



STUDY OF COMPETENCES

**PASSIVE AND LOW-ENERGY
BUILDING 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 passive and energy-saving building sector. The development of the sector should be one of the most important components of the city development strategy, due to social, economic and promotional benefits that such development may offer. For the purpose of the study, the aforementioned sector is considered to be **a sector engaging in designing, constructing and managing energy-saving and passive buildings, including audit of the demand of buildings for heat and electric energy, thermal insulation of the existing buildings, consulting and audits of the energy performance of buildings**. Problems related to the exploitation of renewable energy sources, which are close to the sector described in this report, have been discussed in a report on the power sector.

Based on the analysis of job offers and in-depth interviews with opinion leaders and representatives of businesses, we identified 80 competences of various importance, which are required from the graduates of Kraków's universities. The competences were divided into five areas: **specialist knowledge** (16 competences), **specialist skills** (13 competences), **business knowledge and skills** (14 competences), **soft skills** (16 competences) and **foreign languages and other requirements** (18 competences). At the next stages of research work, quantitative analysis related to the demand for competences (23 sector companies employing more than 1100 employees in total), was compared with results related to the supply of competences (12 fields, more than 20 specialisations of studies, to be completed by 1400 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 **integrity, knowledge about energy-saving technologies, effective power management, general technical and engineering knowledge, knowledge about building materials, as well as competences that will be demanded in a five-year perspective, including: designing of energy-saving buildings, designing of passive houses, ability to use simulation engineering applications**. Competences that are most difficult to acquire on the market are related to **designing of energy-saving buildings, HVAC facility control systems, initiative, energy consumption optimisation, effective power management and general technical and engineering knowledge**. We also present key information related to the dynamics of employment in the sector, which – in case of the passive and low-energy building sector – show an increasing tendency. Most graduates will be offered employment on the basis of civil law contracts or self-employment, but in the five-year perspective, the trend will be reversed. 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 presents the assessment of educational results as seen by employers (the definitions of the competences were "translated" into educational results). According to universities, competences important for employers most often achieved are: **general technical knowledge, knowledge about building materials, new trends, mechanical ventilation and air-conditioning installations, learning, integrity and ability to use office packets**.

Co-operation between universities and the representatives of businesses is gaining its momentum, although the co-operation may be said to be potential and informal rather than to have any systemic dimension.

The balance of competences contains also diagrams in which difficulties in acquiring competences were juxtaposed with educational results. **Employers indicated a number of shortages in the competences of graduates and university employees share their views in most cases.** Students do not acquire several competences important for the sector at more general fields of studies related to construction engineering and designing. The results show that it is impossible to acquire all such competences at these fields of studies. However, **students may acquire competences at an increasing number of post-graduate studies the curricula of which – due to their specialisation – are much better tailored to the needs of businesses.**

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

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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 energy-saving (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 extent 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 those 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 team, 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 Drożdżak (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 companies from the passive and energy-saving building sector¹: AEDES, AGA-Bauservice, AMT-Projekt, Archisystem, Architektura Pasywna Pyszczek i Stelmach, BAUTAM - Dawid Tamas, Budimex, Cocos Group, DLJM System, Eko Elprom, Ekoarchitekci.pl, E-SPIN, Frapol, GS Energia, MC2 Paweł Masełko, PRUSDIS S. PRUS, Syneko, Termster, Trade-Off, Wieliterm, WYDRA - Świadectwa energetyczne;
- representatives of universities associated with the sector: AGH University of Science and Technology (Faculty Electrical Engineering, Automatics, Computer Science and Biomedical Engineering, Faculty of Mining Surveying and Environmental Engineering, Faculty of Drilling, Oil and Gas and Environmental Protection, Faculty of Metals Engineering and Industrial Computer Science), Kraków Academy (Faculty of Architecture and Fine Arts), Kraków's University of Technology (Faculty of Architecture, Faculty of Civil Engineering, Faculty of Environmental Engineering, Faculty of Mechanical 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 build 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 Dukala, 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, SPP, 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 study², 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.)

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

- Skills – 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.)

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. Kraśniewski³ 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, 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 BPO/SSC or ITO/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.

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]

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 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 building 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 passive and low-energy building 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 68 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 passive

and low-energy building sector, the survey covered 23 companies in total, employing more than 1100 employees, which makes 34% of the survey sample realization; 13% 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 passive and low-energy building 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: 28)
- c. Structured interviews combined with filling in the supply questionnaire, purported to obtain quantitative data on currently achieved 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 achieved 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 achieved at a given field of study. For the purpose of the passive and energy-saving building sector survey, the questionnaire was filled up by the representatives of 12 fields of studies (out of the total of 20, including post-graduate studies), to be completed by 1400 students of full-time courses or other forms of study in 2014, which makes 43% of the sample realisation.

SECTOR DEFINITION

Generally speaking, the passive and energy-saving building sector covers all construction companies that apply materials and method increasing energy effectiveness of the building as well as enterprises manufacturing tools, equipment and materials which are necessary in the process of low-energy building construction. Such definition implies that actually any construction company from the following groups of the Polish Classification of Economic Activities (PKD) may meet the aforementioned criterion, although a number of such companies, for various reasons (such as investor's interest, know-how, etc.) may not necessarily execute energy-saving projects: 41.10Z Development of building projects, 41.20Z Construction of residential and non-residential buildings In a narrow sense of the definition the sector may cover companies whose one of their areas of activities is the development of buildings of high

exploitation parameters (below 70kWh/sq.m/year) for a low-energy building and below 15 kWh/m²/year for a passive house⁴). There are no precise statistical data that allow to classify construction companies to the construction industry or to the passive and low-energy building sector. The naming convention is not standardised⁵ so that a clear image of the situation could be produced. The low-energy building sector should be treated as an exceptional and integral element of the construction industry.

For the purpose of the study and after consultations with experts, the passive and low-energy building sector is considered to be **a sector engaging in designing, construction and managing low-energy and passive buildings, this including research on heat and power demand, thermal insulation of the existing building as well as consulting services and audits of the energy performance of building**. Problems related to the exploitation of renewable energy sources, which are close to the sector described in this report, have been discussed in a report on the power sector.

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

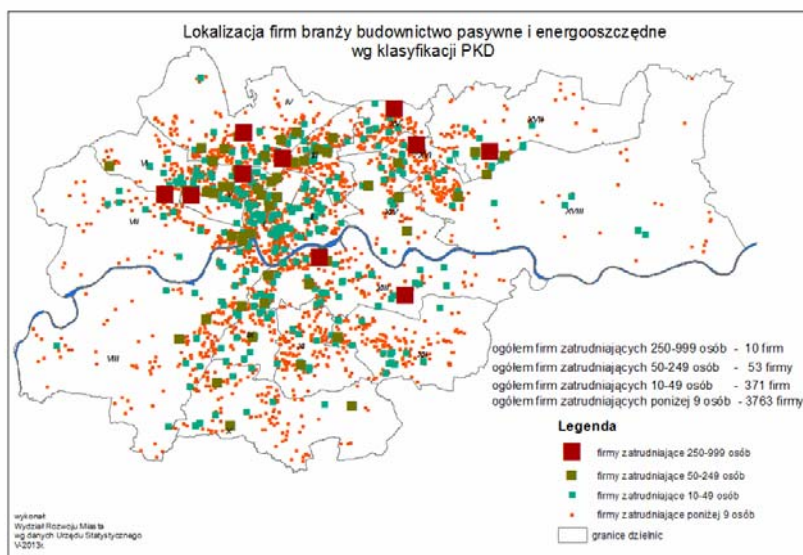


Figure 1. Location of construction companies in Kraków Source: Central Statistical Office (GUS). The graphics provided by the Kraków City Hall.

Legend:

Ogółem zatrudnionych 250 – 999 osób – 10 firm	Total headcount from 250 to 999 – 10 companies
Ogółem zatrudnionych 50 – 249 osób – 53 firmy	Total headcount from 50 to 299 – 53 companies
Ogółem zatrudnionych 10 – 49 osób – 371 firm	Total headcount from 10 to 49 – 371 companies

⁴ Cf: Węglarz, A., Pietraczyk, P., Stępień, R. (2011). *Energooszczędny dom i mieszkanie* [Energy-Saving House and Apartment]. KAPE.

⁵ There are various terms to describe buildings the projects of which intend to decrease energy consumption (in various degrees): e.h. energy-saving building, energy self-sufficient house, low-emission house, green house, ecological house, passive house, economic house, 3,5,7-litre house and many more. Detailed discussion of the foregoing may be found in *Low energy building in Europe: Current state of play, definitions and best practice* (http://ec.europa.eu/energy/efficiency/doc/buildings/info_note.pdf)

Nastawienie na rozwój	Total headcount below 9 – 3763 companies
Firmy zatrudniające 250 – 999	Companies with headcount from 250 to 999
Firmy zatrudniające 50 – 249	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 budownictwo pasywne i energooszczędne wg klasyfikacji PKD	Location of companies operating in the passive house and low-energy building sector, according to Polish Classification of Activities (PKD)

BASIC INFORMATION ABOUT THE SECTOR⁶

Buildings consume 40% of the total energy consumed in the European Union⁷. According to the ambitious Europa 2020 strategy⁸, the low-energy building sector is in the centre of actions purported to decrease energy consumption considerably. In 2010 the Technological Perspective Kraków-Małopolska 2020 was prepared and published under the guidance of the Kraków Technological Park⁹. The report was intended to select 10 technologies of the future, that – in Małopolska – are characteristic of a development potential being huge enough for the region to become a Polish leader in those technologies. One of the technologies mentioned therein is energy self-sufficient building engineering. Małopolska is characteristic of a high research and scientific potential related to the construction engineering, thanks, first of all, to its two technical universities. Low-energy building technology, as opposed to conventional/traditional building techniques, is based, in a higher degree, on advanced technologies, materials and precision of development. This provides an advantage to manufacturers and developers of higher standards and skills. Małopolska and Kraków, as compared to other regions of Poland, are recognisable players on the market of building construction services. Several companies manufacture materials and equipment necessary to furnish buildings. The growth of demand for energy-saving buildings and investments purported to improve energy performance of existing buildings may ensure a broader area for activities of small and medium enterprises as well as huge international players acting on the local market. The development of the sector would create higher demand not only for knowledge created in university centres, but also for skilled graduates from fields of study related to the construction industry. Such development could decrease unemployment and encourage many graduates to stay in the region. It would also help to develop research projects related to energy saving in the construction industry.

The low-energy building sector owes its strength, first of all, to favourable political atmosphere, many small architectonic studios and institutional support from the Cracow University of Technology and AGH. The Kraków's University of Technology educates not only engineers and

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 Eurostat (2010). Energy, transport and environment indicators.

⁸ European Commission (2010) Commission Communication. Europa 2020.Strategia na rzecz inteligentnego i zrównoważonego rozwoju sprzyjającego włączeniu społecznemu. [Strategy for Smart Sustainable and Inclusive growth] Brussels, 3.3.2010

⁹ Bendyk, E., Kisieliński, S. (ed.)(2010). Perspektywa technologiczna Kraków – Małopolska 2020 [Technological Perspective Kraków – Małopolska 2020]. Development challenges

architects for the staff of construction companies, but also carries out research related to low-energy building engineering. A specific example of such activities is Małopolskie Laboratorium Budownictwa Energooszczędnego [Małopolska Energy-Saving Building Laboratory] scheduled for opening in 2014. The unit, developed in co-operation with the Małopolska voivodship authorities and the town of Tarnów authorities will be the largest investment of such type in Poland. Researches to be carried out in the laboratory will cover not only technologies, but also the comfort of building users. The whole unit will be equipped with thousands of sensors so that an image of energy performance of the building is as complete as possible. The project of the laboratory is complementary to another training centre located in Tarnów, which is intended to be a support unit of the laboratory and a breeding ground for future developments.

In the recent dozen years, the free-market economy was accompanied by the establishing of many architectonic studios, offering energy-saving solutions in their portfolios. Although the building industry here is as dispersed as in other regions of Poland, and dominated by companies employing 10 or less workers, the potential of Małopolska and Kraków to become leaders in the development of low-energy buildings is noticeable. In interviews with experts, the problem of a broader application of energy-saving solutions in buildings was raised a couple of times. In this respect, Kraków and Małopolska are pioneers on the national scene. It was in Kraków, where passive sports halls were developed for the University of Agriculture¹⁰ and for the Słomniki municipality. The buildings were the first of such type in Poland¹¹. The scale of the building is of great importance for its energy performance, because of its size and greater difficulties in constructing separate thermal zones. The aforementioned developments posed a great challenge for designers and contractors. The sports halls eventually erected may be used as model solutions to be followed by later projects.

The research also shows that the Małopolska Voivodship Marshall Office plays a special role in the sector. The office is particularly engaged in the promotion of energy-saving and passive building¹², initiating and participating in a number of projects and congresses. The office is also the promoter of investments of this type over the whole region. The office also invested into the aforementioned Małopolska Energy-Saving Building Laboratory.

