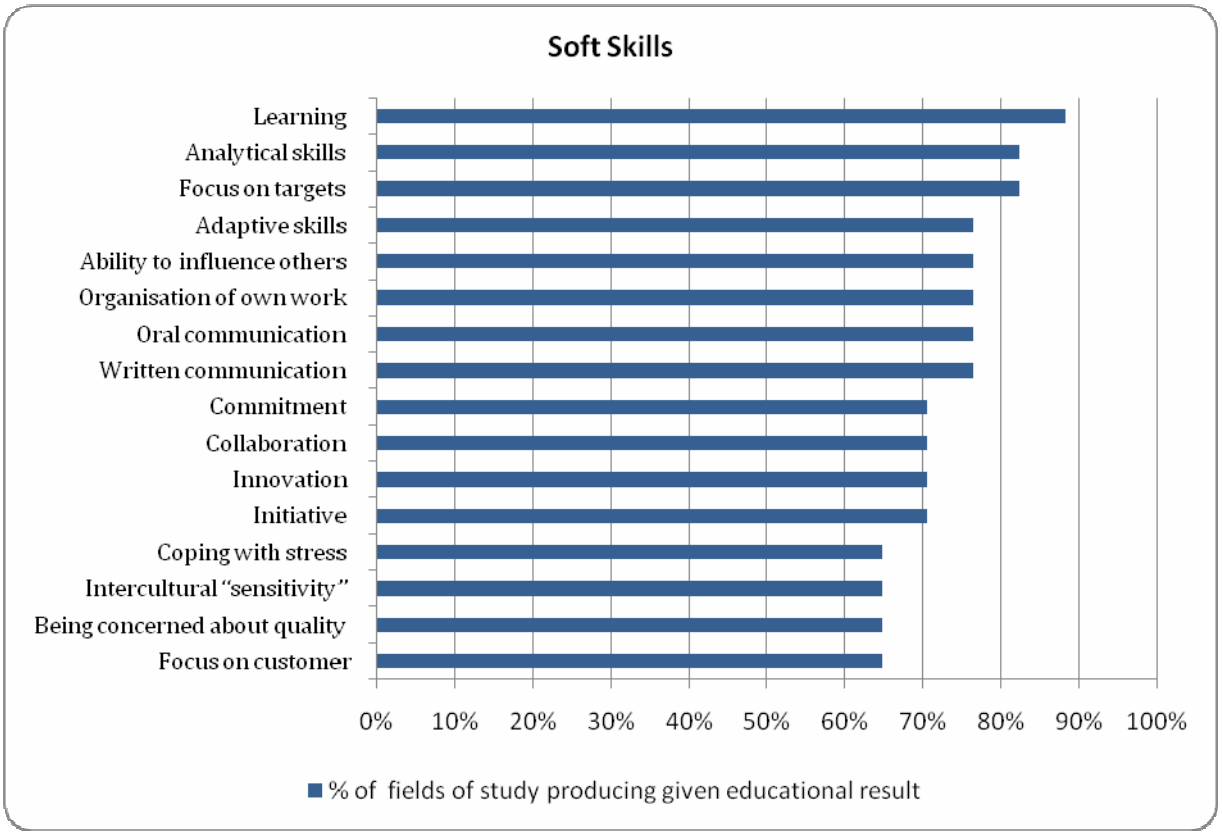


Fig. 17. Percentage of courses and specialisations producing at least medium level educational results in the area of "Soft skills" (universities' perspective).

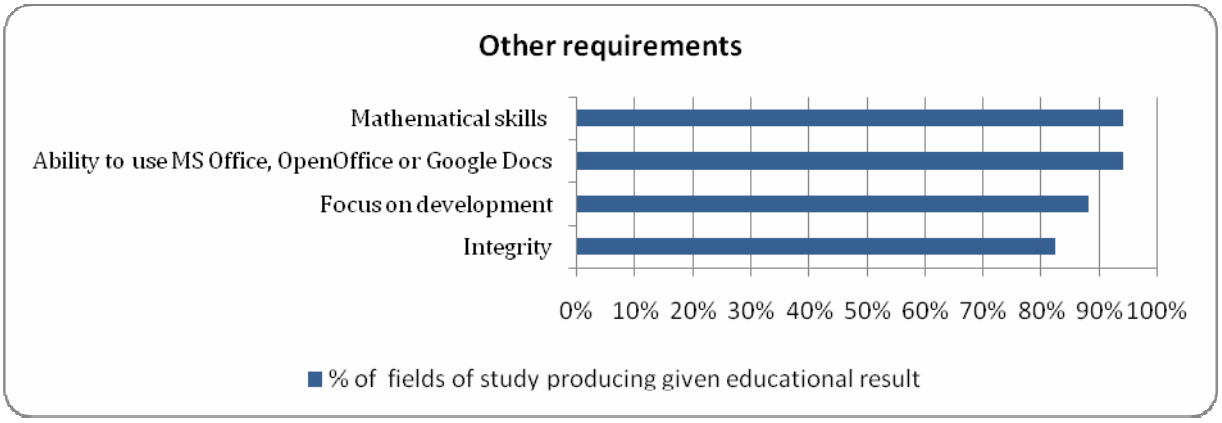

Fig. 18. Percentage of courses and specialisations producing at least medium level educational results in the area of "Other requirements" (universities' perspective).

As regards education in language skills, the institutions directly responsible for the quality of education are foreign language colleges of universities. The English language is a mandatory course at almost all fields of the 1st and 2nd level of university studies. However, students may elect to attend an additional free-of-charge course in a foreign modern language. An additional value is offered in the form of lectures administered in the English language. Foreign language courses are not included in the curricula of most post-graduate studies. According to figures showing the attendance of foreign language classes, most students chose the English language (level B2), then German, French and the English language of a higher level. According to statements by the representatives of foreign language colleges, the offer of foreign language courses is quite flexible and may be easily adapted to the requirements of the labour market and/or students' preferences. The status of foreign language courses at universities is such that students may have a decisive vote by subscribing, or refusing to subscribe to certain courses and developing their language competences at least at the basic level. The development of language skills at higher levels is obstructed by a limited number of available classes.

To sum up the foregoing, what follows from the analysis of competence supply is that teaching in the fields and in specialisations of study covered by the research are capable to achieve – at least at the average level – a half of educational results important for the sector (50% of effects in specialist knowledge and 43% of specialist skills, respectively). Such situation should not come as a surprise because various companies recruit personnel for diverse positions and the sector consists in different segments. The situation seems natural and was additionally proved in the balance of competences in which the expectations of companies were confronted with educational results. The representative of the field of study which meets requirements best, declares that 86% educational result is obtained in relation to knowledge and 69% – in relation to specialist skills. With regard to the specific characteristics of the fields of study covered by the research, and considering the fact that many of these studies prepare students not only for a single sector, we asked the representatives of universities to indicate additional educational results that may be important to employers. The results are presented in table below.

| **Additional educational results acquired at fields of study related to the sector** |
|---|
| Ability to design, manufacture and apply new materials |
| Knowledge of mining and geological lows and regulations |
| Biological knowledge suitable for solving problems related to renewable and geothermal energy sources. |
| Knowledge of the role and importance of natural environment |
| Pneumatics and hydraulics |

| Additional educational results acquired at fields of study related to the sector |
|---|
| Ability to control pneumatic and hydraulic devises and equipment |
| Nanotechnologies |
| Visual systems |
| MDLAB environmental |
| Software for process control |
| Labview |
| CAD environment |
| Social capital – relationships and contact with the representatives of the sector |
| Ability to acquire experience |

Table 7 List of additional educational results

# BALANCE OF COMPETENCES TRANSFER OF COMPETENCES FROM UNIVERSITIES TO BIZNESSES

Our demand analysis revealed competences that are perceived by the sector as core ones, along with shifts in their importance in the future, and difficulties suffered by employers in recruiting graduates possessing actual knowledge and skills. The analysis of supply showed what educational results are acquired at fields of study related to the sector, and how comprehensive is relevant education. In this chapter, we juxtaposition the two perspectives with focus on the comparison of difficulties in acquiring competences with the average level of their being obtained at universities. In this context, certain reservations need to be made in relation to differences we observed in the assessment of said difficulties and university education.

**In the event that the views of businesses and of universities were the same, we would have a situation in which competences that employers find difficult to acquire would not be taught at universities in the universities' opinion.** Such correlation shown by results presented herein applies only to the teaching of soft skills and other requirements, and is very low (correlation r=0.27)[25]. In other areas, there is no correlation between declared difficulty/easiness of acquiring a competence and the educational results actually obtained. The results show that most important competences were assessed by employers as moderately difficult or difficult to acquire. It should be noted, however, that average results are much better than those recorded in other sectors. Hence, it is relatively easier to find candidates in this sector than, for instance, in the passive and low-energy sector. The results are also influenced by the fact that a few companies, that took part in the research, co-operate with universities and in their opinions proper competences may be found very easily. Other entities are of slightly different opinion. All these elements give an image saying that although it is difficult to acquire proper candidates, in most cases it is not particularly difficult. With regard to competences that were assessed as hardly available, we would like to note that the situation does not mean that this is the "fault" exclusively of universities that cannot adequately assess their educational offer.

[25] Correlation (or Pearson's r) is a coefficient describing a linear relationship between two variables, varying between –1 (with -1 a perfect negative relationship - every increase in the value of one variable means proportional decrease in the value of the other), through 0 (no relationship - every increase of the value of one variable means random change in value of the other) to +1 (every increase in the value of one variable means proportional increase in the value of the other).

Although this fact may be one of the reasons for which the assessments are different, there are also other possible and equally probable interpretations here[26].

One of them is related to the observed differences in the level of the development of human resources processes in various companies of the sector, where there are huge organisations using corporation procedures as well as small entities that may not have any personal processes developed at all. Problems related to acquiring proper candidates may be a result of the application of improper recruitment and selection tools as well as remuneration policies or onboarding programmes. Another one is related to the method of educational result defining. The educational result refers to qualifications acquired by an average student, which means that the labour market is entered by graduates who present a level above average as well as those who present a level below average. Another reason may be sought in the fact that graduates of the fields of studies indicated as fitting the sector profile are employed in other sectors of economy, in other towns and even abroad. Although there is no data available, it is likely that employment abroad is found by engineers possessing language and business skills above average rather than those who do not decide to leave abroad. The perception of competences by business and universities may vary because what may represent a satisfactory level to one party may be below an acceptable minimum to the other. Eventually not all competences that are sought may or should be taught at universities, which fact is confirmed by a juxtaposition presented at the end of this chapter. Therefore, the results of the study of competences should be perceived as a tool to be used by universities and businesses to establish an effective co-operation and debate about teaching curricula.

Fig. 19 presents a matrix illustrating interdependencies between difficulties in acquiring certain competences and educational results achieved for the 20 competences of key importance for the sector. Expectations related to the English language and the driving licence were replaced by competences that were respectively next on the list in terms of their importance. The range of data presented in the chart was arbitrarily set, which enables a clear presentation of division of competences into easily and hardly acquirable ones along with higher or lower levels of educational results (difficulties in acquiring of competences in range from 3.0 to 4.5 and educational results in range from 3.0 to 5.0). It is surprising that differences between competences easily available and corresponding educational results relate mostly to competences that on the one hand are hardly acquirable in the opinion of companies, and on the other their level of educational results is not necessarily the highest in the opinion of universities. The two competences that stand out from the others are **new trends and general knowledge of the sector**: both are hardly acquirable on the market and highly scored by universities. Hardly acquirable and taught at a lower level are the following competences: **effective power management, oral communication, investment financing and investment management**. Competences easily acquirable on the market and acquired at universities are, for instance, **general technical and engineering knowledge, learning and focus on development (or development orientation)**.

[26] We encourage those interested to review charts containing all quantitative data obtained from the surveys in Appendix 2. The comparison of difficulties in acquiring a given competence with a percentage of university courses in which it is developed at least in a moderate degree and with the average score assigned to a given educational result, gives a better picture of the reasons for such discrepancies (e.g. significant difficulties in acquiring along with high assessment of average level of achieved educational results compared with very small percentage of university courses where such skill is being taught suggests that one of the reasons for problems with recruitment is a small number of graduates having the relevant skill or knowledge, etc.).

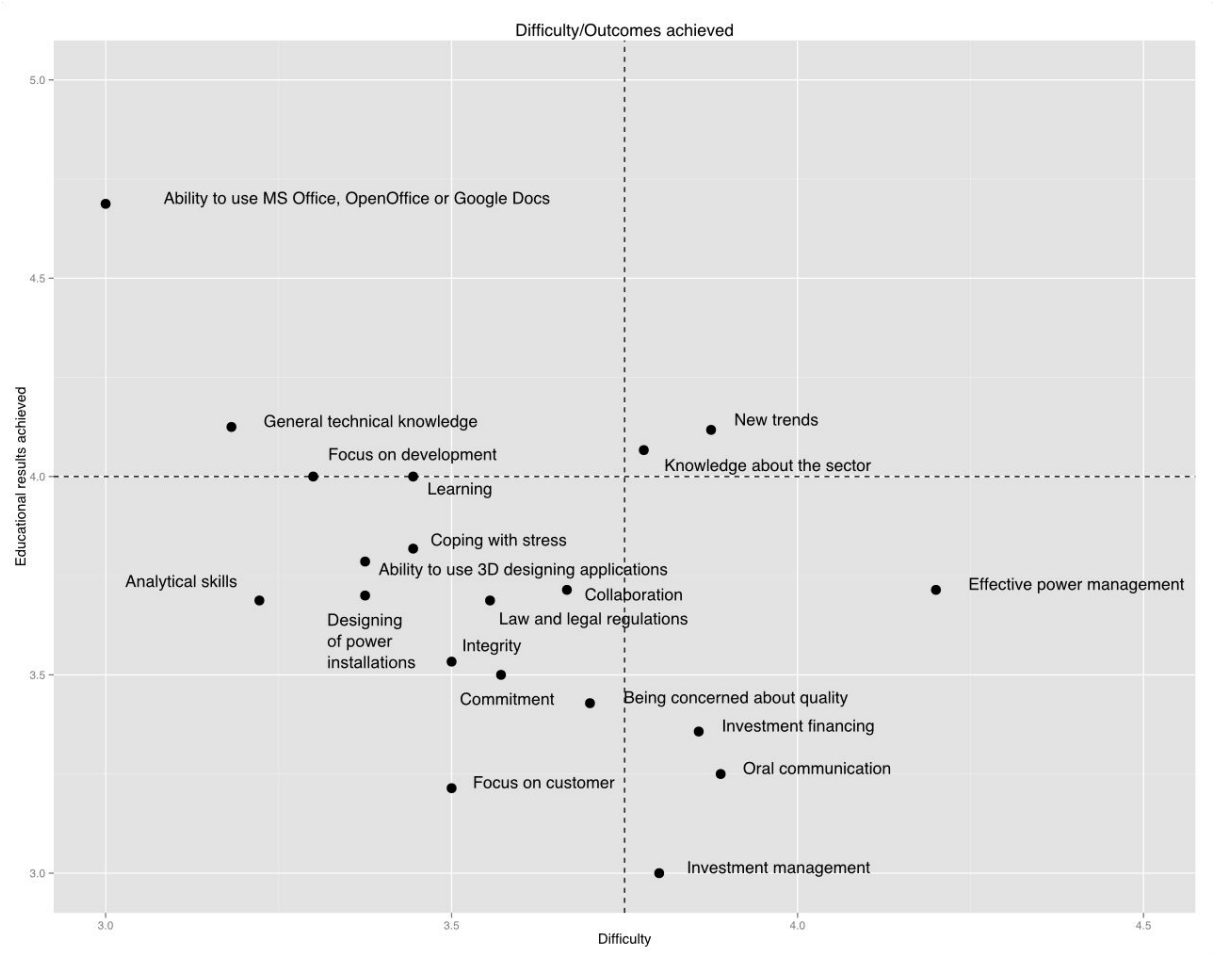


Fig. 19. Matrix illustrating interdependencies between difficulties in acquiring certain competences (employers' perspective) and educational results achieved (universities' perspective) for the 20 competences of key importance for the sector. Limited scales (from 3 to 4.5 and from 3 to 5.0)) is used in the graph for more clarity.

The charts below present difficulties in acquiring competences and the educational results achieved at universities in five basic groups of competences.

In the group of specialist knowledge, particularly noteworthy are such competences as **water power engineering, effective power management or solar and photovoltaic engineering**, that are relatively hard to acquire, but – in the opinion of universities – the competences are taught within the framework of respective curricula (Fig. 20).

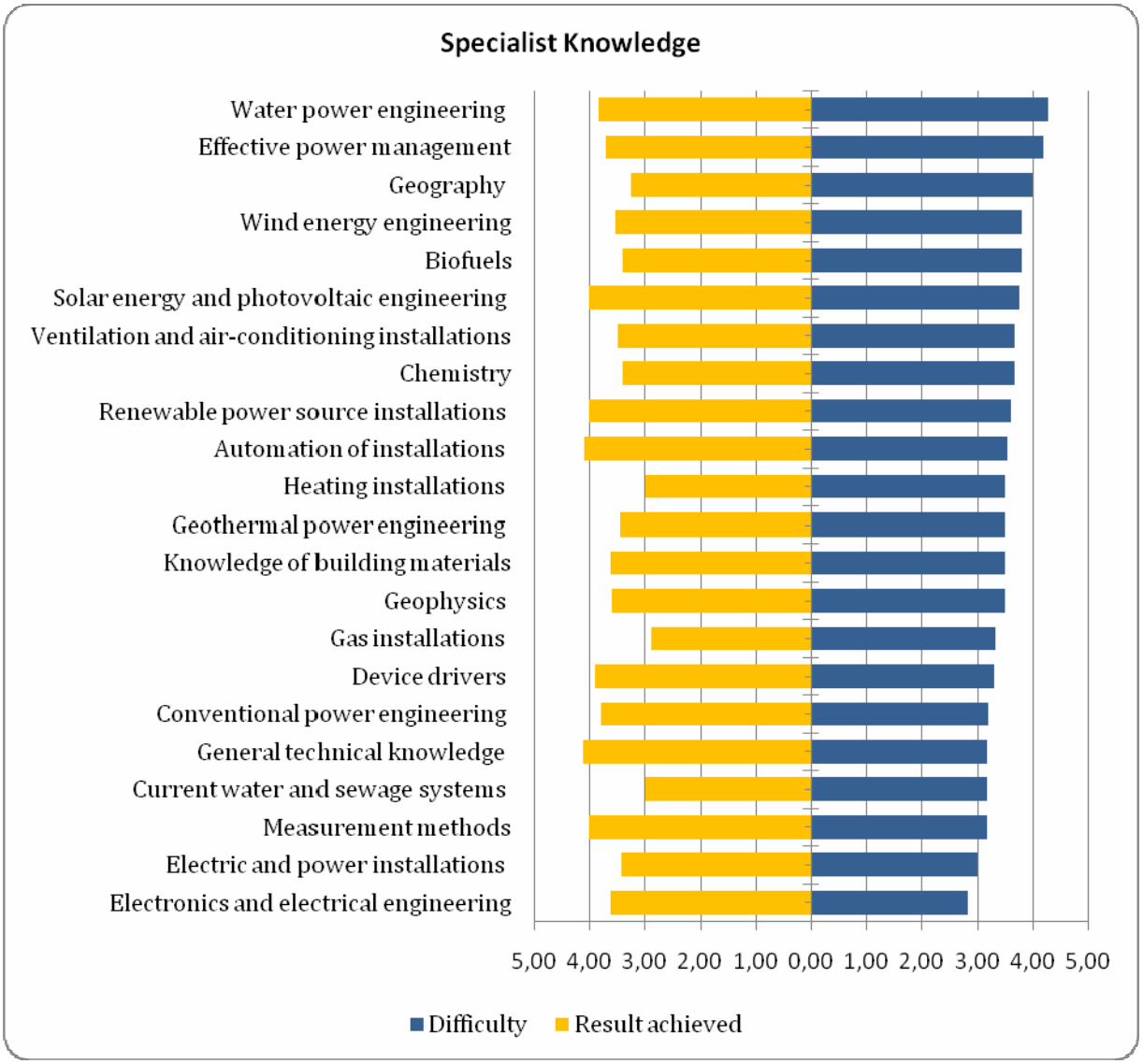

Fig. 20. Juxtaposition of difficulties in acquiring competences (employers' perspective) with educational results achieved (universities' perspective) in the area of "Specialist knowledge".

In the group of specialist skills (Fig. 21) a competence that is both: hard to acquire on the labour market and – according to the representatives of universities – is taught may be considered the **operation of simulating engineering software**.

In the group of business knowledge and skills (Fig. 22) competences that in the opinion of business are hard to acquire but achieved from the universities point of view are **knowledge about new trends and knowledge about the sector**.

An interesting image emerges from the analysis of soft skills and other requirements of graduates posed by employers (Figs. 23 and 24). In most cases the competences – in the opinion of universities – are the tasks of universities and taught at a medium level. These opinions, however, do not quite agree with those of the representatives of businesses as regards **initiative, adaptation and learning.**

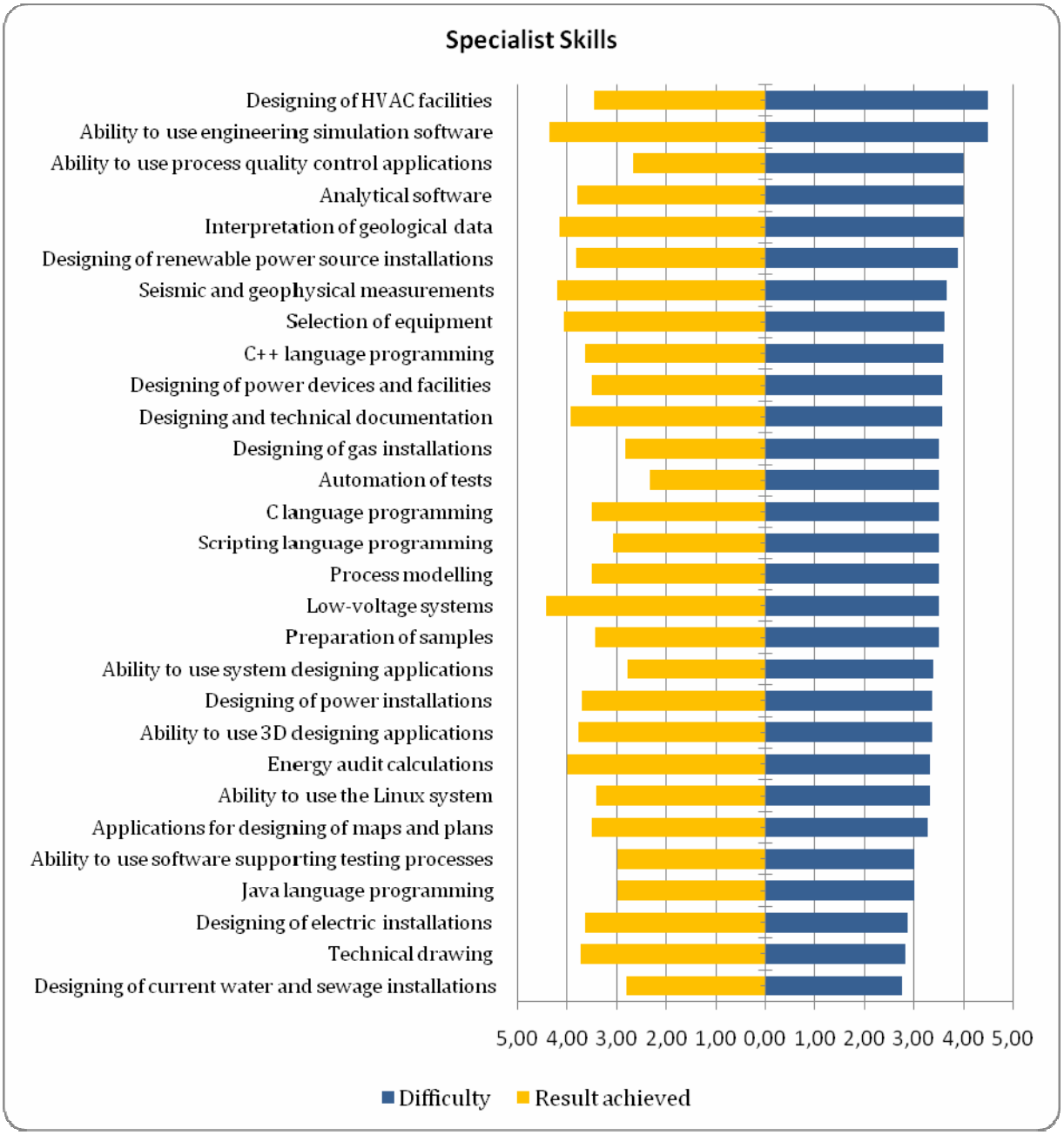

Fig. 21. Juxtaposition of difficulties in acquiring competences (employers' perspective) with educational results achieved (universities' perspective) in the area of "Specialist Skills".