Kraków, as an important conference centre, also draws the attention of the organisers of energy-saving building sector. In 2012, the Building Modernisation Fair¹³ was organised. The support in terms of professional matters was provided by the Polish Institute of Passive Building. Promotion materials of the fair emphasised that the fair was, first of all, an opportunity to meet people from the sector and exchange knowledge about the latest energy-saving solutions. An important event of the national range was also Energodom¹⁴, a cyclic conference which was

¹⁰ <http://innowacyjnapolska2010.pl/wiecej-o-akcji.html>

¹¹ Architektura Pasywna (2010) [Passive Architecture]. Innowacyjna Polska 2010 – 2020 [Innovative Poland 2010 – 2020]. Wysokoenergooszczędne budynki pasywne w każdej polskiej gminie i mieście [Highly Energy-Saving Passive Buildings in Each Polish Commune and Town]. http://mistia.org.pl/pliki/1341835909_Wysokoenergooszczedne%20budynki%20pasywne%20w%20polskich%20gminach%20i%20miastach.pdf

¹² Urząd Marszałkowski Województwa Małopolskiego (2013). Model Transferu Innowacji w Małopolsce [Innovation Transfer Model in Małopolska]. <http://www.spin.malopolska.pl/>

¹³ Targi w Krakowie [Fairs in Kraków] (2012). Targi Modernizacji Budynków - premierowa edycja za nami [Building Modernisation Fair is Over]. <http://targi.krakow.pl/pl/strona-glowna/targi/targi-modernizacji-budynkow/strona-glowna.html>

¹⁴ <http://www.energodom.eu>

organised for the 11th time on the campus of the Kraków's University of Technology. Researchers engaged in low-energy buildings from Europe are invited to take part in the conference. Apart from conferences and fairs, also lectures and seminars are administered for non-academic public. An example of such event may be "Innovations in energy-saving, passive, close-to-zero energy building engineering"¹⁵. The range and variety of initiatives reflect well the interest in low-energy building engineering in Małopolska. It is clear that the Kraków's University of Technology and the Marshall Office play important roles in the sector.

BUSINESS AND SCIENCE

Quality research results show that co-operation between business and science in Kraków has an informal form of personal relations, which does not necessarily mean any systemic solution. It is logical that persons strongly related to the sector form a relatively small community of people often coming from a single scientific institution (for instance, faculty of architecture or engineering of the Kraków's University of Technology). Within the framework of co-operation several architectonic studios and construction companies engage research units, mostly of the Kraków's University of Technology, but also those of AGH, in order to consult non-standard solutions. The representatives of universities get placements in companies, although it is not a common practice. Research programmes are implemented, including the co-operation between business and science.

However, co-operation between companies and universities related to the curricula and education of students is still at an initial stage, which fact is admitted by the representatives of companies and universities almost in unison. It is hard to point out reasons behind such situation. However, a limited trust is clearly noticeable. "Accusations" coming from either side are of similar nature: lack of initiative, willingness and openness, as well as specific mentality or unclear awareness of own needs and expectations. In spite of the aforementioned psychological barriers, the representatives of companies as well as those of universities have hopes that the status quo will change in the future and closer co-operation ties will be established in the form of study tours, better arrangements of student's traineeships (which, in the opinion of both sides only rarely serve their purpose), indications coming from the labour market as to the modification of curricula as well as joint execution of projects. These are students that more and more often argue that curricula should be modified towards a closer contact with practice; these demands being put forward even by the students of the most appreciated fields of study. Technical universities educate students in energy-saving building engineering not only at MSc and engineer courses, but also at post-graduate studies. The Kraków's University of Technology opened post-graduate studies¹⁶ of energy-saving building engineering, audit and energy assessment of buildings. The studies are intended to integrate knowledge from various engineering and the most modern architectonic solutions in order to prepare professional staff for the energy-saving building sector. The increase of importance of construction of such type,

¹⁵ Małopolskie Obserwatoria Rozwoju Regionalnego [Małopolska Observatory of Regional Development (2012). Seminarium "Innowacje w budownictwie energooszczędnym, pasywnym, niemal zero energetycznym". [Seminar: "Innovations in Energy-Saving, Passive, Close-to-Zero Energy Building Engineering"] <http://www.obserwatoria.malopolska.pl/pl/maopolskie-obserwatorium-gospodarki/75-seminarium-qinnowacje-w-budownictwie-energooszczdnym-pasywnym-niemal-zero-energetycznymq>

¹⁶ http://www.pk.edu.pl/index.php?option=com_content&task=view&id=1058&Itemid=975

results in increased demand for managers of higher qualifications and contractors with proper expertise.

According to experts, the most important barrier in quick development of the sector not only in Kraków, but all over Poland, is legislative chaos in both: building laws, which do not set uniform standards of energy saving, and public procurement laws that do not provide any preferences for investments focused on long-term savings at a price of higher investment expenses. The programme of subsidies, currently in force, which is intended to prepare investors, designers, manufacturers of building materials and contractors to the requirements of the Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings¹⁷ is criticised for its rigorous formal requirements and limited market effects.

An important threat comes from a small number of graduates from vocational schools and decreased duration of field training offered to construction engineers. These facts result in the drop of qualifications. Shortages of competences – for a sector in which the precision and correctness of project performance are essential – are particularly dangerous. Lack of precision in the development of a building may thwart savings provided by the project. Considering challenges related to the quality of building development so that it meets implied energy-saving criteria, the market for energy audits and certificates will grow.

Experts are of the opinion that influence should be exerted on both: individual and institutional investors¹⁸ in order to accelerate the adoption of energy-saving standards, Obligations of Poland towards the European Union cause that in the next few years more and more energy-saving projects should be developed in Poland. Therefore, financial incentives and programmes promoting energy-saving building technologies should be offered as well as laws and regulations should be amended so that the purchase and construction of such buildings would be within the range of individual investors¹⁹. Public institutions are obliged to adapt energy-saving standards more promptly than individual investors. Hence, public procurement procedures should be made more flexible so that the decisive factor no longer would be the lowest price, but the relation between quality and price and the energy performance (which may be expressed in a long-term energy consumption level). In this context an important role may be played by the Kraków City Hall, promoting energy-saving solutions in public utility building and urban space. Of course, it would require that the training of the Kraków City Hall staff (for instance, the employees of the Department of Architecture and Urban Studies) should be strongly focused on energy-saving building technologies. And then, the Kraków City Hall could use its position to propose several additional initiatives: meetings with representatives of other local governments and conferences.

Another barrier in the development of the sector is the fact that in Poland there are not institutional forms of support to energy-saving building business and actions so far developed have only incidental nature and do not constitute any uniform strategy. In order to improve the

¹⁷ <http://www.nfosigw.gov.pl/srodki-krajowe/doplata-do-kredytow/doplata-do-kredytow-na-domy-energooszczedne/informacje-o-programie/>

¹⁸ Zob. <http://przegrodyb2b.pl/wydarzenia/z-firm/1793-kampania-szoste-paliwo-promuje-budownictwo-energooszczedne>

¹⁹ <http://www.administrator24.info/artukul/id5432,rzad-bedzie-promowac-budownictwo-energooszczedne>

situation the said directive should be implemented as soon as possible and competent institutions should be established not only to control the implementation of the directive and provide financial support to relevant projects, but, first of all, to launch information and promotional actions shaping consumer's awareness.

Consumer's lack of knowledge is hindering quick development of the sector. Education on relevant solutions and long-time savings is likely to be transposed into increased demand for and greater number of orders in the sector. Unfortunately, the dispersion of businesses in the sector does not allow any coordination of promotional actions. Hence, the involvement of the city authorities in the capacity of a co-ordinator and sponsor could play a significant role in the development of the sector. In spite of the fact that the research potential is immense and private business are willing to co-operate, there are no coordinated municipal initiatives. The town, as one of the largest property owners in Kraków, could become the leader and an exemplary investor for other investors and other municipalities.

SECTOR DEVELOPMENT OUTLOOK

The two factors that have the strongest impact on the development of the sector in Kraków as well as in any other town in Poland are the rising energy prices on the one hand, and the EU regulations, on the other. The meaning of the Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings should be emphasised in this context. In spite of the facts that the term in which Poland should have started to implement the directive into Polish legislation has lapsed and Poland is being threatened by penalty payments, while ecological organisations urge Poland to act, the government has not taken any actions in order to accelerate the implementation process, which implies that the term provided by the directive will be failed. Nonetheless, the directive will be a reference point for the building sector and for investors. Hence, the number of investments meeting criteria of energy-saving building should gradually increase.

The stress put on pro-ecological solutions in the building sector may be translated into regulatory provisions introducing various tax rates with respect to various solutions and thus accelerate the process of transition to more energy-saving technologies by the sector. Such strategy was applied in France, for instance²⁰. A tax incentive may make investor to apply more expensive, but more energy-efficient solutions. Without such incentive, an estimated period for the return of expenses incurred in order to significantly decrease demand of the building for energy lasts from 7 to 30 years²¹ and depends on the size and energy sources used for heating of the building .

If an optimistic scenario of the sector development comes true in Kraków and the guidelines of the European Union are not changed, houses constructed with the use of energy-saving technologies will become a standard. A quick development of low-energy building sector may have a positive effect in the increased demand for services of architectonic and design studios, as well as for advanced building materials and monitoring instruments, i.e. service of all sectors operating in the environment of the construction industry. Construction companies will record

²⁰ Cf.: Małopolska Energy-Saving Building Centre Wariant obszarowy modelu SPIN [Spatial Variant of the SPIN Model]. http://www.spin.malopolska.pl/images/Wariant%20obszarowy_PK_BE.pdf

²¹ *Low energy building in Europe: Current state of play, definitions and best practice* (http://ec.europa.eu/energy/efficiency/doc/buildings/info_note.pdf)

higher profit due to higher investment expenses for buildings of such type, which will have a favourable impact on the economy of the city.

PESTER AND SWOT ANALYSES

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

a) Political and legal environment

The low-energy building sector strongly depends on the political will of governments to implement EU regulations. Should EU is weakened or lose its power to influence member states, the pace of dissemination of the aforementioned technologies may be slowed down. A change in the policies of Poland or the implementation of EU regulations into the Polish legislation is inept, may give the effect of dead law, a law that is not effectively enforced.

b) Economic environment

The most important economic factor that determines the situation of the sector is the level of mineral fuel prices. Should the prices of fuel drop, then savings from reduced heat losses may be nullified and low-energy building technology may become less profitable. Another important factor of impact may be the economic crisis, which may result in the migration of professional staff to countries offering more favourable financial conditions. In such case costs of the construction of a building having a proper standard would increase, while its quality would drop. Another threat related to the economic crisis is the shortage of investment capital, which may delay the development of public and/or private investments.

Kraków and the Małopolska Region are the only areas in which the problems of energy-saving buildings meet with vivid actions. In 2008, the Passive and Low-Energy Building Cluster was established in Katowice and Kraków's universities are also engaged in the projects of the cluster. The location of the Śląsk Region in the vicinity of Kraków, stimulates co-operation and exchange of specialists, but also creates competition affecting local businesses.

c) Sociocultural environment

Pro-ecological social attitudes as a component of social processes may be a factor influencing the development of the passive and low-energy building sector. As the importance of ecological values grows in the social perception, the readiness of public to incur additional costs is growing. And vice versa, when the importance of such values decreases, a resistance of public against excessive legal control is becoming greater.

d) Technical environment

Where an inexpensive method for energy acquisition is developed, the economic profitability of the low-energy building may drop. On the other hand, there is progress in the development of technologies for absorption and storing of energy and in technologies of modern materials having better insulation properties. Where the prices of such materials are low (provided that the materials preserve proper characteristics) , then the costs of a low-energy building will decrease.

e) Natural environment

Where abrupt weather phenomena occur more frequently, then interest in low-energy building may increase because it will be easier to ensure comfort of living to residents, should connection with power grid or central heating system is broken.

f) Regulatory environment

In the event that formal regime of requirements of individual investors is softened, it may result in a greater number of subsidies and developed projects. On the other hand, imposing too many formal obligations on investors may discourage them from developing investments of such type.

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

Strengths of the low-energy building sector in the region:

- Recognisable technical universities
- Pilot projects for testing the usability of innovative solutions.
- Political support for sector development

Weaknesses of the low-energy building sector in the region:

- Low level of technology transfer between universities and businesses.
- No exemplary houses to show.

Opportunities of the low-energy building sector in the region:

- Appropriation of subsidies from central funds.
- Exploitation of the favourable situation created by the EU directives.

Threats to the low-energy building sector in the region:

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

DEMAND ANALYSIS

SECTOR DEMAND FOR COMPETENCES

An overview of findings in 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. There are also companies in which such policy is unreal and recruitment procedures refer exclusively 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 low-energy building sector
Designer (including architect designer, designer of installations, designer of interiors)
Assistant designer (junior designer)
Energy auditor, assistant to energy auditor, auditor
Construction engineer, construction site manager
Administration office posts, office assistant
Constructor (design engineer)
Automation specialist
Specialist in low-energy building technologies
Specialist in cooling and air-conditioning technologies
Specialist in electrical installations
Specialist in developing technical drawings
Visualisation specialist
Logistic specialist
Thermal insulation specialist
Contract specialist
Technical counsel, technical and commercial advisor
Commercial representative
Probationer

Table 1 List of jobs offered to graduates in the passive and low-energy building sector.

Employment of graduates in 2014	Employment of graduates in 2019
8.2%	14.7%
Increase in dynamics of employment of graduates	

Table 2 Dynamics of employment of graduates in the passive and low-energy building sector

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

Almost 60% of the employees of companies that participated in the research are employed under contracts of employment, and 40% - under civil-law contracts (Fig. 2).