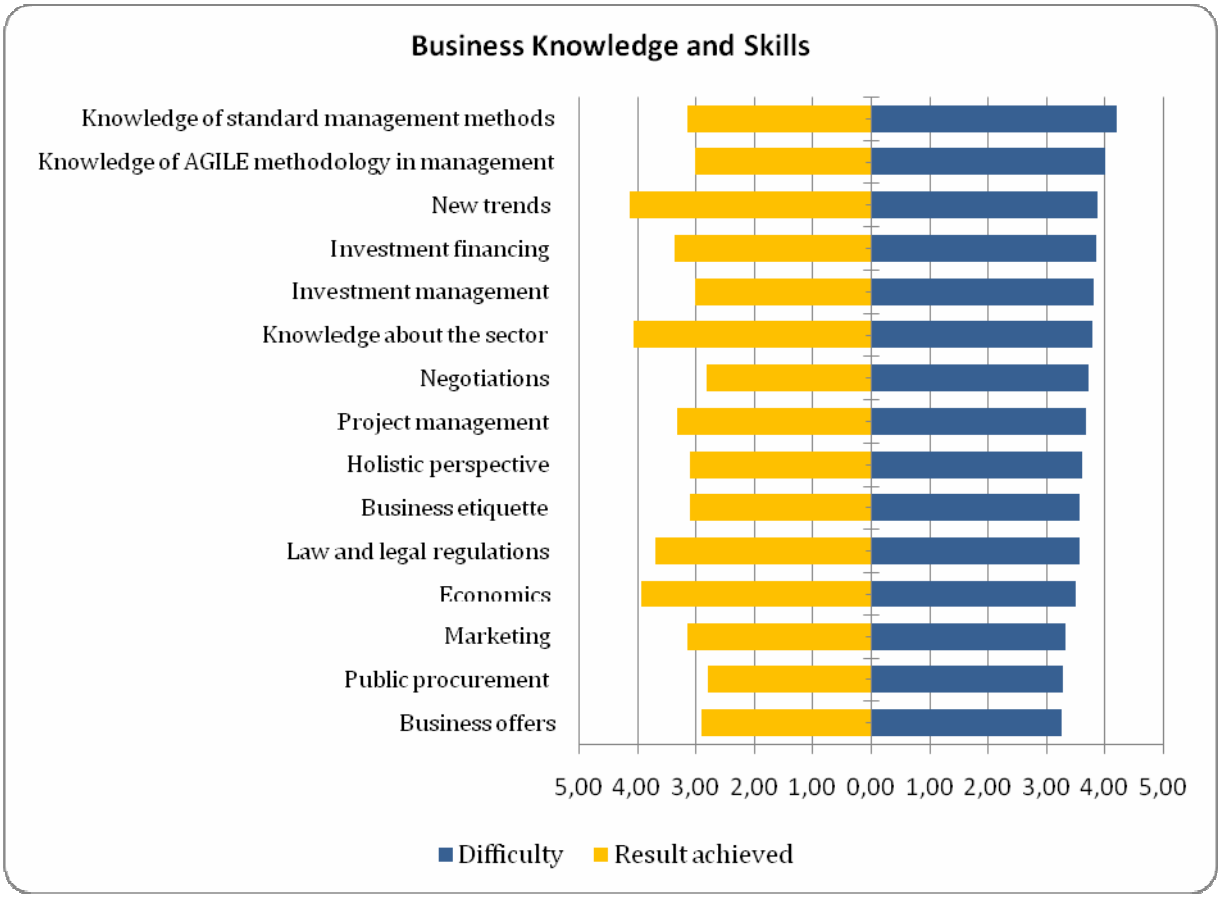


Fig. 22. Juxtaposition of difficulties in acquiring competences (employers' perspective) with educational results achieved (universities' perspective) in the area of "Business knowledge and skills".

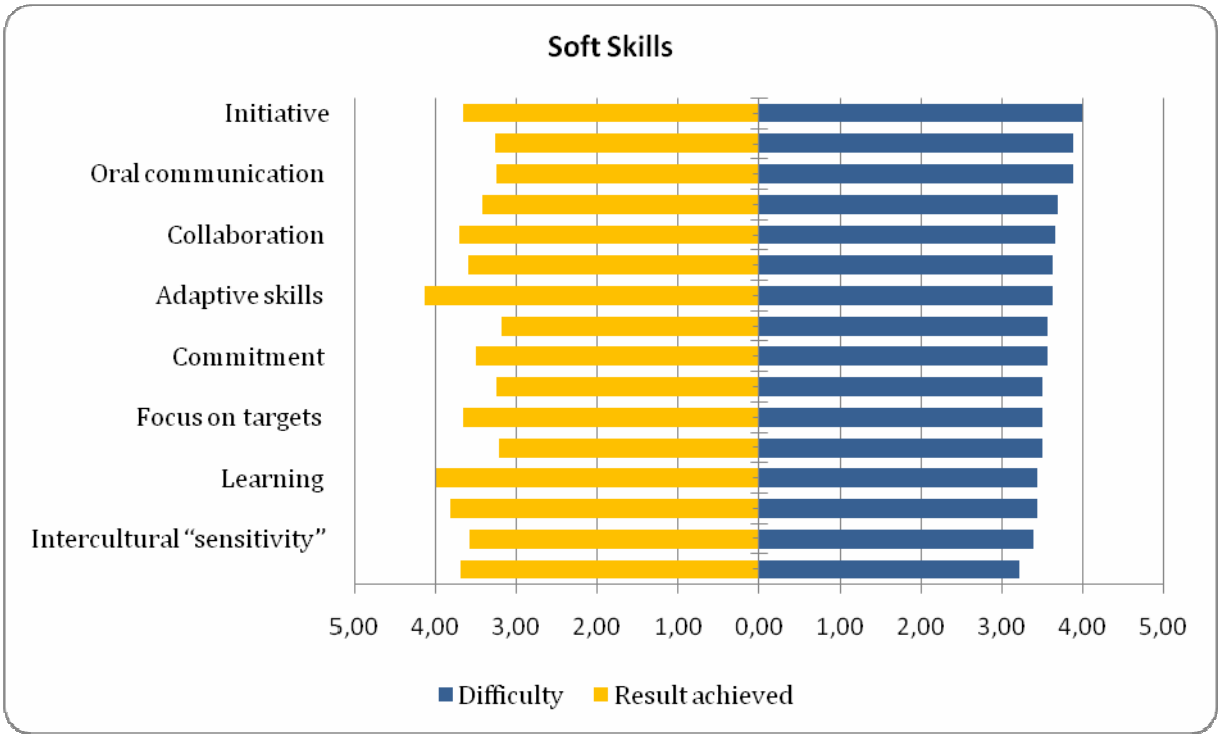


Fig. 23. Juxtaposition of difficulties in acquiring competences (employers' perspective) with educational results achieved (universities' perspective) in the area of "Soft Skills".

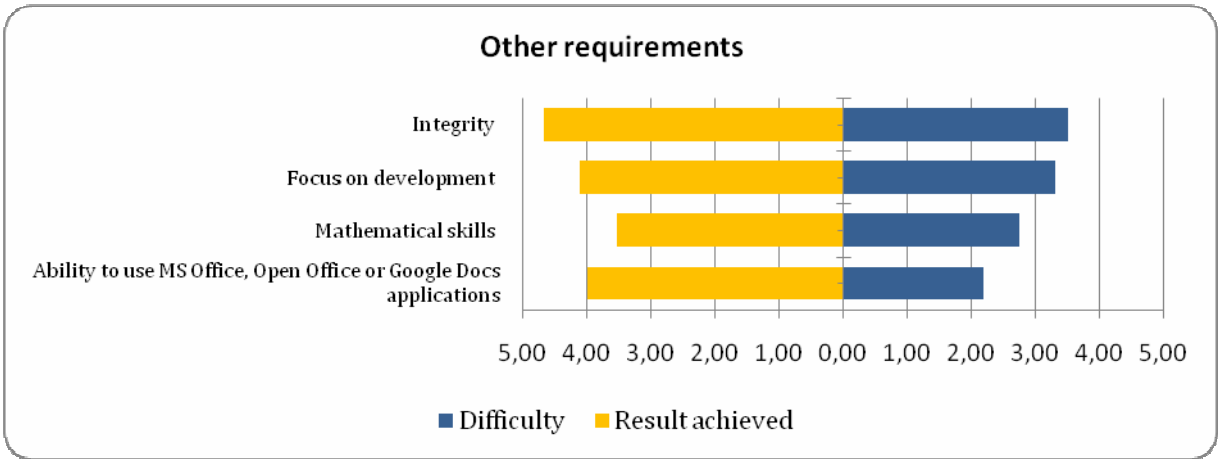

Fig. 24. Juxtaposition of difficulties in acquiring competences (employers' perspective) with educational results achieved (universities' perspective) in the area of "Other requirements".

## TASKS OF UNIVERSITIES

One of an additional aspects subject to analysis within the framework of the study of competences was constituted by the convictions of the representatives of business and of universities as to how far the teaching of competences should be a task of universities. The inclusion of the area implied a certain risk: at the stage of consultations related to the research tool, certain doubts appeared as to whether (or not) such question may be applied in any other manner than what entrepreneurs claim, i.e. that the whole responsibility for education rests with universities. The results of research show that our fears were groundless, while the inclusion of an additional perspective allowed a better understanding of the relationships between the supply of and demand for competences in the sector.

**Where the opinions as to which competences should be taught at universities are fully shared by employers and universities, we could expect well correlated replies from both milieus.** In the presented results a high correlation appears in regard of specialist knowledge (correlation: r=0.61) and specialist skills (correlation: r=0.41). As regards soft skills and business knowledge and skills such effect is marginal.

Fig. 25 presents opinions of the representatives of companies and of universities concerning the extend to which the teaching of the 20 most important competences should be a task of universities. For better clarity, the results on the diagram are presented in the scale reduced to values ranging from 3.5 to 5 scores. There is a considerable agreement between companies and universities. According to the opinions of both milieus the universities should provide mostly the following: **general engineering and technical knowledge, effective power management, learning and operation of 3D designing software**. According to business and universities **co-operation, commitment and focus on customer** (or customer orientation) should be taught to a lesser degree. The critical importance has the interpretation of the right bottom quarter of the graph, i.e. the competences the acquisition of which is attributed by businesses mostly to universities, i.e. **investment management, designing of electric installations, law and legal provisions and knowledge about investment financing**.

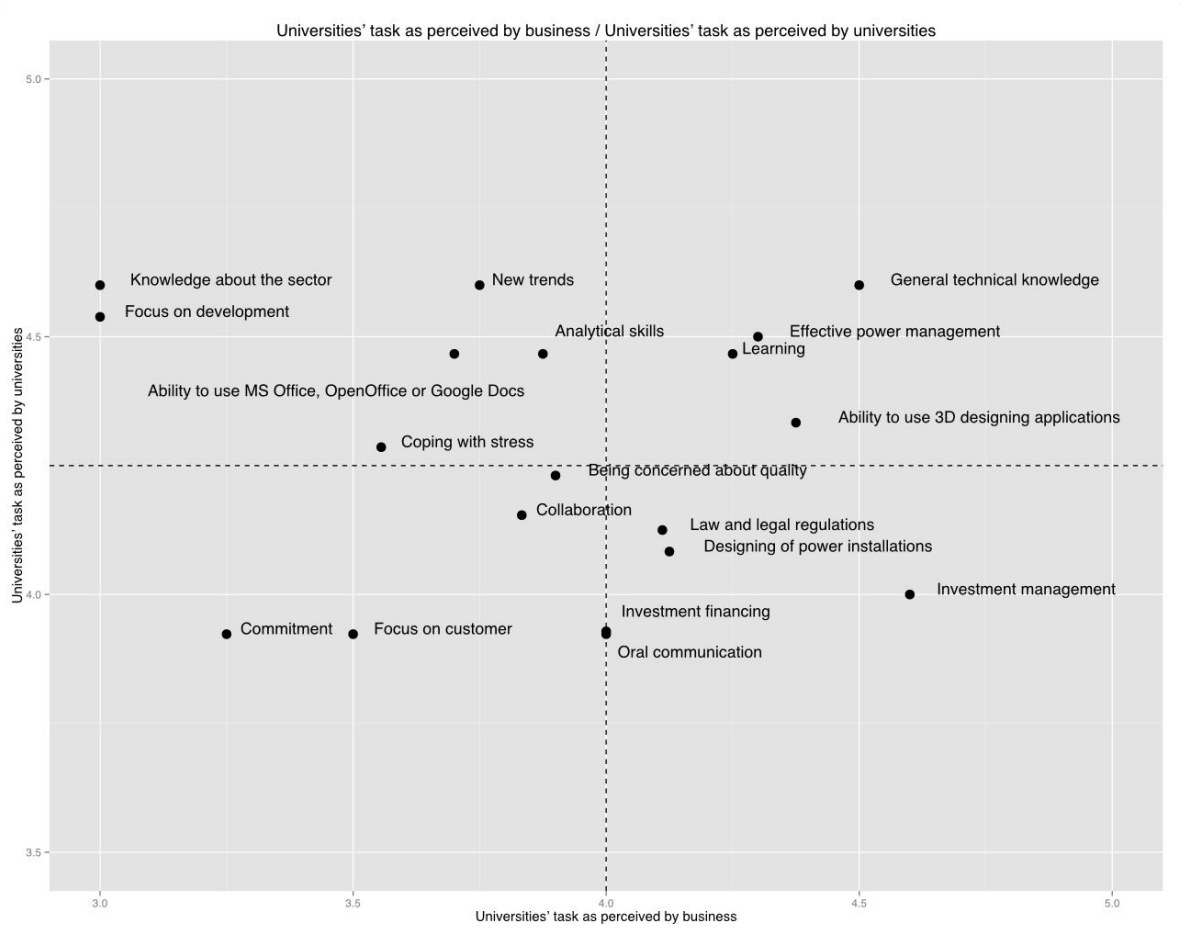


Fig. 25. Matrix illustrating differences in the perception of development of certain competences as a universities' task by representatives of business and of universities for the 20 competences of key importance for the sector. Limited scales (from 3.5 to 5) is used in the graph for better clarity.

There is a considerable agreement between companies and universities as regards the understanding of the role of universities in developing specialist knowledge (Fig. 26). They agree that these competences should be taught at universities. However, their opinions differ as regards the degree to which they should be taught. The strongest disagreement is observed with respect to **heating installations and knowledge of construction materials** - here, employers' expectations as to the commitment of universities are much bigger than those of the universities themselves. In other cases the replies are either almost identical or universities assign more responsibility to themselves than it could be derived from the opinions of the representatives of companies.

As for specialist skills (Fig. 27), companies assign broader responsibility to universities with respect to **HVAC installation designing, ability to use analytical software and C## programming language**. A reverse image appears, inter alia, with respect to **process modelling and development of design documentation**.

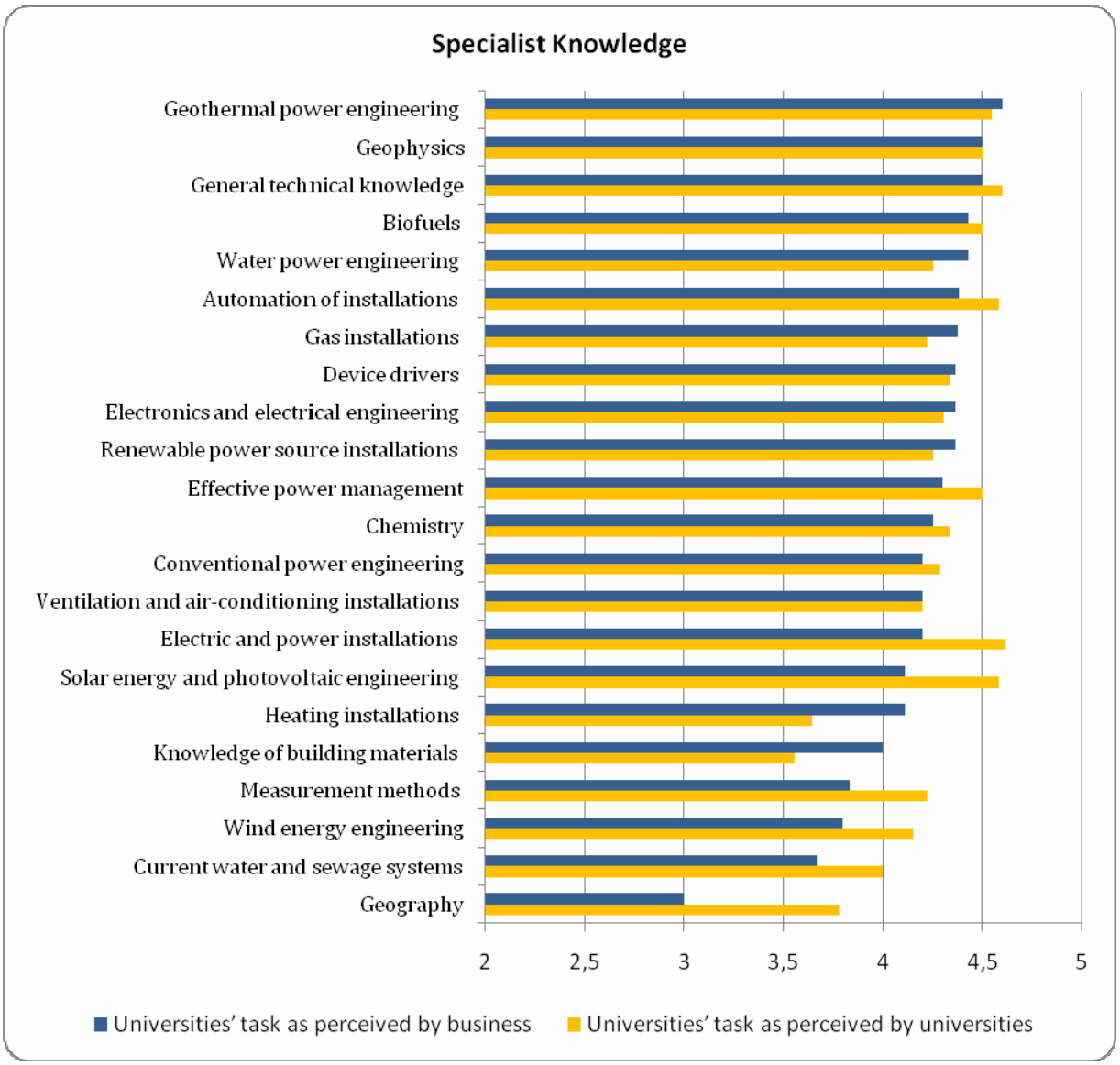

Fig. 26. Perception of the role of universities in developing competences in the area of "Specialist knowledge".

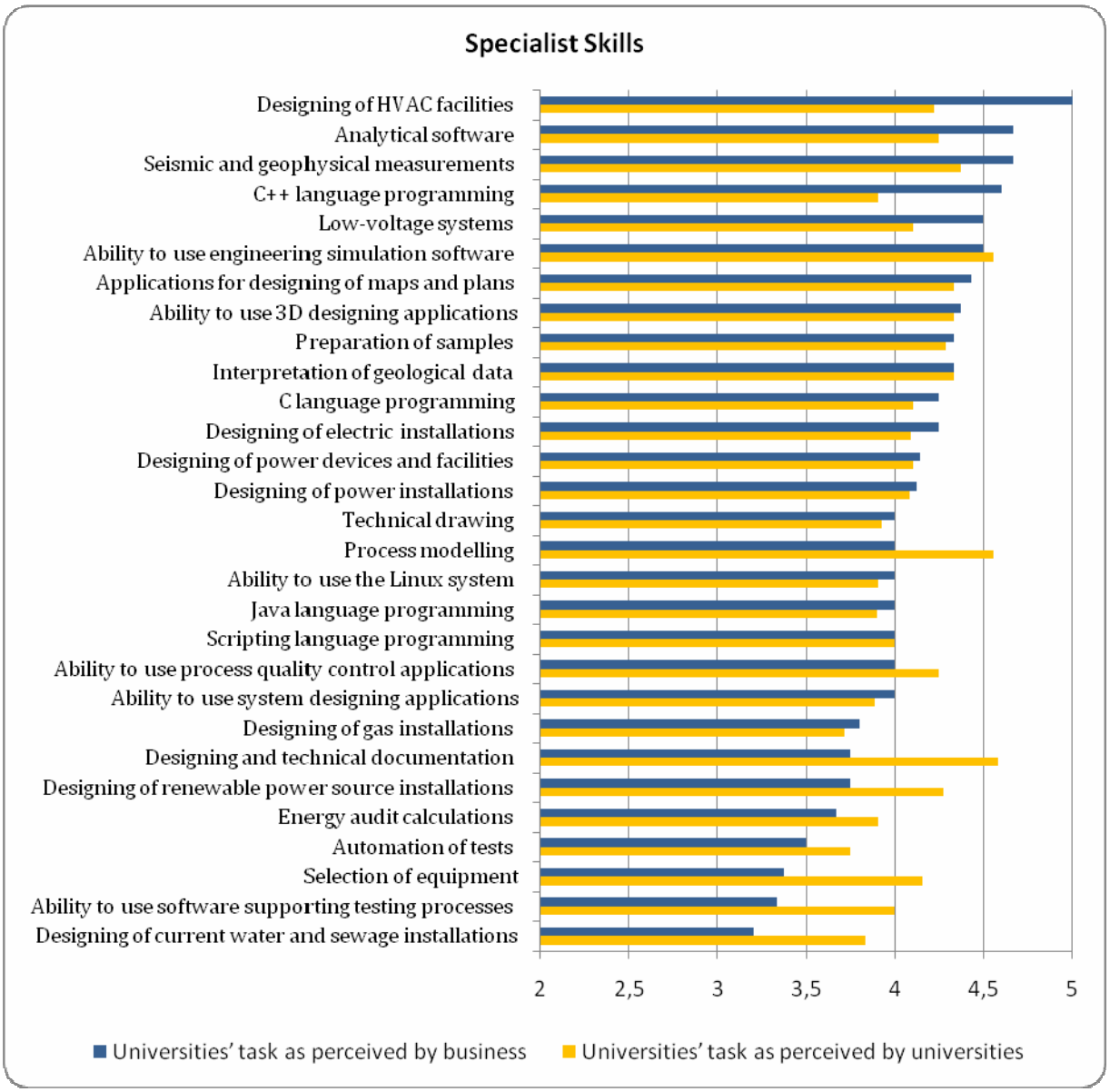

Fig. 27. Perception of the role of universities in developing competences in the area of "Specialist skills

Results related to business knowledge and skills are very interesting (Fig. 28) An opinion that the developing of competences related to **investment management and knowledge of project management** should be the task of universities, is more common amongst businesses than amongst universities. What is particularly interesting is that such competences as: **knowledge of the sector or new trends** are designated as the tasks of universities more commonly by universities than by the representatives of businesses. The result does not allow to derive a conclusion that the full responsibility for these areas lies on the side of companies. Information acquired in the course of interviews seems to indicate that the developing of these competences should be achieved (on the one hand) in co-operation between business and universities (apprenticeships for students and exchange of personnel) or a result of student's and graduate's own initiative.

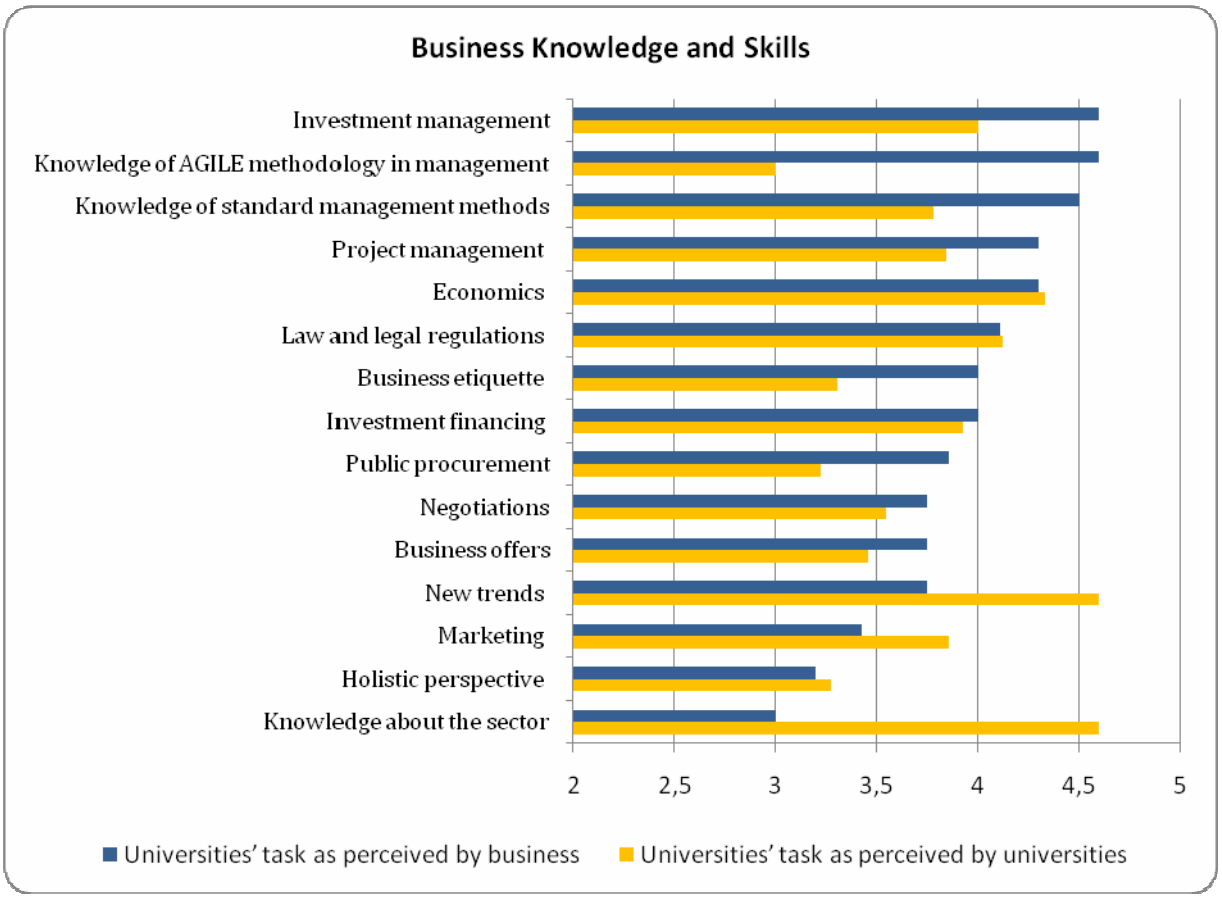

Fig. 28. Perception of the role of universities in developing competences in the area of "Business knowledge and skills".