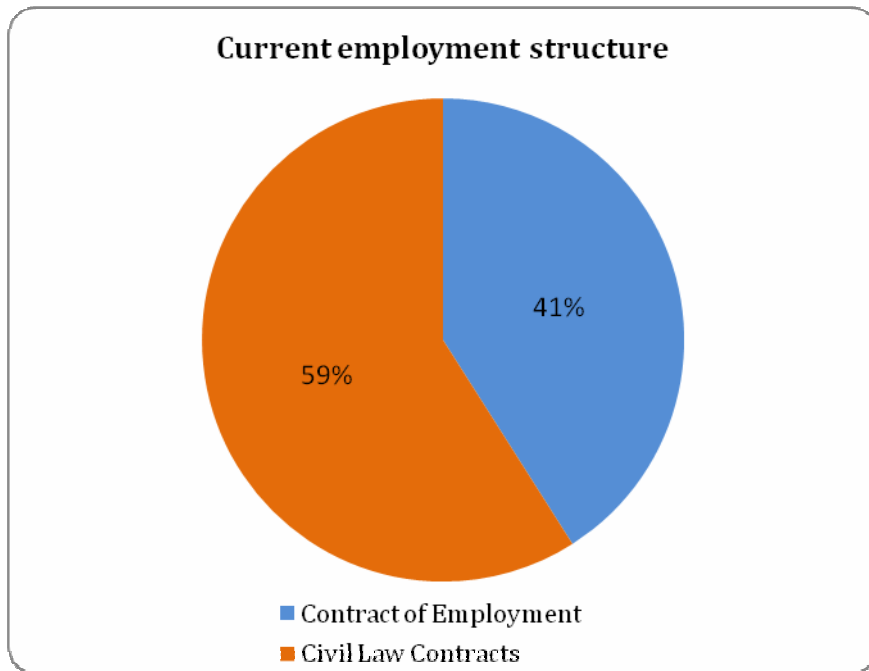


Figure 2. Structure of employment in the passive and low-energy building sector by contract type

Slightly different situation appears in the planned employment of graduates (Fig. 3) Companies intend to employ more graduates (60%) by means of civil-low contracts or as self-employed entrepreneurs in 2014, while only 40% of newly created positions will be offered under employment contracts. We could not observe any rules that would make larger companies different from micro- or small enterprises in this respect. In any case, the companies clearly declare that these are only estimates, rather than plans, which corresponds to the fact that the operations of the sector are based, to a considerable degree, on actually acquired projects. In the perspective of 5 years the relationship is supposed to be balanced, which may be just another indicator of optimism related to the situation of the sector in the future.

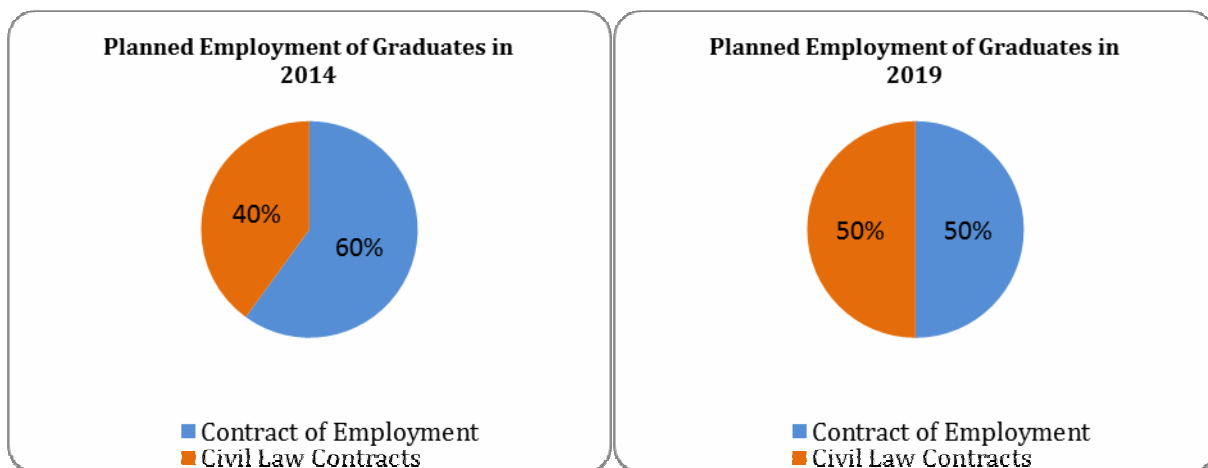


Figure 3. Structure of planned employment of university graduates in the passive and low-energy building sector by contract type in 2014 and 2019.

THE COMPETENCES OF TODAY AND THE COMPETENCES OF TOMORROW

Before we present results of research works related the importance of given competences for the passive and low-energy building 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**, which, to a certain degree – reflects the specific characteristics of the sector.

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 homogenous, 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 graduates labour market as the whole.** While interpreting the results, the following should be taken into consideration. For instance, the ability to design prefabricated buildings has been given low position (although the weight of the ability considerably increases in 2019). 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 - are the following competences: **integrity, knowledge about low-energy technology, effective power management, knowledge of building materials and general technical an engineering knowledge**²². The five competences that will become the most important in future are: **knowledge about low-energy technology, effective power management, ability to design passive and low-energy buildings, ability to develop and understand project documents.** It is also noteworthy that the importance of the following competences is increasing, namely: **operation of simulating engineering applications, operation of 3D designing applications or ability to operate equipment.** Generally saying, on the list of "the future" there are less soft skills and more specialist competences. However, not always does it mean that the importance

²² Precise definitions of these and other skills are provided in the Glossary in Appendix No.1.

of a given competence decreases. What is certain, is that the importance of specialist knowledge and skills increases most.

I seems that in the perspective of the whole sector, **the German language is underestimated**. Its importance is emphasised mostly by design studios, while for other businesses in the sector, it does not have a decisive meaning.

20 most important competences (requirements) today	Importance in 2014	20 most important competences (requirements) today	Importance in 2019
Integrity	4.88	Energy-saving technologies	4.82
Energy-saving technologies	4.84	Designing of low-energy buildings	4.72
Effective power management	4.67	Effective power management	4.69
General technical knowledge	4.65	Designing of passive houses	4.69
Knowledge of building materials	4.63	Project documentation	4.65
Ability to use MS Office, Open Office or Google Docs applications	4.61	Integrity	4.62
Being concerned about quality	4.60	Mechanical ventilation and air-conditioning installations	4.61
Mechanical ventilation and air-conditioning installations	4.57	Ability to use simulation software	4.60
Project documentation	4.56	Knowledge of building materials	4.59
Energy consumption optimisation	4.53	Energy consumption optimisation	4.59
New trends	4.50	Being concerned about quality	4.57
Learning	4.50	New trends	4.57
Thermal modernisation	4.50	Ability to operate equipment	4.56
Organisation of own work	4.50	Physics of constructions	4.53
Customer-focused	4.46	Operation of 3D designing applications	4.53
Initiative	4.44	General technical knowledge	4.50
Commitment	4.43	Learning	4.50
HVAC facility control systems	4.42	HVAC facility control systems	4.50
Designing of low-energy buildings	4.40	English	4.50
Physics of constructions	4.40	Technical English	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). It is also noteworthy that knowledge related to the following areas is increasing, namely: **ability to operate equipment, structure of buildings, physics of constructions.**

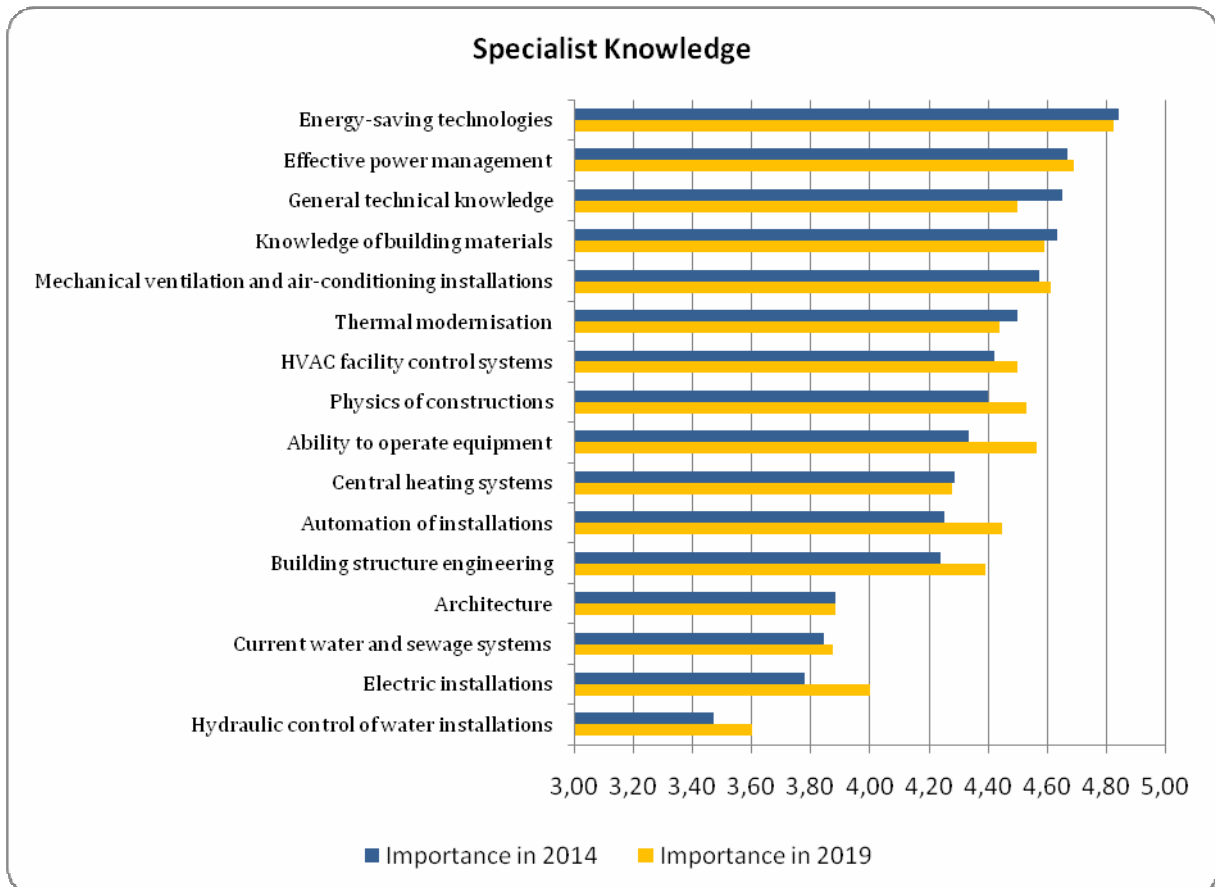


Figure 4. Expected importance of individual competences in the area of “Specialist Knowledge” as perceived by employers in 2014 and 2019.

Much greater changes in the importance of competences expected from graduates relate to specialist skills (Fig. 5). In each case, the employers declared a greater importance. In the five-year perspective, the most important skills will be: **designing of energy-saving buildings, designing of passive buildings and operation of simulation engineering applications.** The importance of skills related to **performing tightness tests, designing 3D installations and designing prefabricated buildings** will also increase.

Business skills (Fig. 6) are generally less important than specialist knowledge and skills. In the next years, the most important skills will continue to be: **knowledge about newest trends, project management and economy of investments.** The importance of the following

competences will grow: **knowledge of laws and regulations, negotiation skills, knowledge about investment financing and project "smart" management methodology** (accompanied by the decreasing importance of the project standard management methods).

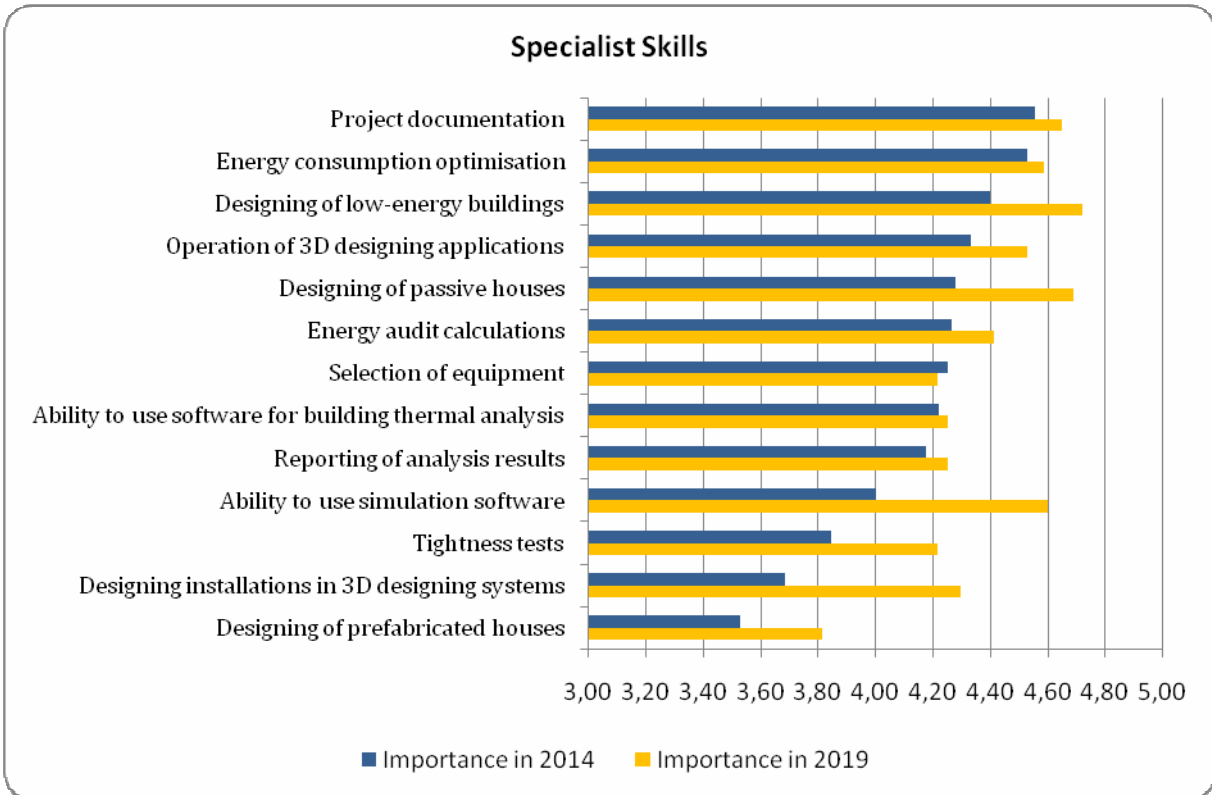


Figure 5. Expected importance of individual competences in the area of “Specialist Sills” as perceived by employers in 2014 and 2019.



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

Soft skills (Fig. 7) are an important component of the "assets" of graduates, although no basic changes will occur in the perspective of five years. The most important soft skills are: **being concerned about quality, learning, scheduling of own work and focus on customer**. It is surprising that the importance of the two latter competences, in the opinion of employers, will slightly decrease, likewise the importance of **focus on targets (or target orientation) written communication**. The importance of **initiative, co-operation, coping with stress**, and – in the greatest degree – **inter-cultural sensitivity** will increase.

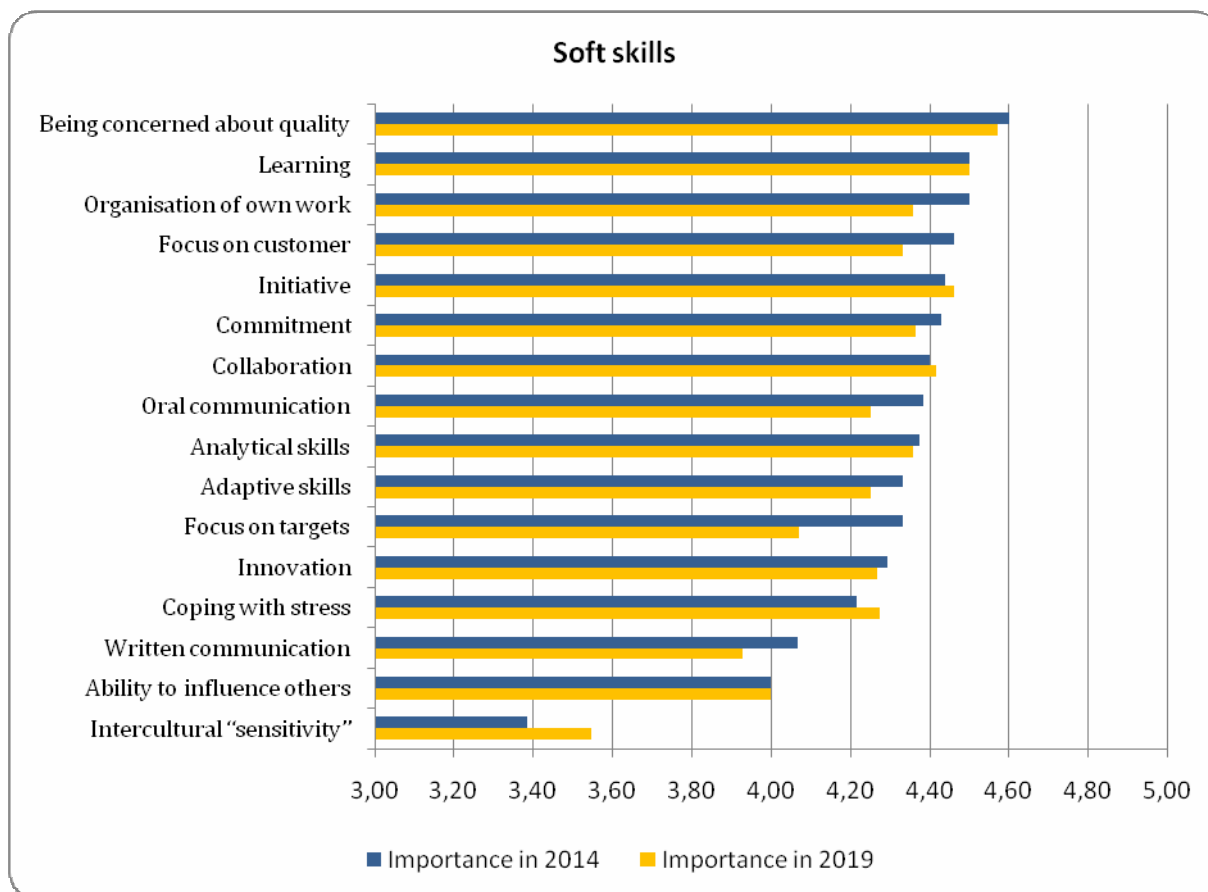


Figure 7. Expected importance of individual competences in the area of “Soft skills” as perceived by employers in 2014 and 2019.

As regards foreign languages, the most important now and increasingly important in the future will be: **English language, technical English, German**, (also technical German). Employers also predict that the **importance of other languages will considerably increase** in relation to their current position of marginal importance (this applying, for instance, to Chinese and Russian). Amongst other expectations, the most important are: **integrity** (whose importance will slightly drop), **ability to use basic office software packets and focus on development (or development orientation)**.

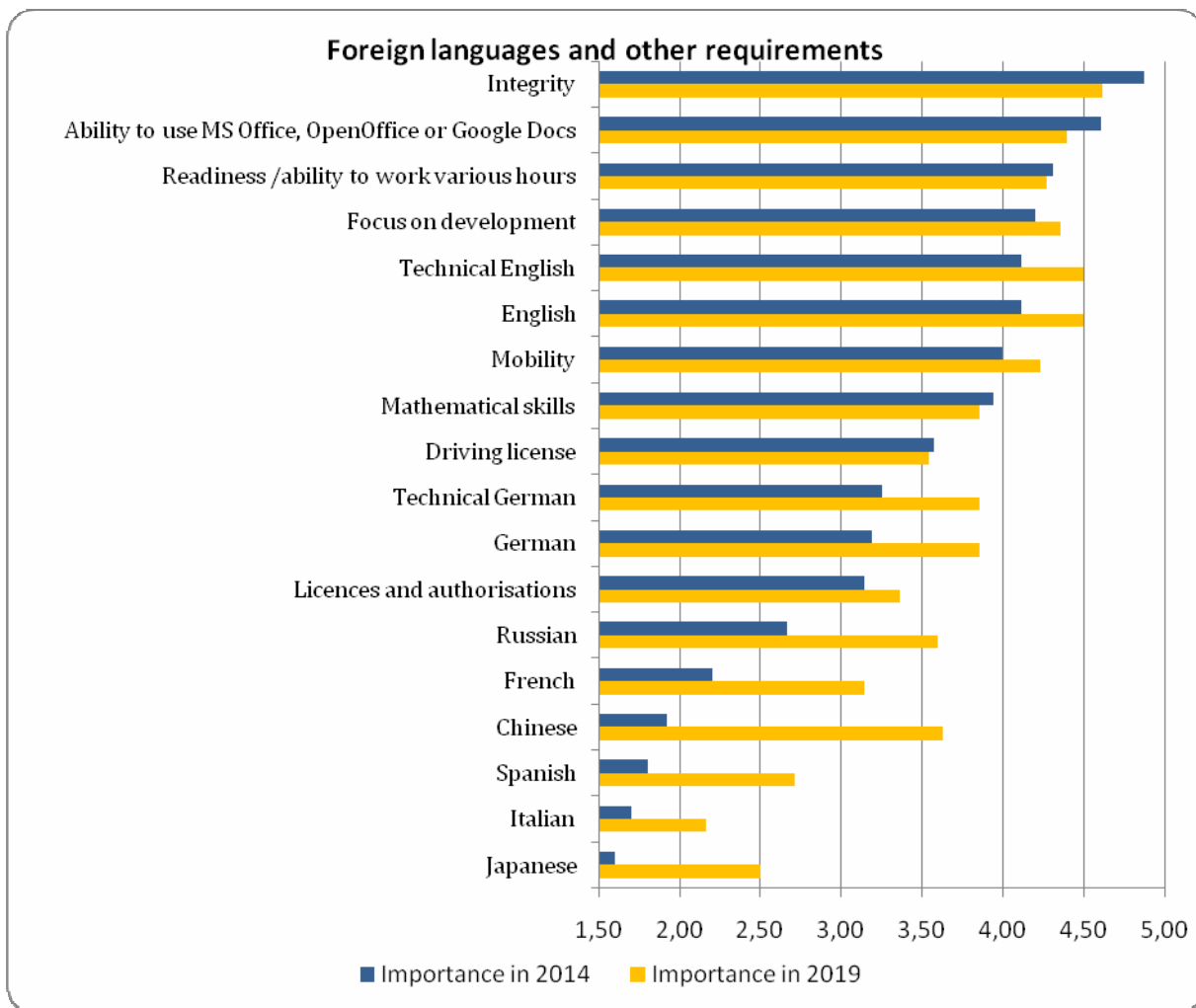


Figure 8. Expected importance of individual competences in the area of “Foreign languages and other requirements” as perceived by employers in 2014 and 2019.

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
Ambition
Building relations
Accuracy
Effectiveness at work
Flexible forms of co-operation
Initiative
Innovation, creativity
Intelligence
Contact with customer, customer co-operation skills
Openness
Diligence
Personal development (willingness to participate in training sessions), willingness to lift qualifications, readiness to learn
Self-reliance, independent thinking
Broad technical knowledge

List of competences / requirements of key importance in the context of promotion at work
Integrity
Negotiation skills
Ability to design (in 2D and 3D)
Ability to solve problems
Commitment, commitment to work
Resourcefulness
Team management
Foreign of foreign languages
Knowledge of specialist applications

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 indicators 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: **Designing of energy-saving buildings, HVAC facility control systems, initiative, effective power management, energy consumption optimisation and general technical and engineering knowledge.**

20 most important competences (requirements) today	Importance	Difficulties in acquiring
Integrity	4.88	2.67
Energy-saving technologies	4.84	3.73
Effective power management	4.67	3.93
General technical knowledge	4.65	3.81
Knowledge of building materials	4.63	3.64
Ability to use MS Office, Open Office or Google Docs applications	4.61	2.33
Being concerned about quality	4.60	3.58
Mechanical ventilation and air-conditioning installations	4.57	3.76
Project documentation	4.56	3.75
Energy consumption optimisation	4.53	3.88
New trends	4.50	3.77
Learning	4.50	3.08
Thermal modernisation	4.50	3.60

20 most important competences (requirements) today	Importance	Difficulties in acquiring
Organisation of own work	4.50	3.83
Customer-focused	4.46	3.80
Initiative	4.44	4.00
Commitment	4.43	3.55
HVAC facility control systems	4.42	4.13
Designing of low-energy buildings	4.40	4.13
Physics of constructions	4.40	3.79

Table 5 20 most important competences in the passive and low-energy building 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).

As regard difficulties in acquiring competences in the specialist knowledge group, the employers who took part in the survey are of the opinion that there are not substantial differences in the aforementioned difficulties (Fig. 9). Out of the most important competences in this group, the most difficult to acquire are competences related to **HVAC facilities control systems and automation of installations**. Competences that are most difficult to acquire, and that are assigned the highest importance are: **knowledge of energy-saving technologies, effective power management and general technical and engineering knowledge**. Replies correspond to the empiric material collected in the course of in-depth interviews. The competences that are most easily acquired, but still relatively difficult to find are: **general technical knowledge about architecture and designing of buildings**.

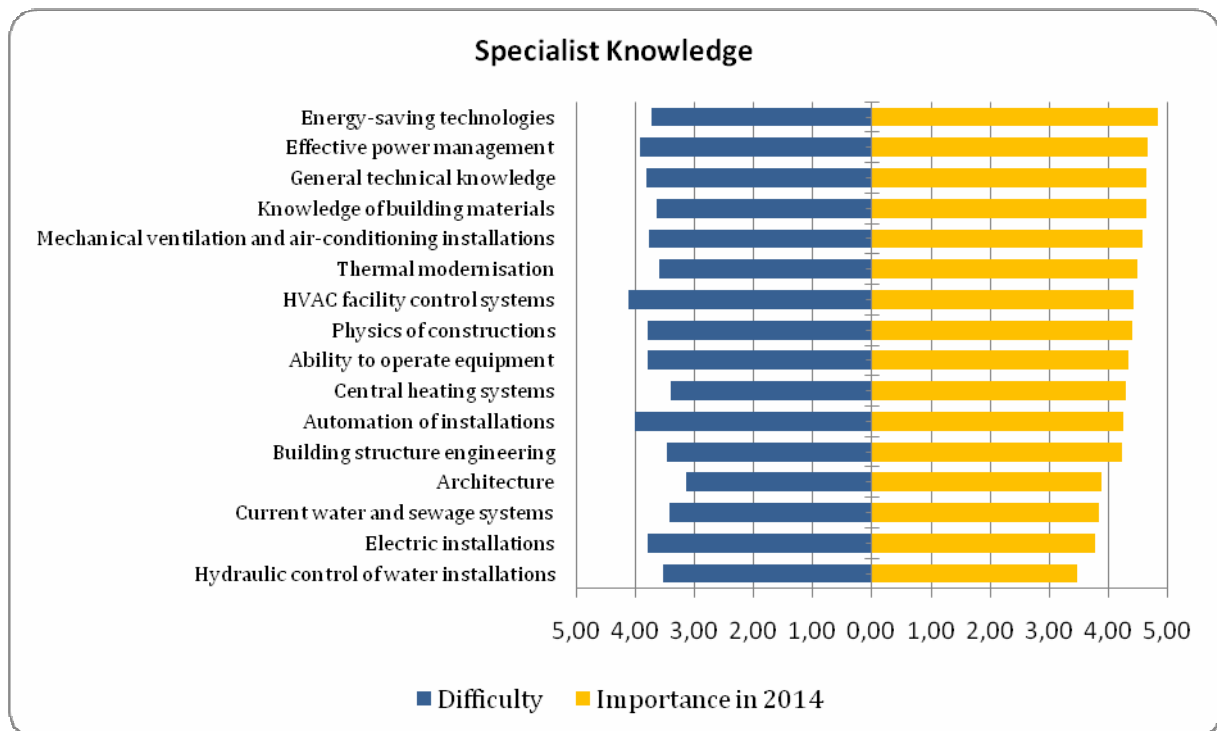


Figure 9. Importance of and difficulty in acquiring individual competences in the area of “Specialist knowledge” as perceived by employers.