The results related to the perception of the role of universities in developing **soft skills and other requirements** are surprising. In almost all cases the competences are assigned to universities by companies much less commonly than universities do. The representatives of companies are of the opinion that these competences should be a task of universities (average value 3.0), whilst such expectation related to other groups of competences are far less powerful. In other words, employers who require such competences from graduates are not fully convinced that their development should be a task of universities. The representatives of universities perceive the development of such competences as their own task to a much greater degree. Such approach of universities is fully reasonable: soft competences are transferred and applied in practice to any job (and not only jobs) to be performed by graduates. The solutions that universities could adopt in order to develop soft competences at a higher level was discussed in the entire chapter of the Study of Competences in BPO/SSC and IT/ITO in 2012[27].

[27] Balance of Competences in BPO and ITO in Kraków. http://www.krakow.pl/zalacznik/1165

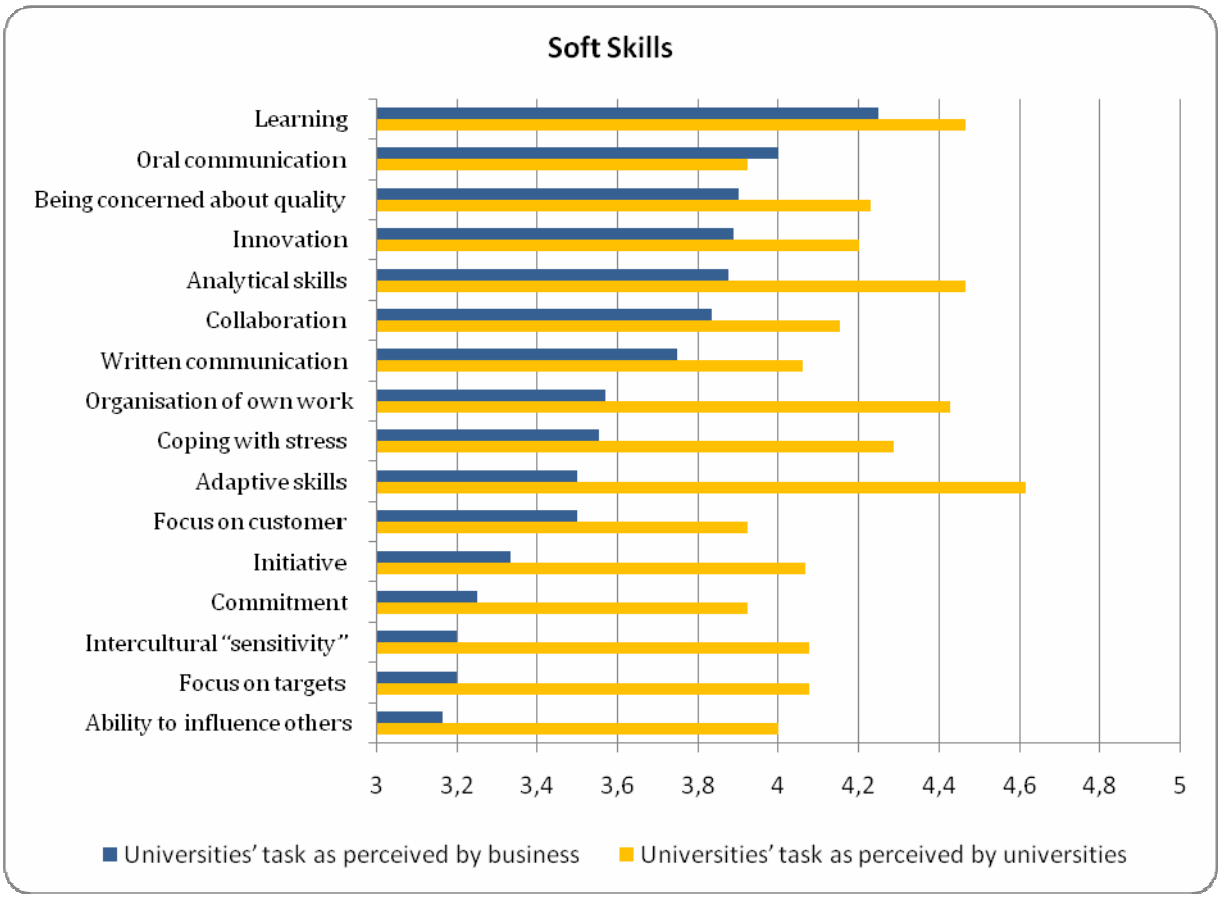


Fig. 29. Perception of the role of universities in developing competences in the area of "Soft skills"

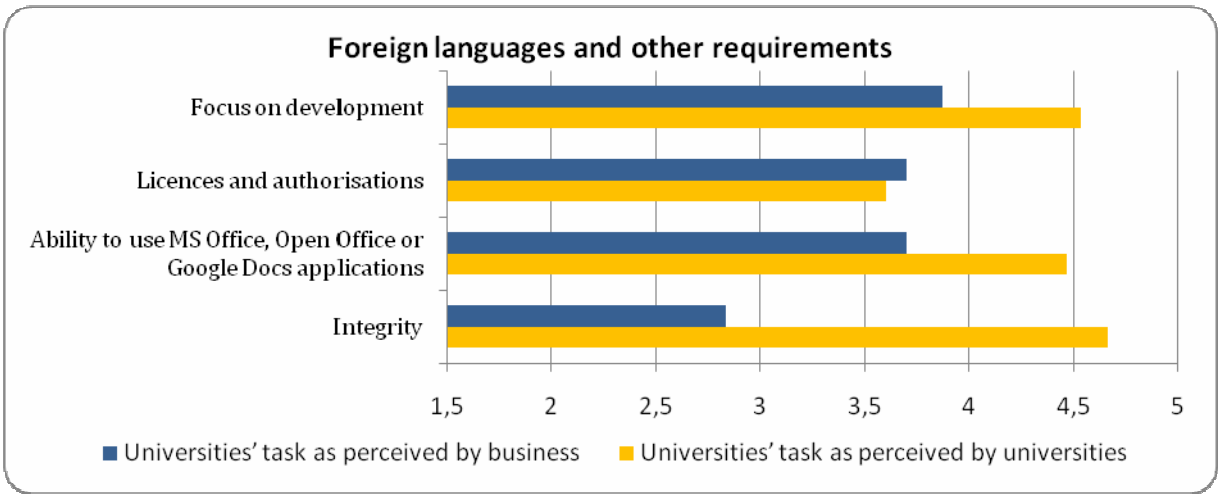


Fig. 30. Perception of the role of universities in developing competences in the area of "Other requirements.

## FINAL CONCLUSIONS AND RECOMMENDATIONS

With regard to the meaning of the power sector to the other sectors of economy and the whole region, and with respect to the fact that companies in the sector employ huge number of employees, **the sector has been reasonable assigned one of priorities in the development strategy of the City of Kraków**. As regards scientific support, **Kraków is already one of the leaders in both: education activities and R&D programmes.** The universities may be proud of numerous examples of their co-operation with businesses in the context of R&D programmes as well as their commission of jobs and offers of apprenticeships and traineeships. However, **not always does co-operation involve local companies, particularly smaller businesses which may face serious barriers in establishing such co-operation**. Some companies indicate that there is shortage of information about procedures and locations for submission of co-operation proposals to universities.

The Kraków's power sector as such, shows very different features. At the most general level we may talk about some kind of stagnation and limited development perspectives. However, there are symptoms of revival in the area of renewable energy sources and most modern technologies. The sector is strongly dependent on legal regulations, while regulations applicable to renewable energy sources leave a lot to desire and constitute a development barrier. One of the characteristic features of the sector in Kraków is that on the one hand it is very diverse (companies engage in various areas of power technologies), whilst, on the other hand, the sector is strongly oriented towards trade and sales, which results in **relatively high importance of soft skills**.

**As regards the availability of competences on the labour market, the situation seems quite optimistic**. The replies of companies generally indicate that there is no major problem with recruiting proper candidates, although there are areas of knowledge and skills that are hard to acquire. One remark deserves to be made here: the pool consisted of a few companies whose answers may slightly distort the image of the whole sector. These are the companies that co-operate with technical universities on a regular basis, the result of which is that it is easier for them to recruit proper candidates with a set of desired competences. This is an important observation, indicating that co-operation between business and universities is possible and brings desired effects.

Briefly saying, the most important findings of the research relating the demand for competences in the power sector are presented in Table 8.

| **Key findings of the Study of Competences for the power sector (summary)** | |
|---|---|
| Key competences currently looked for by employers (as stated by employers) | Ability to use 3D designing software, ability to use MS Office Packet, OpenOffice or Google Docs, driving licence, coping with stress, English, integrity, investment management. |
| The most considerable relative growth in importance of competence over 5 years (as stated by employers) | Public procurements, energy audit calculations, ability to use simulating engineering software, holistic perspective, innovation, investment financing |
| Important competences which are the least available on the labour market (as stated by employers) | Effective power management, oral communication, investment financing and investment management. |
| Competences which are the least available on the labour market regardless of their importance (as stated by employers) | Ability to use simulating engineering software, HVAC installation designing, water power engineering, effective power management, knowledge of project management methodology (standard and AGILE) |

| Key findings of the Study of Competences for the power sector (summary) | |
|---|---|
| Important competences which are the most available on the labour market (as stated by employers) | Ability to use office packet software, driving licence, the English language, general technical and engineering knowledge, analytical abilities. |
| Competences which are the most available on the labour market regardless of their importance (as stated by employers) | Designing of current water and sewage installations, electronics and electrical engineering, technical drawing. |
| The most often educational results important for employers (in universities' opinion) | Law and legal regulations, ability to use MS Office, Open Office or Google Docs, general technical and engineering knowledge, new trends, learning. |
| Universities' task as perceived by business | HVAC installation designing, seismic and geophysical measurements, ability to use analytical software, technical English, AGILE, investment management, general technical and engineering knowledge. |
| Universities' task as perceived by universities | Technical English, Electrical and power installations, adaptation, general technical and engineering knowledge, knowledge about the sector, new trends. |

Table 8 Synthetic summary of the Study of Competences findings for the power sector in Kraków

**As regards co-operation of universities and the representatives of the sector, a number of very positive examples may be quoted**: One of the effects of the co-operation is that competences taught at universities meet the requirements of business. This may be connected with the number of today's students and future engineers, which – combined with the situation of the sector – causes that we have a market of employers and competition struggle is for the best graduates. **The generally positive balance of competences should not overshadow certain shortages pointed out by companies**. These are, inter alia, **effective power management, investment financing, solar and photovoltaic technology, investment management and oral communication.** The anticipated increase of the meaning of competences related to renewable energy sources was not fully confirmed by obtained results. It appears that the structure of the sector in Kraków is still strongly connected with the conventional power technology.

In the opinions of companies there appeared claims related to **shortages in practical preparation of graduates** (these having a less negative appeal than in the case of other researched sectors). Such opinions are common to any balance of competences, though. These opinions are generally shared also by representatives of universities. The results indicate that an excellent vehicle to solve the problem is co-operation between companies and universities concerning **apprenticeships and traineeships**. However, it is important that both parties take this problem really seriously: the universities should focus on promotion of such solutions and produce students of proper quality, while companies must assign enough time so that such apprenticeships occur beneficial to students as well. The problem related to the establishing such relationships arises from the lack of effective systemic solutions in the sphere of co-operation between business and science. The representatives of companies often do not know who and how to approach with a proposal which results in aversion of the other side, perceived by both communities.