Difficulty in acquiring specialist skills (Fig. 10), is only slightly higher than that in acquiring specialist knowledge. Competences that are easiest to acquire from the market are those related to energy performance calculations. The most difficult to acquire are: **designing of passive and low-energy buildings and operation of simulation engineering applications**. It is surprising that the difficulty in acquiring skills in designing prefabricated buildings is relatively lower, which may correspond to the fact that today few companies seek such skills on the market.

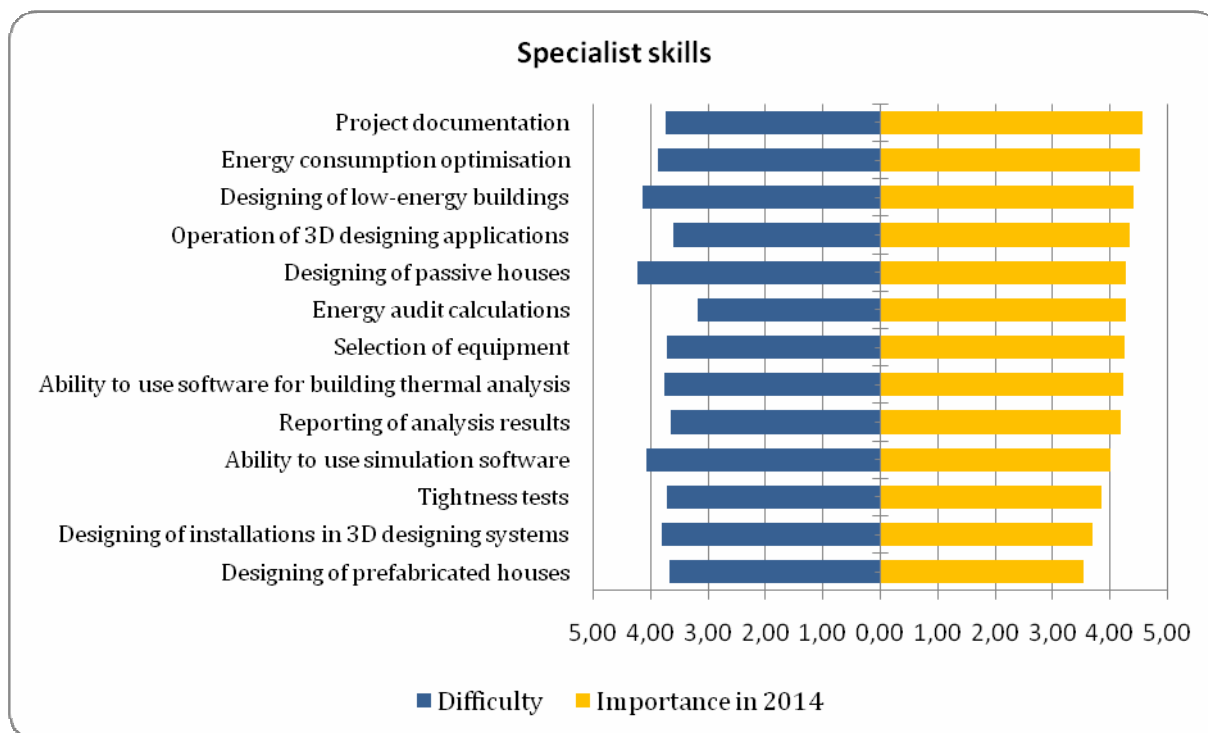


Figure 10. Importance of and difficulty in acquiring individual competences in the area of “Specialist skills” as perceived by employers.

It is noticeable that in the group of business knowledge and skills (Fig. 11) the most important competence, i.e. **knowledge about new trends** is one of the easily acquirable competence in this group. Relatively easily acquirable competence is also **general knowledge about the sector**. Competences that are difficult to acquire and very important from the employers’ point of view is **ability to manage projects and economy**.

It is surprising that amongst soft skills (Fig. 12) **ability to learn** in the opinion of the employers, got high scores. It is a very important and relatively easily acquirable competence, which does not quite agrees with opinions collected in the course of interviews. The competences of critical importance for the development of the sector are: **innovation and initiative**, which are also very important and difficult to acquire.

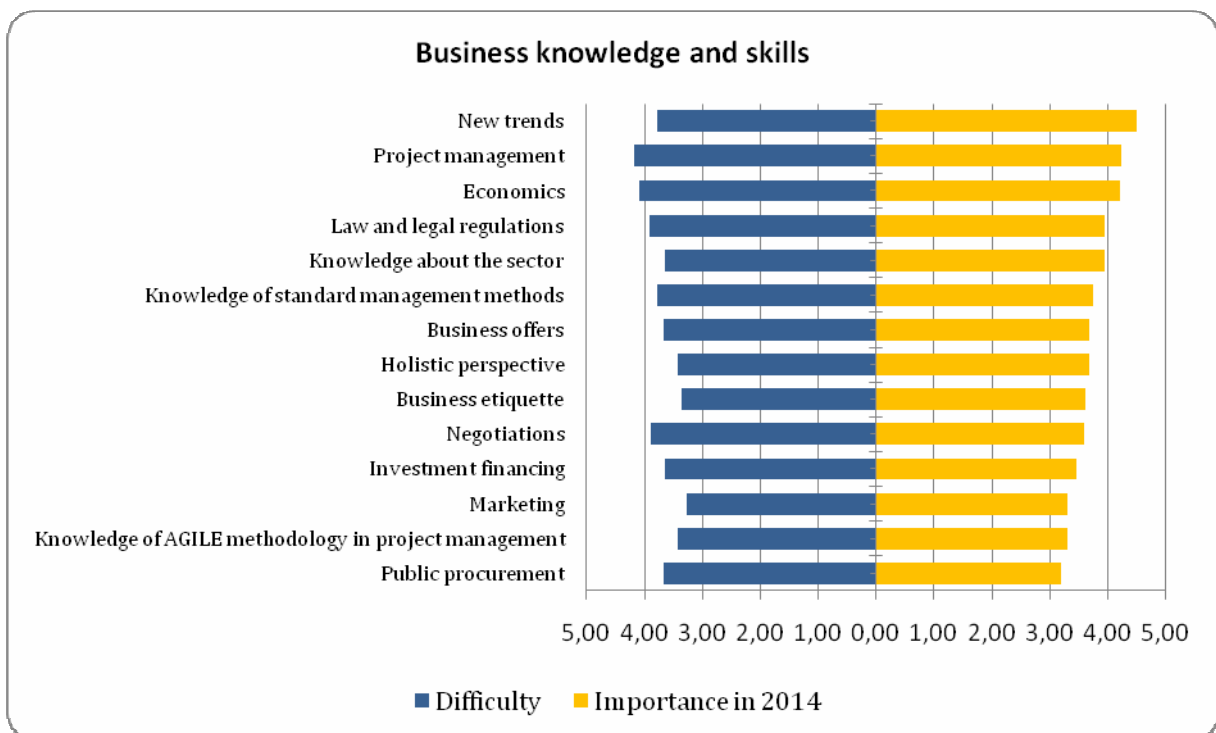


Figure 11. Importance of and difficulty in acquiring individual competences in the area of “Business knowledge and skills” as perceived by employers.

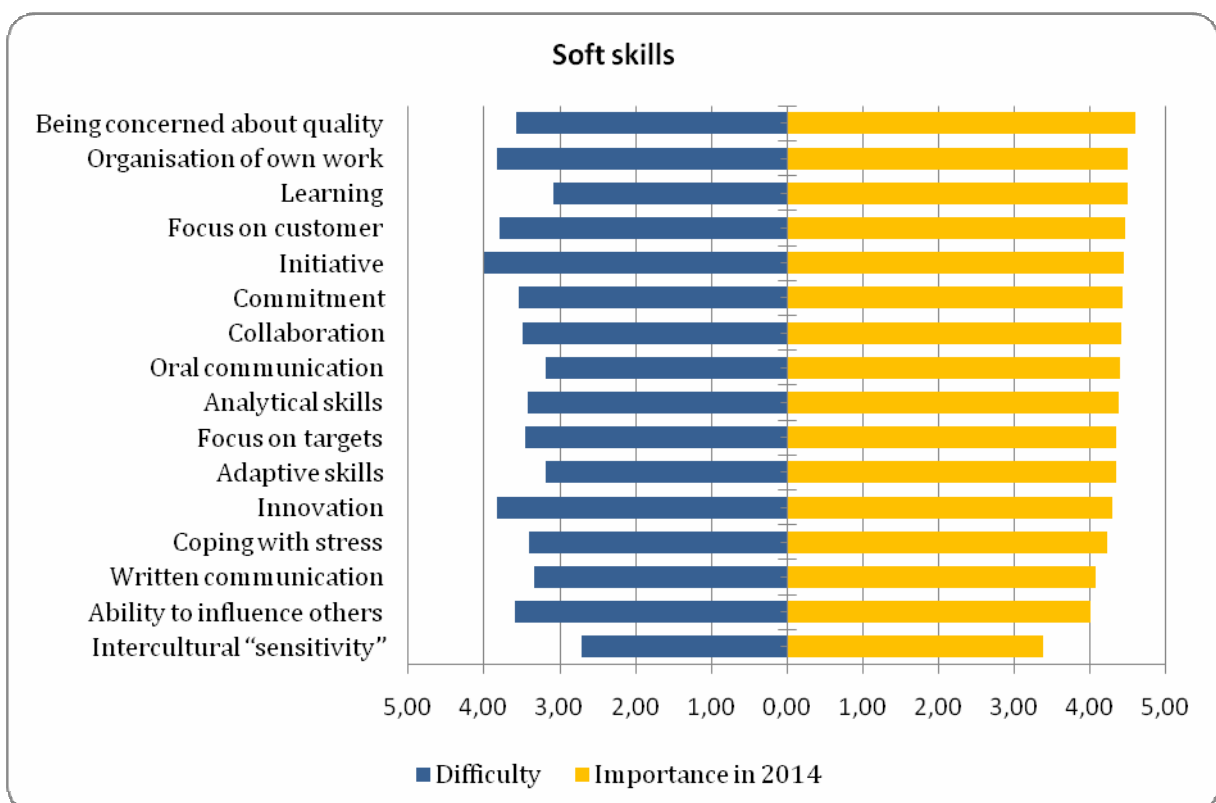


Figure 12. Importance of and difficulty in acquiring individual competences in the area of “Soft skills” as perceived by employers.

One of the requirements scored amongst the most important requirements is **integrity**, a characteristics that is relatively easily acquired on the labour market. The employers also assessed that it is not particularly difficult to acquire a candidate with competence in **the English language**. However, **technical English** is a competence the shortage of which is painfully noticed. The employers assess that to find a candidate with command of other languages is a serious challenge. While difficulties in acquiring candidates capable of communicating in rarer foreign languages does not threaten the development of the sector (which view may change as the increase of the importance of these languages is predicted to raise), **shortages related to the German language and technical German** may constitute a considerable development barrier. (Fig. 13)

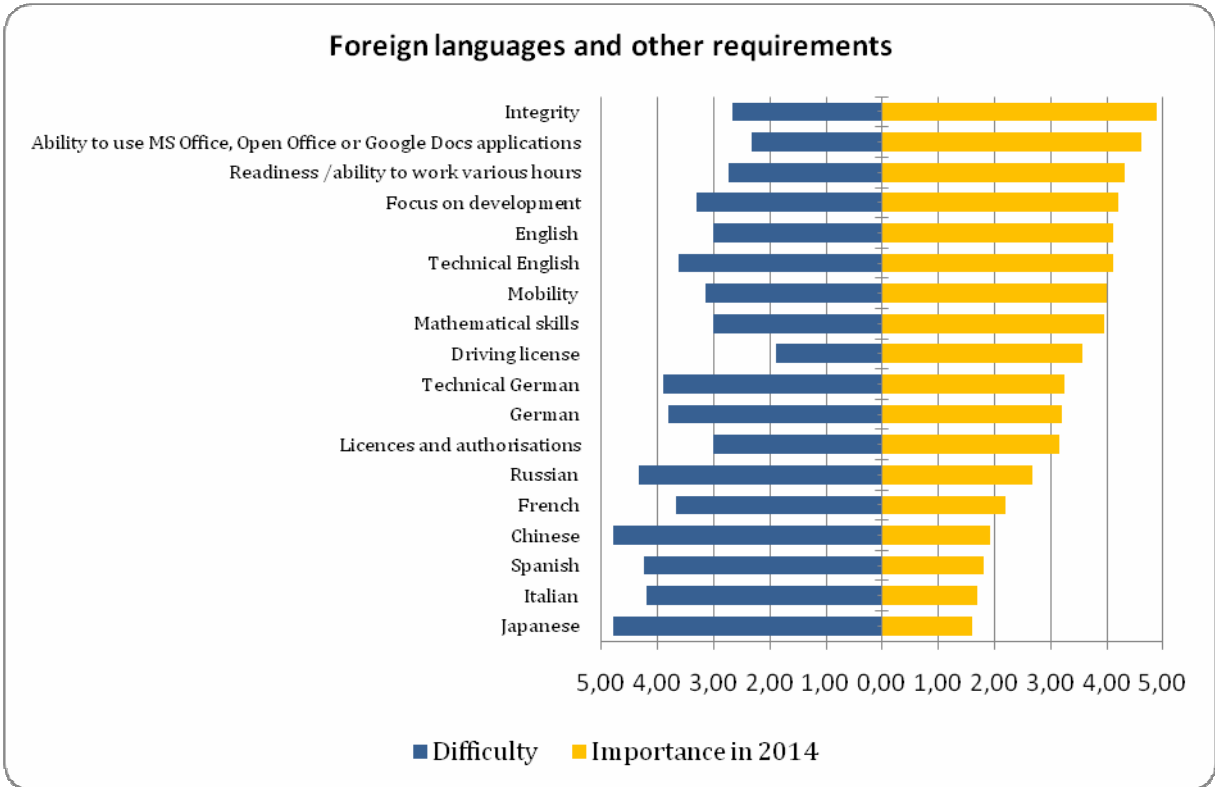


Figure 13. Importance of and difficulty in acquiring individual competences in the area of “Foreign languages and other requirements” as perceived by employers.