**An important role in moderating the debate should be played by the Kraków City Hall. The Kraków City hall, acting as an investor and an important actor of social life, may participate in simulating the development of the sector** by applying proper policy related to the municipal infrastructure and the promotion of new solutions (mainly in the area of renewable energy sources, modern waste management or smart grids).

# APPENDIX 1 LIST OF COMPETENCES AND EDUCATIONAL RESULTS

| Specialist Knowledge | | | |
|---|---|---|---|
| Item No. | Name | Competence description | Educational result |
| 1 | Automation of installations | Knowledge about automatic processes in the power industry | The student possesses knowledge about automatic processes in the power industry |
| 2 | Biofuels | Knowledge about power industry based on biofuels (processes, technologies, facilities and devices) | The student possesses knowledge about power industry based on biofuels (processes, technologies, facilities and devices) |
| 3 | Chemistry | Knowledge about chemical composition, structure and chemical properties of substances and processes of their transformation | The student possesses knowledge about chemical composition, structure and chemical properties of substances and processes of their transformation |
| 4 | Effective power management | Knowledge about effective management, processing and transmission of energy. | The student possesses knowledge about effective management, processing and transmission of energy. |
| 5 | Electronics and electrical engineering | Knowledge about electronic and electrical engineering (including analogue and digital electronics, electrical diagrams etc.) | The student possesses knowledge about electronic and electrical engineering (including analogue and digital electronics, electrical diagrams etc.) |
| 6 | Geothermal power engineering | Knowledge about geothermal power engineering (processes, technologies, facilities and devices) | The student possesses knowledge about geothermal power engineering (processes, technologies, facilities and devices) |
| 7 | Conventional power engineering | Knowledge about conventional power engineering (processes, technologies, facilities and devices) | The student possesses knowledge about conventional power engineering (processes, technologies, facilities and devices) |
| 8 | Solar energy and photovoltaic engineering | Knowledge about solar energy/photovoltaic engineering (processes, technologies, facilities and devices) | The student possesses knowledge about solar energy/photovoltaic engineering (processes, technologies, facilities and devices) |
| 9 | Wind power engineering | Knowledge about wind power engineering (processes, techno-logies, facilities and devices) | The student possesses knowledge about wind power engineering (processes, technologies, facilities and devices) |
| 10 | Water power engineering | Knowledge about water power engineering (processes, technologies, facilities and devices) | The student possesses knowledge about water power engineering (processes, technologies, facilities and devices) |
| 11 | Geophysics | Knowledge about geophysics and seismic science | The student possesses knowledge about geophysics and seismic science |
| 12 | Geography | Knowledge about rules and methods for the description of properties of soil, water and air, including their physical properties and interrelations | Student possesses knowledge about rules and methods for the description of properties of soil, water and air, including their physical properties and interrelations |

| Specialist Knowledge | | | |
|---|---|---|---|
| Item No. | Name | Competence description | Educational result |
| 13 | Heating installations | Knowledge about designing and operating heating installations | Student possesses knowledge about designing and operating heating installations |
| 14 | Electric and power installations | Knowledge about designing and operating electric and power installations | Student possesses knowledge about designing and operating electric and power installations |
| 15 | Gas installations | Knowledge about designing and operating gas installations | Student possesses knowledge about designing and operating gas installations |
| 16 | Renewable power source installations | Knowledge about designing and operating installations for producing energy from renewable sources | Student possesses knowledge about designing and operating installations for producing energy from renewable sources |
| 17 | Ventilation and air-conditioning installations | Knowledge about designing and operating ventilation and air-conditioning installations | Student possesses knowledge about designing and operating ventilation and air-conditioning installations |
| 18 | Current water and sewage systems | Knowledge about designing and operating current water and sewage systems | Student possesses knowledge about designing and operating current water and sewage systems |
| 19 | Measurement methods | Knowledge about geophysical, geochemical and seismic measure-ment methods | Student possesses knowledge about geophysical, geochemical and seismic measurement methods |
| 20 | General technical knowledge | Systematic knowledge about processes and effects related to physics, chemistry, thermodynamics and mathematics applicable to the work in the sector | Student possesses systematic knowledge about processes and effects related to physics, chemistry, thermodynamics and mathematics applicable to the work in the sector |
| 21 | Device drivers | Knowledge about control algorithms and operation of driver units (e.g. PLC, DCS, UCS) | Student possesses knowledge about control algorithms and operation of driver units (e.g. PLC, DCS, UCS) |
| 22 | Knowledge of building materials | Knowledge about various building materials (including insulation materials) and their physical properties | Student possesses knowledge about various building materials (including insulation materials) and their physical properties |

| Specialist Skills | | | |
|---|---|---|---|
| Item No. | Name | Competence description | Educational result |
| 1 | Automation of tests | Ability to use testing automation software (e.g. Selenium, Squish, JMeter) | The student is able to use testing automation software (e.g. Selenium, Squish, JMeter) |
| 2 | Selection of equipment | Ability to select equipment proper for the project | The student is able to select equipment proper for the project |
| 3 | Designing and technical documentation | Ability to develop and – with respect to requirements – check comprehensible and attractive graphic project documentation and technical descriptions | The student is able to develop and check comprehensible and attractive graphic project documentation and technical descriptions |
| 4 | Interpretation of geological data | Ability to analyse and interpret research data and develop relevant reports (maps, tables, diagrams, etc.), related, in particular, to mineral fuels and minerals | The student is able to analyse and interpret research data and develop relevant reports (maps, tables, diagrams, etc.), related, in particular, to mineral fuels and minerals |
| 5 | Process modelling | Ability to model energy thermodynamic processes | The student is able to model energy and thermodynamic processes |
| 6 | Energy audit calculations | Ability to perform detailed calculations of energy characteristics, demand for energy and heat flows in buildings in winter and summer seasons. | The student is able to perform detailed calculations of energy characteristics, demand for energy and heat flows in buildings in winter and summer seasons. |
| 7 | Operation of process quality control applications | Ability to use quality control applications (e.g. SPC, procella, QS Stat) | The student is able to use quality control applications (e.g. SPC, procella, QS Stat) |
| 8 | Operation of 3D designing applications | Ability to use 3D designing applications (e.g. AutoCAD, Solid Edge, SolidWorks, MicroStation, ArchiCAD, Revit, Inventor) | The student is able to use 3D designing applications (e.g. AutoCAD, Solid Edge, SolidWorks, MicroStation, ArchiCAD, Revit, Inventor) |
| 9 | Operation of electronic system designing applications | Ability to use applications supporting electronic system designing processes (e.g. OrCAD Capture, OrCAD Layout, Allegro/PCB Editor, CADSTAR, Altium Designer) | The student is able to use applications supporting electronic system designing processes (e.g. OrCAD Capture, OrCAD Layout, Allegro/PCB Editor, CADSTAR, Altium Designer) |
| 10 | Ability to use software supporting testing processes | Ability to use software supporting testing processes (e.g. JIRA, ALM, QAComplete) | The student is able to use software supporting testing processes (e.g. JIRA, ALM, QAComplete) |
| 11 | Ability to use simulation engineering applications | Ability to use simulation and modelling applications (e.g. Aspen Plus, Hysys, PRO II, GateCycle) | The student is able to use simulation and modelling applications (e.g. Aspen Plus, Hysys, PRO II, GateCycle) |
| 12 | Operation of the Linux system | Ability to use the Linux operating system with ease | The student is able to use the Linux operating system with ease |
| 13 | Analytical software | Ability to use analytical and/or research software for analysis and testing of geological samples | The student is able to use analytical and/or research software for analysis and testing of geological samples |
| 14 | Applications for designing of maps and plans | Ability to use Applications for designing and analysis of maps and plans | The student is able to use applications for designing and analysis of maps and plans. |

| Specialist Skills | | | |
|---|---|---|---|
| Item No. | Name | Competence description | Educational result |
| 15 | Seismic and geophysical measurements | Ability to schedule and carry out seismic and geological measurements | The student is able to schedule and carry out seismic and geological measurements |
| 16 | Scripting language programming | Ability of programming in scripting languages (e.g. Python, Perl, PHP, JavaScript) | The student is able to programme in scripting languages (e.g. Python, Perl, PHP, JavaScript) in a practical manner to solve problems typical for the sector corresponding to his/her profile of education. |
| 17 | C language programming | Ability to programme in C language | A student is able to use C language programming in a practical manner to solve problems typical for the sector corresponding to his/her education. |
| 18 | C++ language programming | Ability to programme in C++ language | The student is able to use C++ language programming in a practical manner to solve problems typical for the sector corresponding to his/her profile of education. |
| 19 | Java language programming | Ability to programme in Java language. | A student is able to use Java language programming in a practical manner to solve problems typical for the work in the sector corresponding to his/her profile of education. |
| 20 | Designing of power installations | The student is able to design power grids and installations. | The student is able to design power grids and installations. |
| 21 | Designing of electric installations | Ability to design electrical grids and installations. | The student is able to design electrical grids and installations. |
| 22 | Designing of gas installations | Ability to design gas networks and installations. | The student is able to design gas networks and installations. |
| 23 | Designing of HVAC facilities | Ability to design HVAC installations and networks. | The student is able to design HVAC installations and networks. |
| 24 | Designing of renewable energy source installations | Ability to design grids and installations related to renewable energy sources. | The student is able to design grids and installations related to renewable energy sources. |
| 25 | Designing of current water and sewage installations. | Ability to design current water and sewage systems and installations. | The student is able to design current water and sewage systems and installations. |
| 26 | Designing of power devices and facilities | Ability to design, set in operation and test power facilities (including feeding devices) | The student is able to design, set in operation and test power facilities (including feeding devices). |
| 27 | Preparation of samples | Ability to prepare samples for laboratory tests, in a proper manner. | The student is able to prepare samples for laboratory tests, in a proper manner. |
| 28 | Technical drawing | Ability to develop, analyse and review technical drawings. | The student is able to develop, analyse and review technical drawings. |
| 29 | Low-voltage systems | Ability to design and operate low-voltage systems (for instance, SAP, CCTV, DSO, SSWIN, KD, BMS, etc.) | The student is able to design and operate low-voltage systems (for instance, SAP, CCTV, DSO, SSWIN, KD, BMS, etc.) |

| Business Knowledge and Skills | | | |
|---|---|---|---|
| Item No. | Name | Competence description | Educational result |
| 1 | Economics | Ability to analyse, calculate and practically apply key profitability parameters concerning the application of various solutions (for instance, investment profitability, return form investment, depreciation/amortisation, etc.) | The student is able to apply knowledge on the profitability of various solutions, using the analysis and calculations of important parameters/indices (for instance, return from investment, depreciation/amortisation, etc.) |
| 2 | Business etiquette | Knowledge and practical application of business savoir-vivre rules. Ability to behave according to standards, and to select proper dressing and adequate language register, also in the context of customer relations and international cooperation. | The student possesses knowledge about business savoir-vivre. He/she is able to behave according to standards (including the selection of proper dressing, use of a language register adequate to situation etc.) |
| 3 | Investment financing | Knowledge about various forms and methods for the financing of investments and other performed projects | The student possesses knowledge about various forms and methods for the financing of investments and other sector projects. |
| 4 | Marketing | Knowledge about marketing methods and techniques | The student possesses general knowledge about marketing. |
| 5 | Negotiations | Ability to conduct business negotiations and knowledge of their rules | The student is able to conduct trade negotiations according to art. |
| 6 | New trends | Knowledge about new trends in the sector, development directions and technical novelties specific to a given sector. | The student possesses knowledge about technical novelties, development directions and about development trends in the sector related to his/her profile of education. |
| 7 | Business offers | Ability to prepare and analyse commercial and business offers, including the diagnostics of customer needs and expectations. Ability to develop optional solutions, etc. | The student is able to analyse and prepare commercial offers and optional solutions with regard to customer needs and expectations. |
| 8 | Holistic perspective | Knowledge and understanding of social and professional roles which are present in the project execution process (for instance, investor, customer, external customer, user, designer, contractor, maintenance worker, etc.) Application of own actions and co-ordination of own tasks with regard to differences related to the specific features of the aforementioned roles. | The student possesses knowledge on various social and professional roles present in the process of the execution of projects related to the sector (for instance, investor, external and internal customer, user, contractor, etc.) He/she is able to adjust and coordinate his/her own actions with regard to differences related to the specific features of the aforementioned roles. |
| 9 | Law and legal regulations | Knowledge about and understanding of laws, regulations, parliamentary acts and standards specific to the sector. | The student possesses knowledge about laws and regulations specific to the sector related to his/her profile of education. He/She knows and understands certain laws, regulations and standards. |