The surveyed companies reported a few additional competences and expectations related to graduates. In most cases they relate to soft competences or attitudes. A part of them overlap with competences put on the initial lists, while others are formulated in a different manner. Hence, they are worth while our attention.

Additional competences/requirements indicated by employers
Resourcefulness
Empathy
Logical thinking
Proper approach to changes
Trustworthiness
Objectivity
Perseverance
Ability to use MS Project

Table 6 List of additional competences, important for the sector.

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. In this context replies of companies and universities, concerning the quality of education seem quite similar. Generally saying, in the opinion of both milieus, the level of teaching (achieving competences) in the recent years got slightly lower. This does not mean that the number of very well prepared graduates also dropped.

According to the representatives of universities, in the next years one may expect that the number of graduates will drop (averagely by 15%). 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. However, the number of graduates from post-graduate studies and the number of highly specialist studies should not change. This means that although the overall number of graduates will decrease, the quality of education, and – subsequently – the availability of desired competences on the market may increase.

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 study²³ most often mentioned by sector companies as best meeting their expectations
Installations; sanitary and heating installations; cooling, heating and air-conditioning, cooling and air-conditioning systems, heating technology.
Environmental engineering; renewal energy sources engineering
Civil engineering; intelligent buildings, technology and organisation of the building process, civil engineering structures
Architecture; designing
Power engineering, energy sources, sustainable energy development
Building automation, automatics/electronics, mechanics and mechanical engineering
Energy audit, energy counselling, building energy performance audits
Environmental engineering, geoengineering
Logistics

Table 7 List of courses, specialisations, and profiles of study most often mentioned by employers as teaching students in areas needed in the life science sector.

Educational results achieved in each of the five competence groups will be presented in a number of diagrams (figures) 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

²³ The original names given by entrepreneurs are preserved; individual categories do not always constitute a separate area. Results supplemented by desk research analysis.

educational result is achieved 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 judgements 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 building materials**, and further – **knowledge about thermal modernisation, effective power management, ability to operate equipment, mechanical ventilation and air-conditioning installations and physics of constructions**. The following are the least common subjects found in curricula: **knowledge about electrical installations, HVAC facilities control systems** (Fig. 14)

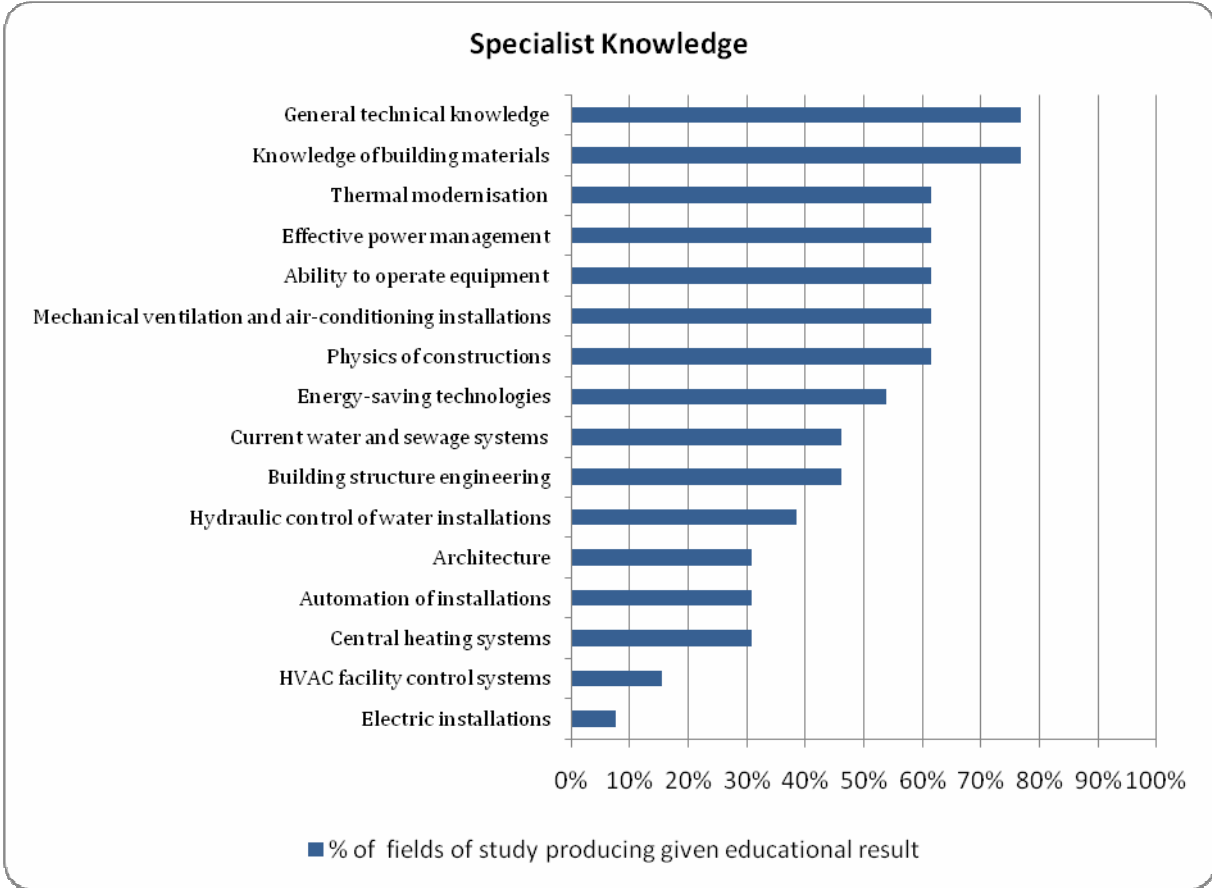


Figure 14. Percentage of courses and specialisations producing at least medium level educational results in the area of “Specialist Knowledge” (universities’ perspective).

As regards educational results in the area of specialist skills (Fig. 15), generally they are less frequently achieved by universities than those related to specialist knowledge. Skills related to the use of **3D designing applications and the development of project documentation** are

acquired – at least – at a medium level at half of the fields of study. The following skills are taught least frequently: **tightness testing and designing prefabricated buildings.**

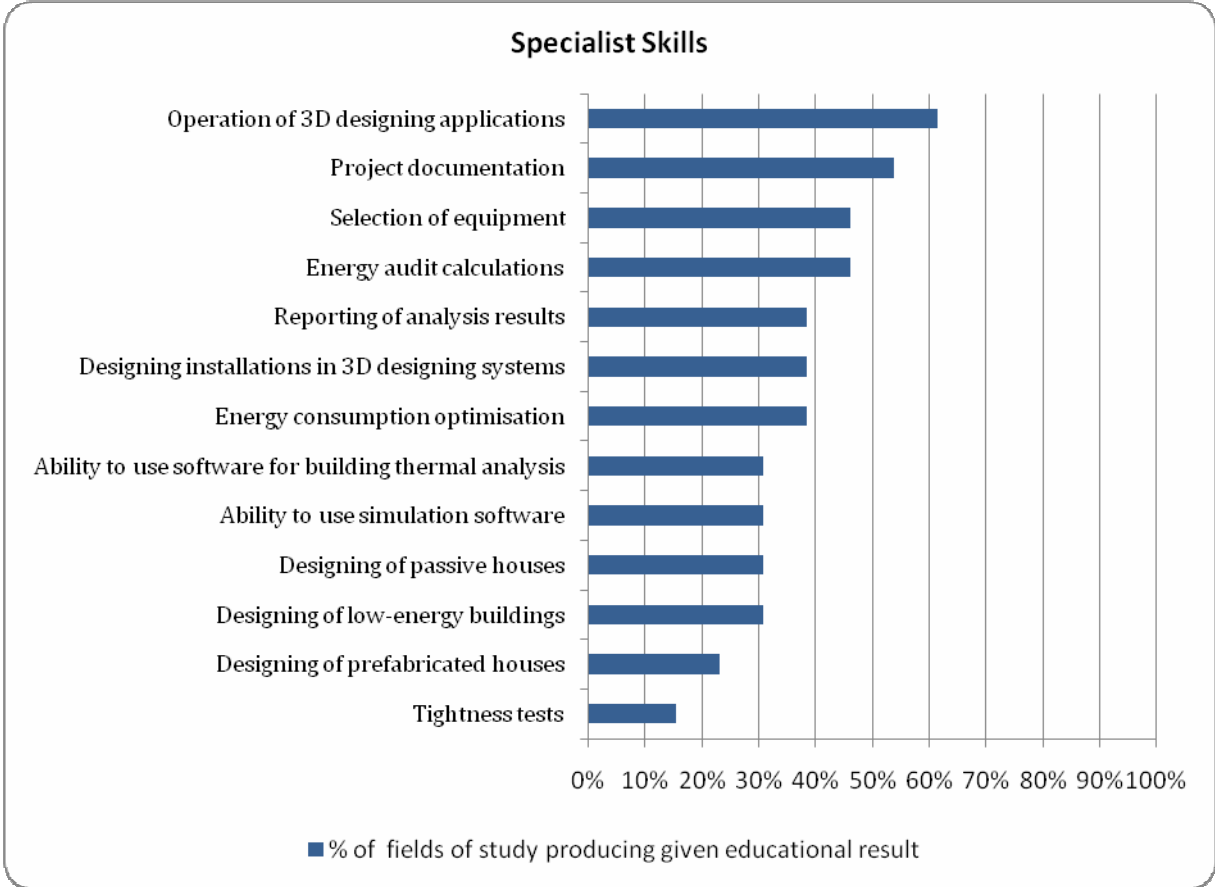


Figure 15. Percentage of courses and specialisations producing at least medium level educational results in the area of “Specialist Skills” (universities’ perspective).

As regards business knowledge and skills (Fig.16) the image is strongly diversified. On the one hand, students of most fields of study achieve **newest trends, law and regulations and general knowledge about the sector.** On the other hand no educational results are actually achieved in **project management methodology, negotiation skills and development of business offers.**

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. Skills related to **oral and written communication, co-operation, influence on others (assertiveness) and innovation** are acquired at the largest number of fields of study.

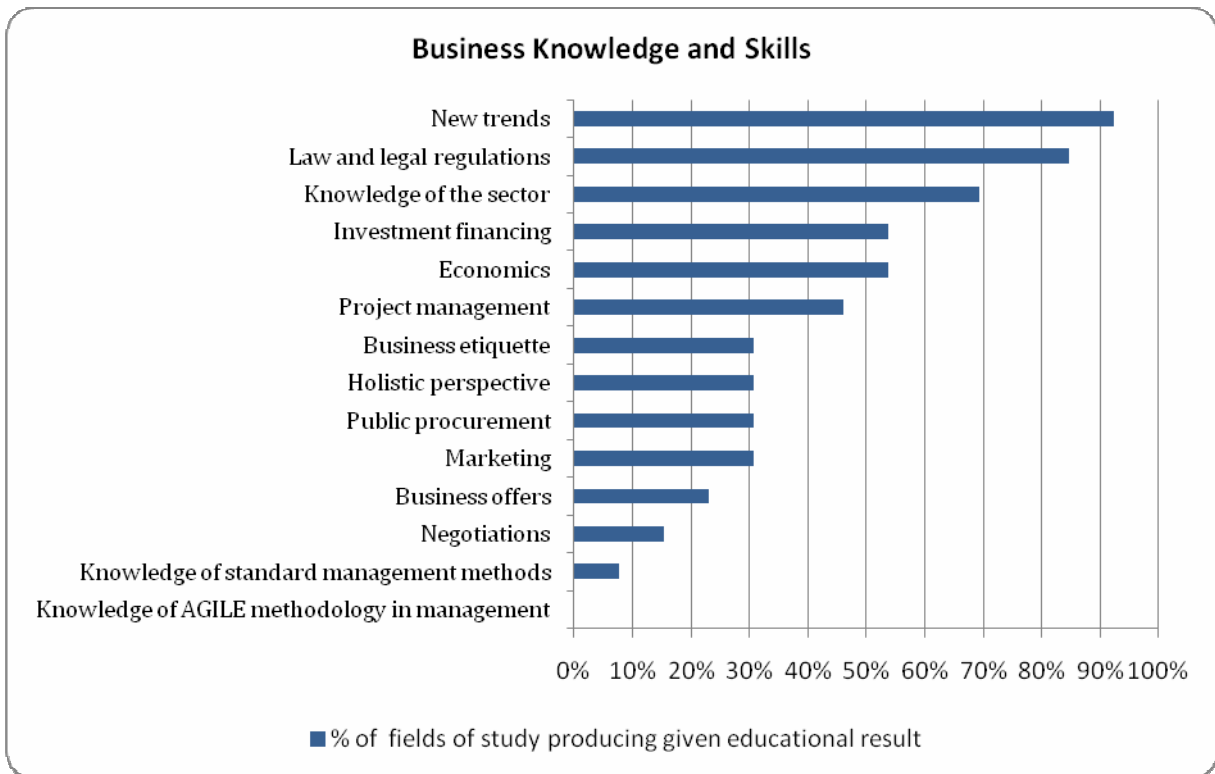


Figure 16. Percentage of courses and specialisations producing at least medium level educational results in the area of “Business Knowledge and Skills” (universities’ perspective).