| Business Knowledge and Skills | | | |
|---|---|---|---|
| Item No. | Name | Competence description | Educational result |
| 10 | Knowledge about the sector | Knowledge about entities operating in the sector, and of their environment; understanding of specific aspects and context related to behaviour in the sector; acquaintance with key opinion leaders. | The student knows specific features of the sector related to his/her profile of education. He/She knows and understand the role of entities operating on the market as well as their business and organisational environment. |
| 11 | Public procurement | Knowledge about procurement laws and regulations in force. | The student possesses knowledge about procurement laws and regulations. |
| 12 | Investment management | Knowledge about the execution of investments and the ability to use the same in an effective manner in order to carry out investment projects. | The student possesses knowledge about the rules of investing and is able to use the same in an effective manner in order to carry out investment projects. |
| 13 | Project management | Ability to effectively manage the activities of project teams | The student is able to effectively manage the activities of project teams. |
| 14 | Knowledge of AGILE methods in project management | Ability to work effectively in groups using soft project management methods (AGILE, SCRUM, etc.) | The student is able to work effectively in project groups managed by the rules of soft management methods (for instance, AGILE, SCRUM). |
| 15 | Knowledge of standard management methods | Ability to work effectively in groups using standard ("hard") project management methods (for instance, PMBok, PRINCE2) | The student is able to work effectively in project groups managed by the rules of standard management methods (for instance, PMBok, PRINCE2). |

| Soft Skills | | | |
|---|---|---|---|
| Item No. | Name | Competence description | Educational result |
| 1 | Adaptive skills | Easy and quick adaptation to changing conditions | The student is able to adjust his/her own habits and behaviours to changing conditions. |
| 2 | Initiative | Initiating new activities and assuming responsibility related thereto | The student is able to initiate, at his/her own, a new action (initiative) in a certain organisational and social context, and to assume responsibility for the performance of the initiative. |
| 3 | Innovation | Generating of ideas, creating and implementing new solutions stream-lining working processes | The student is able to generate his own new ideas (innovations), in a certain organisational and social environment, as well as to develop and implement the same in an innovative manner in order to solve problems. |
| 4 | Written communication | Development and presentation of messages in writing, development of clear written reports | The student is able to develop and present messages, professional documents and reports in a written form, using an adequate language register and form comprehensible for the recipient/commissioning party. |

| Soft Skills | | | |
|---|---|---|---|
| Item No. | Name | Competence description | Educational result |
| 5 | Oral communication | Presentation and delivery of information in the verbal form,; ability to speak smoothly and fluently | The student is able to communicate smoothly with other people, and to develop and present information in the verbal form, using the language and form comprehensible to the recipients. |
| 6 | Organisation of own work | Scheduling of own work and organising actions purported to carry out plans; assigning priorities to tasks | The student is able to organise his own actions and time in a reasonable manner, as well as to assign priorities and optimise their performance. He/she is able to assign clear and challenging targets in his/her work on a specified task. |
| 7 | Goal-oriented | Attainment of long- and short-term targets assigned to the position | The student is able to understand and accept short- and long-term targets of the organisation in which he/she operates, and then undertake actions in order to perform them in a timely manner. |
| 8 | Customer-focused | Satisfying customer needs and expectation, consideration of customer's perspective when offering solutions | The student is able to identify needs and expectation of the recipients of his actions (customers or beneficiaries) in the organisation in which he/she operates, and then to apply knowledge to undertake actions purported to satisfy them. |
| 9 | Coping with stress | Acting effectively and with ease in stressing situations | The student is able to act under pressure, using effective strategies to cope with stress. |
| 10 | Being concerned about quality | Actions compliant with the organisation's rules, regulations and procedures, diligence and accuracy in the performance of tasks | The student is able to identify quality criteria applicable to his/her own work (perceived as the fulfilment of the expectations of the customer or the beneficiary of his/her actions). He/She is able to identify the manner in which his/her actions are translated into the result of the organisation, and then to undertake actions compliant with the spirit and letter of rules in force, in a specific organisational context; he/she is diligent and accurate in performing the same. He/she cares of quality and diligence of the performance of his/her tasks. |
| 11 | Learning | Easy and quick learning new knowledge | The student is able to effectively and quickly assimilate new knowledge. |
| 12 | Ability to influence others | Influence on others, persuasion with the use of real arguments and other means of influence, assertiveness in presenting own views | The student is able to conduct substantive discussions, and use arguments to convince others, and to defend his/her own view in a given organisational milieu without giving rise to antagonising relations. |

| Soft Skills | | | |
|---|---|---|---|
| Item No. | Name | Competence description | Educational result |
| 13 | Intercultural "sensitivity" | Practical use of knowledge concerning inter-cultural differences, adjusting own behaviour to different cultural patterns | The student is able to adjust his/her behaviour in the organisation to different cultural patterns. He/She is able to identify cultural determinants of various human behaviours in the organisation. He/she is able to respect differences in viewpoints and cultural differences of co-workers and customers. |
| 14 | Collaboration | Effective work in a group, focus on the performance of group targets | The student is open to co-operation and is able to work with others in the group, assuming a role in the group, which helps to achieve group targets. |
| 15 | Commitment | Enthusiasm and passion for work, "Can do" approach, care of the company's image | The student is able to engage into actions and demonstrate enthusiastic approach and passion for the performance of tasks. He/she acknowledges that the care of the company's image is important in a given organisational context. |
| 16 | Analytical skills | Collecting and processing of information with ease, quickly and reliably | Regardless of conditions, he/she is able to quickly and reliably search, analyse and process information required in order to perform a task. |

| Foreign languages and other requirements | | | |
|---|---|---|---|
| Item No. | Name | Competence description | Educational result |
| 1 | Readiness /ability to work various hours | Flexibility as to working hours, taking overtime jobs with an option to get leave in return of the overtime worked | N/A |
| 2 | English | Ability to use the foreign language in a degree allowing effective and smooth oral and written communication. (B2 level) | The student is able to communicate verbally and in writing in a given language at least at the B2 level of the Common European Framework of Reference for Languages (CEFRL or CEF). (He/She is able to understand the key aspects of real or abstract problems presented in complex texts, including specialist discussion related to his/her professional matters. He/She is able to communicate smoothly and spontaneously so that a conversation with a native speaker is free from stresses on either party to the conversation. He/She is able to express himself/herself in many topics in a clear and detailed manner; he/she is able to express his/her opinion on a given subject showing positive and negative sides of various (proposed) options. |
| 3 | German | | |
| 4 | Russian | | |
| 5 | French | | |
| 6 | Italian | | |
| 7 | Spanish | | |
| 8 | Chinese | | |
| 9 | Japanese | | |

| Foreign languages and other requirements | | | |
|---|---|---|---|
| Item No. | Name | Competence description | Educational result |
| 10 | Mobility | Acceptance of requests to take travels related to business responsibilities and learning (conferences, training sessions) outside the location of his/her employment. | N/A |
| 11 | Focus on development | Willingness to broaden his/her knowledge and skills at his/her own, also in new fields and areas. | The student acknowledges the need of constant development of his knowledge and skills, also in new fields and areas. |
| 12 | Ability to use MS Office, Open Office or Google Docs applications | Effective use of key office software packets | The student is able to use and apply office software (MS Office, OpenOffice, Google Docs) in his/her work. |
| 13 | Driving license | Possession of the category B driving licence | N/A |
| 14 | Technical English | Ability to use foreign specialist language so that maintenance, comprehension and creation of technical documents, as well as oral and written communication with other representatives of the sector are possible. | The student is able to use foreign specialist language so that maintenance, comprehension and creation of technical documents, as well as oral and written communication with other representatives of the sector are possible. |
| 15 | Technical English | | |
| 16 | Integrity | Observance of commonly accepted moral standards. | The student accepts the need of ethic behaviour standards and integrity as well as he/she follows them in his/her actions. |
| 17 | Mathematical skills | Ability to perform advance mathematical operations | The student is able to perform various mathematical operations in order to solve problems and generate knowledge. |
| 18 | SEP licences | Possession of licences awarded by the Association of Polish Electrical Engineers (SEP) | N/A |

# APPENDIX 2 QUANTITATIVE DATA SHEET

| Specialist Knowledge | | | | | | | |
|---|---|---|---|---|---|---|---|
| Name | Importance in 2014 | Importance in 2019 | Difficulties in acquiring | % of fields of study producing given educational results | Educational results scoring | Universities' task as perceived by business | Universities' task as perceived by universities |
| General technical knowledge | 4.58 | 4.33 | 3.18 | 88% | 4.13 | 4.50 | 4.60 |
| Effective power management | 4.50 | 4.70 | 4.20 | 71% | 3.71 | 4.30 | 4.50 |
| Automation of installations | 4.38 | 4.38 | 3.54 | 59% | 4.09 | 4.38 | 4.58 |
| Renewable power source installations | 4.25 | 4.33 | 3.60 | 65% | 4.00 | 4.36 | 4.25 |
| Electronics and electrical engineering | 4.17 | 4.33 | 2.82 | 71% | 3.62 | 4.36 | 4.31 |
| Conventional power engineering | 4.10 | 4.00 | 3.20 | 71% | 3.79 | 4.20 | 4.29 |
| Solar energy and photovoltaic engineering | 4.10 | 4.11 | 3.75 | 53% | 4.00 | 4.11 | 4.58 |
| Electric and power installations | 4.00 | 4.08 | 3.00 | 59% | 3.43 | 4.20 | 4.62 |
| Knowledge of building materials | 3.88 | 4.00 | 3.50 | 41% | 3.63 | 4.00 | 3.56 |
| Device drivers | 3.83 | 3.67 | 3.30 | 53% | 3.91 | 4.36 | 4.33 |
| Heating installations | 3.78 | 4.11 | 3.50 | 53% | 3.00 | 4.11 | 3.64 |
| Water power engineering | 3.75 | 3.50 | 4.29 | 47% | 3.83 | 4.43 | 4.25 |
| Biofuels | 3.75 | 3.63 | 3.80 | 41% | 3.40 | 4.43 | 4.50 |
| Gas installations | 3.38 | 3.63 | 3.33 | 35% | 2.89 | 4.38 | 4.22 |
| Ventilation and air-conditioning installations | 3.33 | 3.83 | 3.67 | 53% | 3.50 | 4.20 | 4.20 |
| Current water and sewage systems | 3.25 | 3.13 | 3.17 | 35% | 3.00 | 3.67 | 4.00 |
| Wind power engineering | 3.25 | 3.38 | 3.80 | 41% | 3.54 | 3.80 | 4.15 |
| Geophysics | 3.25 | 3.25 | 3.50 | 18% | 3.60 | 4.50 | 4.50 |
| Measurement methods | 3.11 | 2.89 | 3.17 | 29% | 4.00 | 3.83 | 4.22 |
| Geothermal power engineering | 3.00 | 3.00 | 3.50 | 53% | 3.45 | 4.60 | 4.55 |
| Chemistry | 3.00 | 3.14 | 3.67 | 53% | 3.40 | 4.25 | 4.33 |
| Geography | 2.40 | 2.20 | 4.00 | 35% | 3.25 | 3.00 | 3.78 |

| Specialist Skills | | | | | | | |
|---|---|---|---|---|---|---|---|
| Name | Importance in 2014 | Importance in 2019 | Difficulties in acquiring | % of fields of study producing given educational results | Educational results scoring | Universities' task as perceived by business | Universities' task as perceived by universities |
| Operation of 3D designing applications | 4.88 | 4.88 | 3.38 | 76% | 3.79 | 4.38 | 4.33 |
| Designing of power installations | 4.50 | 4.44 | 3.38 | 41% | 3.70 | 4.13 | 4.08 |
| Selection of equipment | 4.33 | 4.44 | 3.63 | 76% | 4.07 | 3.38 | 4.15 |
| Designing of power devices and facilities | 4.25 | 4.00 | 3.57 | 29% | 3.50 | 4.14 | 4.10 |
| Seismic and geophysical measurements | 4.20 | 3.50 | 3.67 | 29% | 4.20 | 4.67 | 4.38 |
| Designing and technical documentation | 4.13 | 4.13 | 3.57 | 76% | 3.93 | 3.75 | 4.58 |
| Designing of renewable power source installations | 4.11 | 4.11 | 3.88 | 47% | 3.82 | 3.75 | 4.27 |
| Designing of electric installations | 4.10 | 4.25 | 2.88 | 47% | 3.64 | 4.25 | 4.09 |
| Designing of HVAC facilities | 4.00 | 4.00 | 4.50 | 41% | 3.45 | 5.00 | 4.22 |
| Energy audit calculations | 4.00 | 4.50 | 3.33 | 53% | 4.00 | 3.67 | 3.91 |
| Operation of electronic system designing applications | 4.00 | 4.00 | 3.40 | 18% | 2.78 | 4.00 | 3.89 |
| Operation of simulating engineering applications | 4.00 | 4.50 | 4.50 | 47% | 4.38 | 4.50 | 4.56 |
| Applications for designing of maps and plans | 3.86 | 3.86 | 3.29 | 41% | 3.50 | 4.43 | 4.33 |
| C++ language programming | 3.83 | 3.80 | 3.60 | 47% | 3.64 | 4.60 | 3.91 |
| Interpretation of geological data | 3.80 | 3.40 | 4.00 | 35% | 4.17 | 4.33 | 4.33 |
| Analytical software | 3.75 | 4.00 | 4.00 | 29% | 3.80 | 4.67 | 4.25 |
| Technical drawing | 3.71 | 3.71 | 2.83 | 82% | 3.73 | 4.00 | 3.92 |
| Low-voltage systems | 3.67 | 3.00 | 3.50 | 35% | 4.43 | 4.50 | 4.10 |
| Operation of process quality control applications | 3.50 | 3.50 | 4.00 | 12% | 2.67 | 4.00 | 4.25 |
| Preparation of samples | 3.50 | 3.25 | 3.50 | 41% | 3.44 | 4.33 | 4.29 |