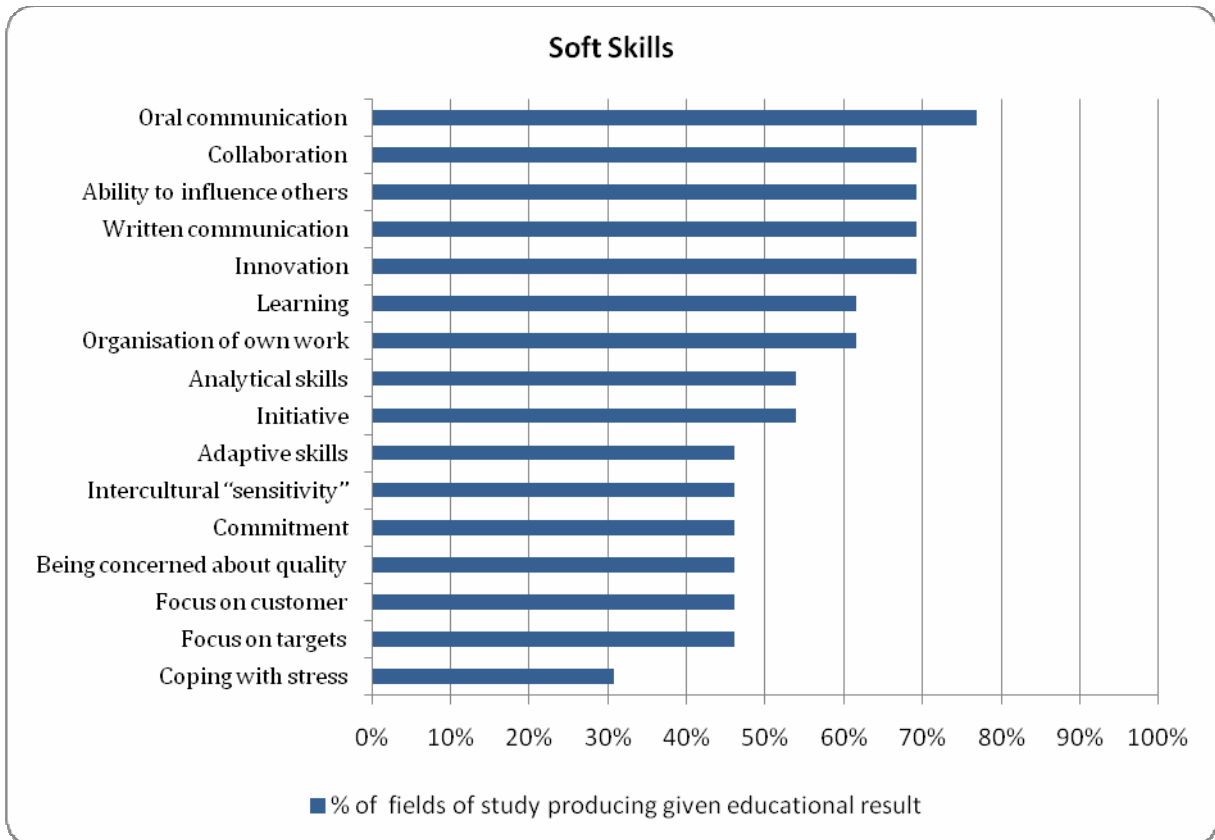


Figure 17. Percentage of courses and specialisations producing at least medium level educational results in the area of “Soft skills” (universities’ perspective).

As regards other requirements of employers (Fig. 18), at most of the fields of study graduates may develop skills related to the **use of basic office software packets, mathematical skills,** and – to a lesser degree – **focus on development and integrity.**

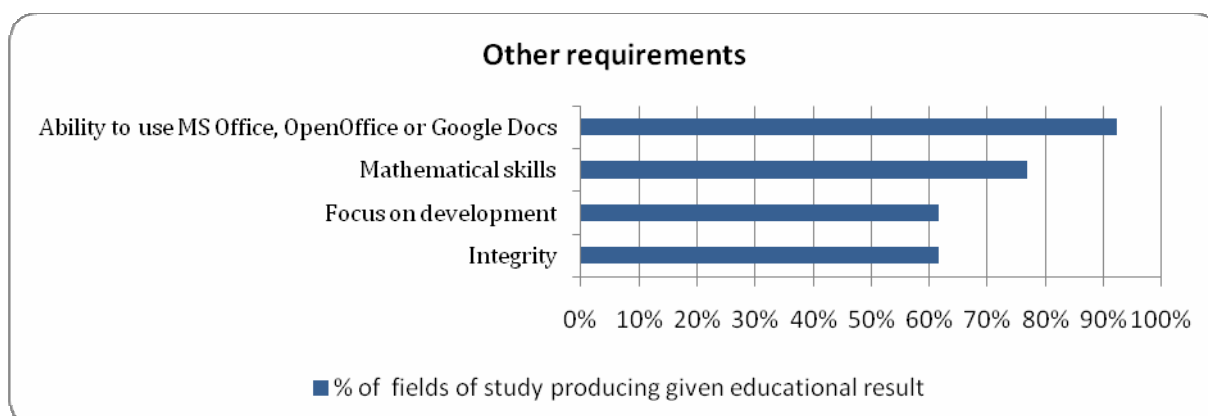


Figure 18. Percentage of courses and specialisations producing at least medium level educational results in the area of “Other requirements” (universities’ perspective).

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 specialisations of study covered by the research is capable to achieve – at least at the mean level – a half of educational results important for the sector (56% of effects in specialist knowledge and 48% of specialist skills, respectively). Such situation should not come as a surprise because various companies recruit personnel for different positions. The situation seems natural and was additionally proved in the balance of competences in which the expectations of companies were confronted with educational results. Considerably higher results are achieved in comprehensiveness index at very specialist fields of post-graduate studies (the field of study which best meets the requirements of business declares that educational results related to knowledge are achieved at the 94% level, whilst the corresponding level in the area of skills is 100%), this would not be possible without educational results achieved by graduates at the first and second level of studies. 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 of the survey are presented in table below.

Additional educational results acquired at fields of study related to the sector
Knowledge of problems related to designing at a global scale
Environmental awareness
Free drawing skills
Free modelling and computer-aided skills
Knowledge of the Polish market of designing
Acquiring information from various sources
Ability to apply interdisciplinary analysis
Communication and IT techniques
Ability to plan and carry out experiments
Ability to interpret data
Application of knowledge in defining and solving engineering tasks
Knowledge about environmental effects of the reduction of energy consumption

Table 8 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 achieved 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 (correlation $r=0.67$)²⁴. In other areas we observe another relationship, i. e. , there is actually no correlation between declared difficulty/easiness of acquiring a competence and the educational results actually achieved. 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. Although this

²⁴ 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).

fact may be one of the reasons for which the assessments are different, there are also other possible and equally probable interpretations here²⁵.

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. 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.

Figure 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. 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 (range from 2.5 to 4.5). Without such division, actually all the competences, except for **ability to use office software packets, integrity and learning** would have to be considered as difficult to acquire, while all the competences, except for **energy consumption optimisation and HVAC facility control systems** would have to be considered as achieved at a medium level. The deepest difference between availability of competences and educational results achieved relates to such competences as: **knowledge about building materials, new trends, general engineering and technical knowledge and mechanical ventilation and air-conditioning installations**. On the one hand, these competences are considered by employers as hard to acquire, and – on the other – universities are of the opinion that these competences are taught. Opinions are more similar as to competences related to: **HVAC facilities control systems, power consumption optimisation, initiative and designing of energy-saving buildings**. These are characteristics that are hard to find and taught at fields of study related to the sector to a limited extend.

²⁵ 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.).

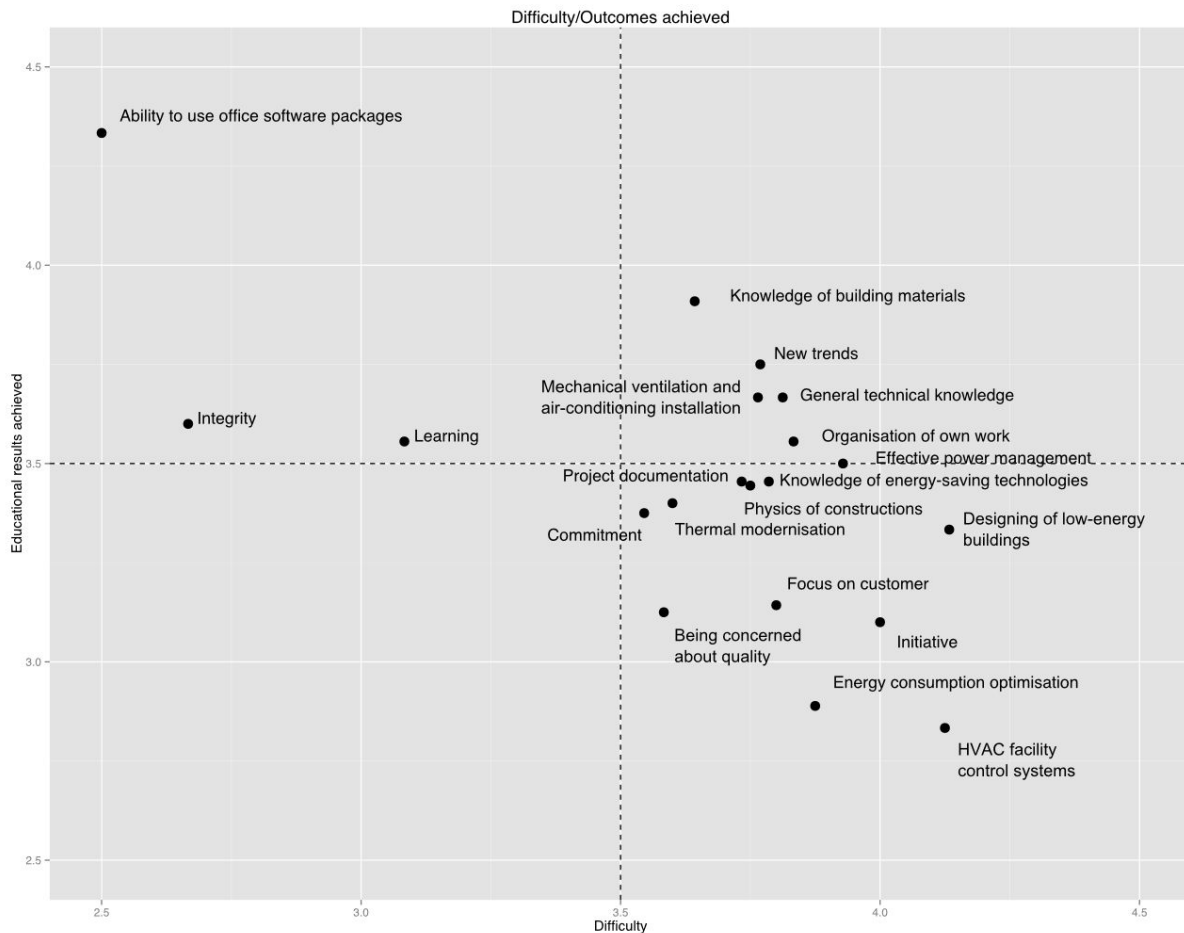


Figure 19. Matrix illustrating interdependencies between difficulties in acquiring certain competences (employers' perspective) and educational results achieved (universities' perspective) for the 20 competences of key importance for the sector. Limited scales (from 2.5 to 4.5) is used in the graph for better clarity.

In the area of specialist knowledge, employers find a direct, though moderate relationship between the assessment of educational results achieved at universities and the difficulty in acquiring relevant competences. Competences such as **knowledge about HVAC facilities control systems, automation of installations or electrical installations** are difficult to acquire and taught at a medium level. The image is different as regards such competences as **general technical and engineering knowledge and knowledge about building materials**: these competences are relatively difficult to acquire and they are taught at universities (see: Fig. 20)

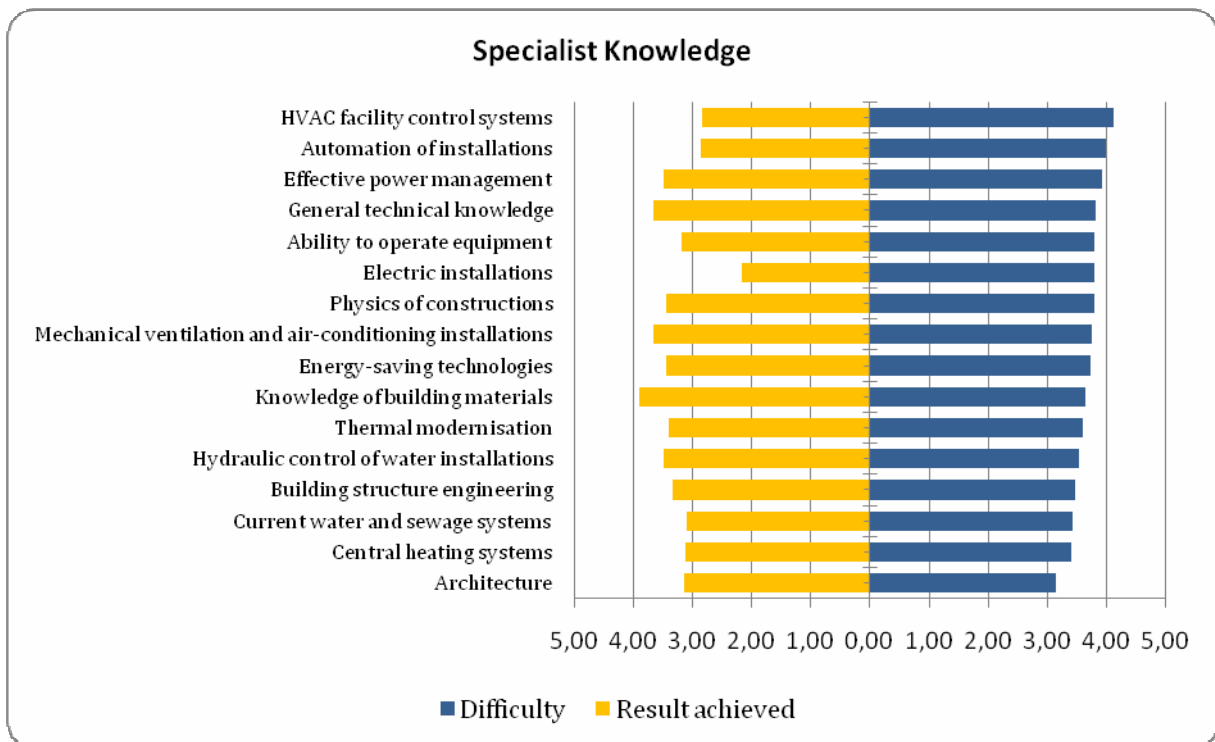


Figure 20. Juxtaposition of difficulties in acquiring competences (employers' perspective) with educational results achieved (universities' perspective) in the area of "Specialist Knowledge".