| Specialist Skills | | | | | | | |
|---|---|---|---|---|---|---|---|
| Name | Importance in 2014 | Importance in 2019 | Difficulties in acquiring | % of fields of study producing given educational results | Educational results scoring | Universities' task as perceived by business | Universities' task as perceived by universities |
| Process modelling | 3.33 | 3.33 | 3.50 | 47% | 3.50 | 4.00 | 4.56 |
| Operation of the Linux system | 3.25 | 3.67 | 3.33 | 53% | 3.42 | 4.00 | 3.91 |
| Designing of gas installations | 3.20 | 3.67 | 3.50 | 24% | 2.83 | 3.80 | 3.71 |
| C language programming | 3.20 | 3.00 | 3.50 | 53% | 3.50 | 4.25 | 4.10 |
| Java language programming | 3.00 | 3.00 | 3.00 | 47% | 3.00 | 4.00 | 3.90 |
| Operation of software supporting testing processes | 2.67 | 2.67 | 3.00 | 6% | 3.00 | 3.33 | 4.00 |
| Designing of current water installations and. .. | 2.60 | 2.80 | 2.75 | 12% | 2.80 | 3.20 | 3.83 |
| Automation of tests | 2.33 | 2.00 | 3.50 | 6% | 2.33 | 3.50 | 3.75 |
| Scripting language programming | 2.33 | 3.00 | 3.50 | 47% | 3.09 | 4.00 | 4.00 |

| Business Knowledge and Skills | | | | | | | |
|---|---|---|---|---|---|---|---|
| Name | Importance in 2014 | Importance in 2019 | Difficulties in acquiring | % of fields of study producing given educational results | Educational results scoring | Universities' task as perceived by business | Universities' task as perceived by universities |
| Investment management | 4.60 | 4.40 | 3.80 | 18% | 3.00 | 4.60 | 4.00 |
| Law and legal regulations | 4.56 | 4.56 | 3.56 | 94% | 3.69 | 4.11 | 4.13 |
| Knowledge about the sector | 4.44 | 4.56 | 3.78 | 82% | 4.07 | 3.00 | 4.60 |
| New trends | 4.44 | 4.56 | 3.88 | 88% | 4.12 | 3.75 | 4.60 |
| Investment financing | 4.43 | 4.71 | 3.86 | 76% | 3.36 | 4.00 | 3.93 |
| Knowledge of AGILE methodology in project management | 4.40 | 4.40 | 4.00 | 29% | 3.00 | 4.60 | 3.00 |
| Project management | 4.40 | 4.50 | 3.67 | 65% | 3.31 | 4.30 | 3.85 |
| Business offers | 4.38 | 4.50 | 3.25 | 41% | 2.91 | 3.75 | 3.45 |
| Economics | 4.30 | 4.10 | 3.50 | 82% | 3.93 | 4.30 | 4.33 |
| Knowledge of standard management methods | 4.29 | 4.43 | 4.20 | 35% | 3.14 | 4.50 | 3.78 |
| Business etiquette | 4.25 | 4.43 | 3.57 | 53% | 3.09 | 4.00 | 3.31 |
| Holistic perspective | 4.17 | 4.60 | 3.60 | 47% | 3.09 | 3.20 | 3.27 |
| Public procurement | 4.00 | 4.71 | 3.29 | 29% | 2.78 | 3.86 | 3.22 |
| Negotiations | 4.00 | 4.13 | 3.71 | 41% | 2.82 | 3.75 | 3.55 |
| Marketing | 3.71 | 3.57 | 3.33 | 71% | 3.13 | 3.43 | 3.86 |

| Soft Skills | | | | | | | |
|---|---|---|---|---|---|---|---|
| Name | Importance in 2014 | Importance in 2019 | Difficulties in acquiring | % of fields of study producing given educational results | Educational results scoring | Universities' task as perceived by business | Universities' task as perceived by universities |
| Coping with stress | 4.70 | 4.56 | 3.44 | 65% | 3.82 | 3.56 | 4.29 |
| Oral communication | 4.60 | 4.30 | 3.89 | 76% | 3.25 | 4.00 | 3.92 |
| Learning | 4.60 | 4.78 | 3.44 | 88% | 4.00 | 4.25 | 4.47 |
| Customer-focused | 4.56 | 4.56 | 3.50 | 65% | 3.21 | 3.50 | 3.92 |
| Commitment | 4.56 | 4.50 | 3.57 | 71% | 3.50 | 3.25 | 3.92 |
| Analytical skills | 4.56 | 4.44 | 3.22 | 82% | 3.69 | 3.88 | 4.47 |
| Being concerned about quality | 4.50 | 4.30 | 3.70 | 65% | 3.43 | 3.90 | 4.23 |
| Collaboration | 4.43 | 4.29 | 3.67 | 71% | 3.71 | 3.83 | 4.15 |
| Initiative | 4.40 | 4.30 | 4.00 | 71% | 3.67 | 3.33 | 4.07 |
| Organisation of own work | 4.38 | 4.13 | 3.63 | 76% | 3.60 | 3.57 | 4.43 |
| Adaptive skills | 4.33 | 4.25 | 3.63 | 76% | 4.14 | 3.50 | 4.62 |
| Innovation | 4.30 | 4.60 | 3.89 | 71% | 3.27 | 3.89 | 4.20 |
| Goal-oriented | 4.13 | 4.00 | 3.50 | 82% | 3.67 | 3.20 | 4.08 |
| Written communication | 4.00 | 3.88 | 3.50 | 76% | 3.25 | 3.75 | 4.06 |
| Ability to influence others | 3.63 | 3.63 | 3.57 | 76% | 3.19 | 3.17 | 4.00 |
| Intercultural "sensitivity" | 3.63 | 4.14 | 3.40 | 65% | 3.58 | 3.20 | 4.08 |

| Foreign languages and other requirements | | | | | | | |
|---|---|---|---|---|---|---|---|
| Name | Importance in 2014 | Importance in 2019 | Difficulties in acquiring | % of fields of study producing given educational results | Educational results scoring | Universities' task as perceived by business | Universities' task as perceived by universities |
| Ability to use MS Office, Open Office or Google Docs applications | 4.82 | 4.64 | 2.18 | 94% | 4.69 | 3.70 | 4.47 |
| Driving license | 4.80 | 4.40 | 2.25 | – | – | 1.50 | |
| English | 4.67 | 4.67 | 2.91 | – | – | 4.55 | |
| Integrity | 4.67 | 4.57 | 3.50 | 82% | 3.53 | 2.83 | 4.67 |
| Technical English | 4.58 | 4.42 | 3.50 | – | – | 4.64 | – |
| Focus on development | 4.55 | 4.50 | 3.30 | 88% | 4.00 | 3.88 | 4.54 |
| Mobility | 4.40 | 4.33 | 2.75 | – | – | 2.33 | – |
| Readiness /ability to work various hours | 4.00 | 3.78 | 2.75 | – | – | 2.40 | – |
| Licences and authorisations | 3.70 | 3.60 | 2.89 | – | – | 2.67 | – |
| Mathematical skills | 3.38 | 3.38 | 2.75 | 94% | 4.12 | 4.29 | 4.69 |
| German | 3.29 | 3.43 | 3.40 | – | – | 4.50 | – |
| Technical English | 3.14 | 3.33 | 4.00 | – | – | 4.40 | – |
| Russian | 3.00 | 3.38 | 4.00 | – | – | 4.33 | – |
| Chinese | 2.33 | 3.60 | 5.00 | – | – | 4.00 | – |
| Italian | 2.17 | 2.00 | 4.50 | – | – | 3.00 | – |
| French | 2.14 | 2.33 | 2.67 | – | – | 3.25 | – |
| Spanish | 2.00 | 2.20 | 4.00 | – | – | 3.67 | – |
| Japanese | 1.83 | 2.40 | 4.00 | – | – | 3.67 | – |

# APPENDIX 3 OVERVIEW OF THE TOOLS USED

## DEMAND QUESTIONNAIRE

The tool for competence demand survey applied in two formats: the electronic on-line form (using Limesurvey software) and MS Excel sheet (where a given company preferred direct contact with the pollster).

The tool consisted in 3 main parts

1. **Company particulars and plans**

– company's name

– number of employees employed under a labour contract by the company or its Kraków's branch

– number of employees under a civil law contract or self-employed entrepreneurs employed by the company or its Kraków's branch

– names of positions to which the company recruits employees most frequently (maximum: 5 positions) and the assessment of difficulties in recruiting candidates who meet expectations (currently and in 2019)

– plans concerning the employment of graduates (individuals who graduated within the last 12 months) under a labour contract (in 2014 and 2019).

– plans concerning the employment of graduates (individuals who graduated within the last 12 months) under civil law contracts or as self-employed persons (in 2014 and 2019).

2. **Assessment of competences by 5 thematic groups (in sequence: specialist knowledge, specialist sills, business knowledge and skills, soft skills, foreign languages and other requirements – list available in Appendix 1, this based on four criteria:**

– importance today (How important it is for your company, that students or graduates possess a given competence, where 1 means: "definitely irrelevant" while 5 means "definitely important")

– importance in 5 years (How important it is for your company, that students or graduates will possess a given competence in 5 years, where 1 means: "definitely irrelevant" while 5 means "definitely important")

– difficulties in acquiring the competence (How difficult it is today to recruit a person whose competence level meets requirements, where 1 means "very easily", while 5 means "very difficult to acquire".

– university task (Is, in your opinion, the teaching of a given competence a task of universities?) Please use scores from 1 to 5 where 1 means "teaching of a given competence definitely should not be a task of universities", while 5 means "teaching of a given competence should be definitely a task of universities")

– using the same criteria, provide and asses maximum 10 additional competences that have not been put on lists previously presented.

3.

**Additional information**

– indication of 5 fields of study that meet best the needs of the company (maximum 5 fields of study; if necessary, also indicate the name of the university)

– indication of maximum 5 competences that are of vital importance in the context of the advancement of a graduate employed by your company

– additional comments

## SUPPLY QUESTIONNAIRE

The tool for competence supply survey applied per analogy to the demand questionnaire, in two formats: the electronic on-line form (using Limesurvey software) and MS Excel sheet (where a representative of a field of study subject to survey preferred direct contact with the pollster).

The supply questionnaire consisted in 3 parts

1. **Particulars**

– name of the university, department, chair, institute and the field of study

– available forms of studying of the given field of study (full-course studies, other)

– available levels of studies offered in the given field of study (level I, level II, post-graduate studies, other)

– indication of specialisation paths/profiles/specialisations which, in the view of the sector, achieve similar educational results

– scheduled number of graduates from each of the aforementioned paths (in 2014 and in 2019)

2. **Assessment of competences by 5 thematic groups (in sequence: specialist knowledge, specialist sills, business knowledge and skills, soft skills, other requirements – list available in Appendix 1, based on two criteria:**

– obtained educational results (To what degree, in your opinion, educational results referred to in this questionnaire are obtained at the field of study, where 1 means "not obtained at all", while 5 means "obtained at a very high level")

– tasks of the university (Is, in your opinion, education for a specific educational result a task of the university, where 1 means: "definitely not", while 5 means: "definitely yes".)

3. **Additional information**

– indication of additional educational results which are obtained at a given field of study, but have not been put on the list, and are potentially important from the point of view of the sector

– indication of mandatory courses in foreign modern languages and opportunities to learn other languages free-of charges

– additional comments