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**. The general assessment of educational results achieved in this area oscillates around mean values.

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 laws and regulations**.

An interesting image emerges from the analysis of soft skills and other requirements of graduates posed by employers (Figures 23 and 24). As regards the three competences that for the business are most difficult to find, i.e. **initiative, innovation and concern about quality** – the universities are of the opinion that their achievements are poor, while achievement in the **ability to learn** is positively assessed by universities and relatively less difficult to acquire for business. Similar relationship occurs in respect of **integrity, focus on development and mathematical skills**: they are relatively easy to acquire and taught at universities.

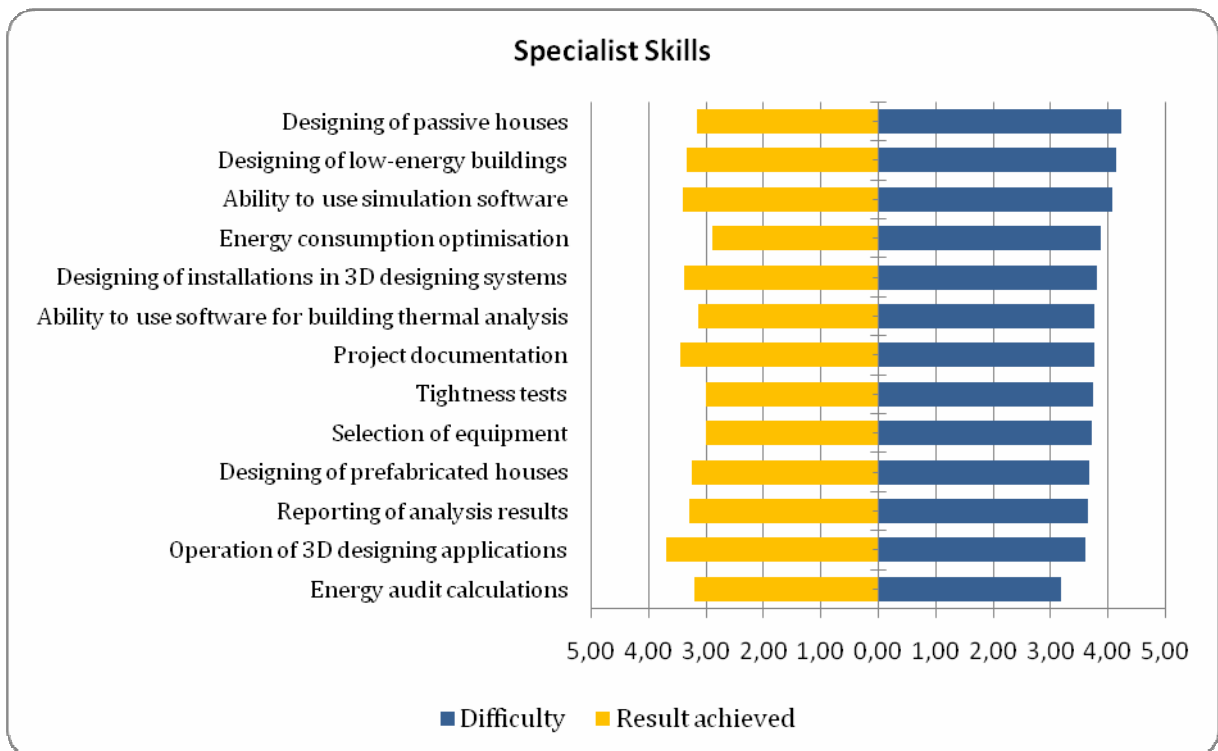


Figure 21. Juxtaposition of difficulties in acquiring competences (employers' perspective) with educational results achieved (universities' perspective) in the area of "Specialist Skills".

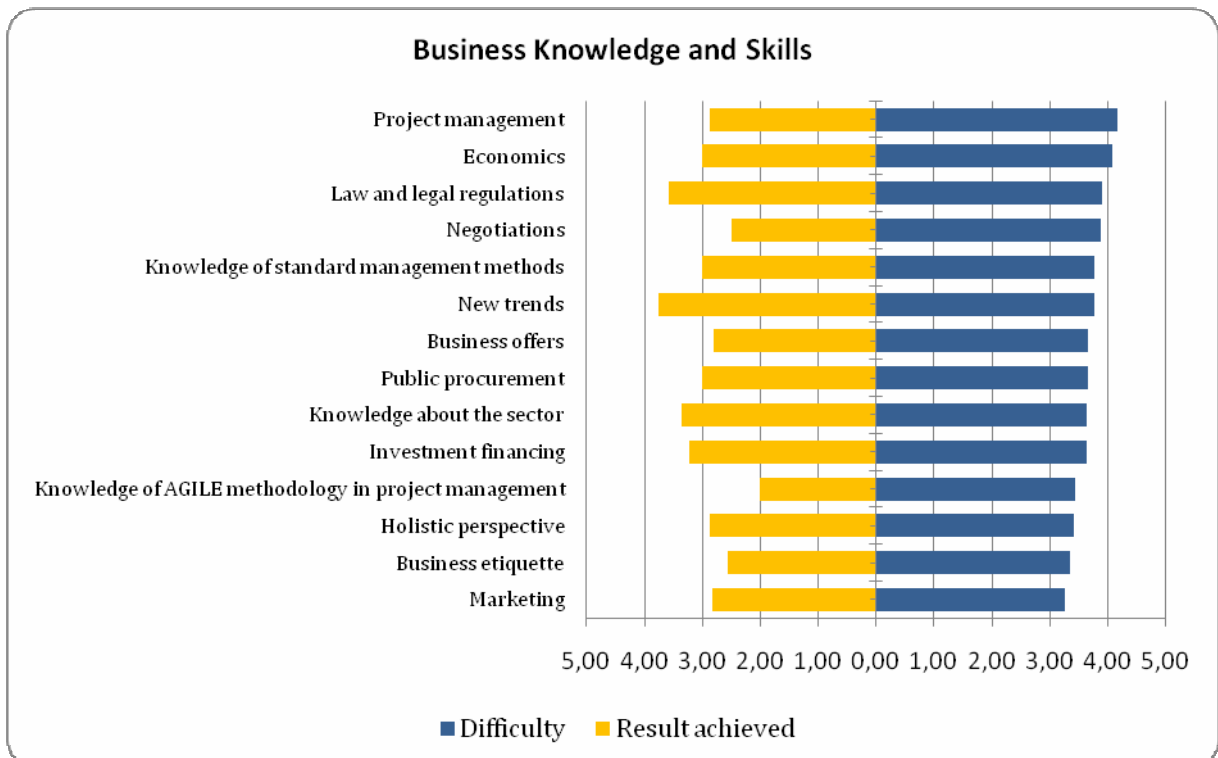


Figure 22. Juxtaposition of difficulties in acquiring competences (employers' perspective) with educational results achieved (universities' perspective) in the area of "Business knowledge and skills".

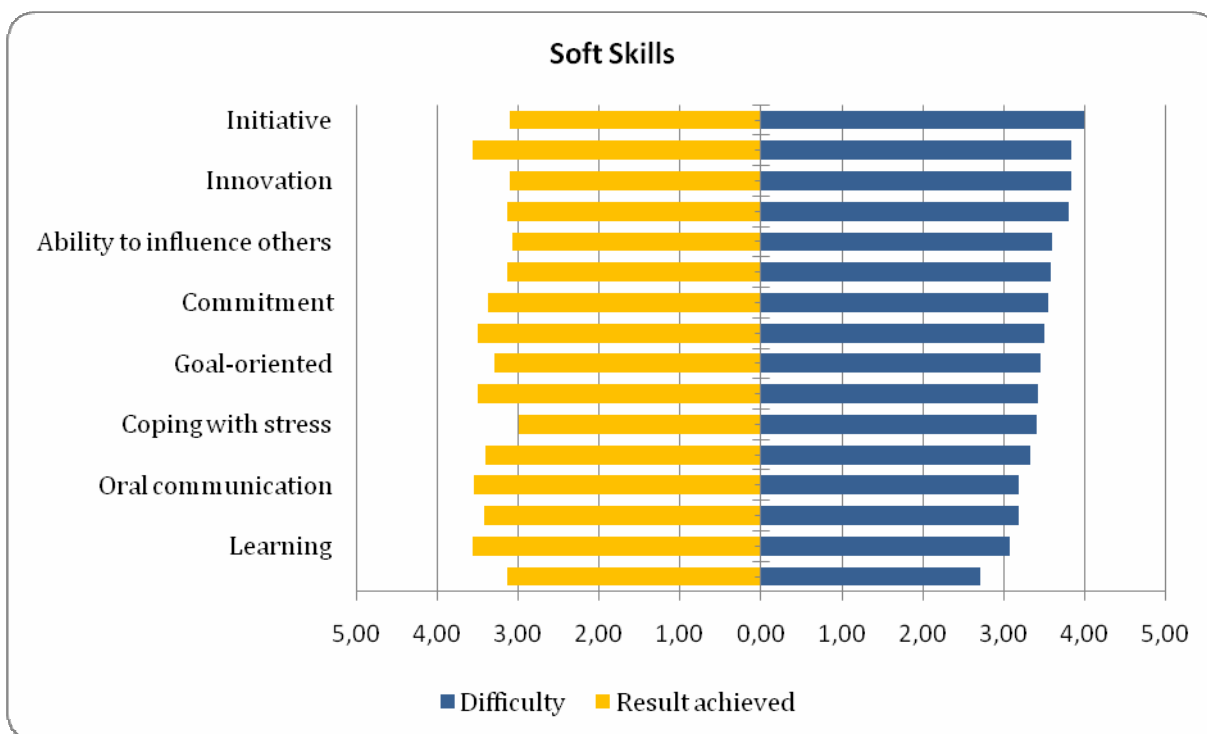


Figure 23. Juxtaposition of difficulties in acquiring competences (employers' perspective) with educational results achieved (universities' perspective) in the area of "Soft Skills".

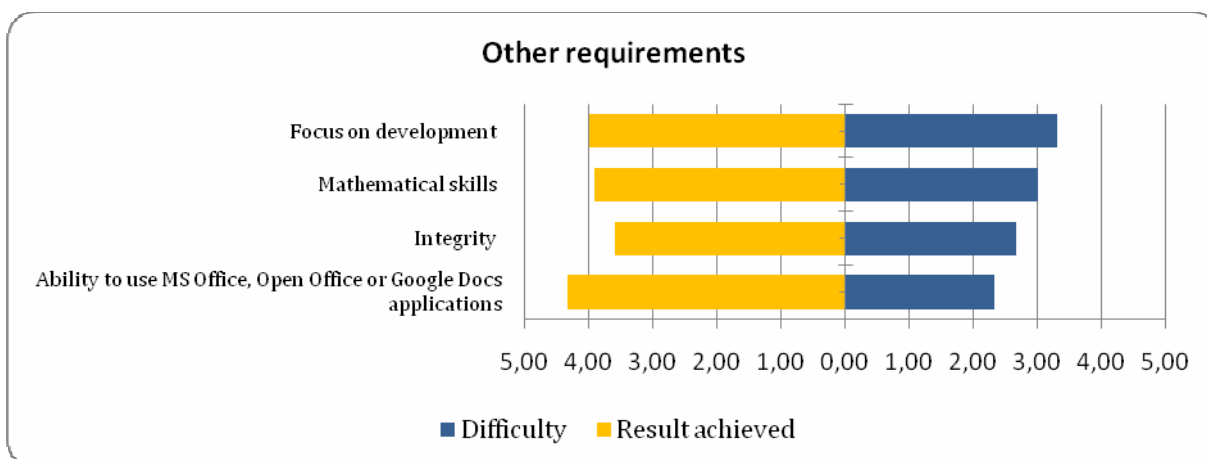


Figure 24. Juxtaposition of difficulties in acquiring competences (employers' perspective) with educational results achieved (universities' perspective) in the area of "Other requirements".

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, moderate relationship of this type is observable in soft skills ($r= 0.43$), while in all the other groups of competences the correlation is much weaker. This means that there is no agreement - except for soft skills - between universities and business as to what competences desired in the sector should be taught.

Figure 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. The results indicate that there is a relatively strong agreement between universities and business: most of important competences may be found in the upper right quarter of the chart, i.e. where the chart presents competences that in the opinion of both milieus should be taught at universities. In the opinion of business and to the contrary of the opinion of universities, universities should teach matters related to **thermal modernisation, power consumption optimisation and concern about quality**. On the other hand universities emphasise **ability to learn, integrity and commitment** as the targets of their teaching to the extend that is not expected by business. What may occur surprising is that both, business and universities agree that **initiative, ability to organise own work and focus on customer** (or customer orientation) should not be a task of universities.

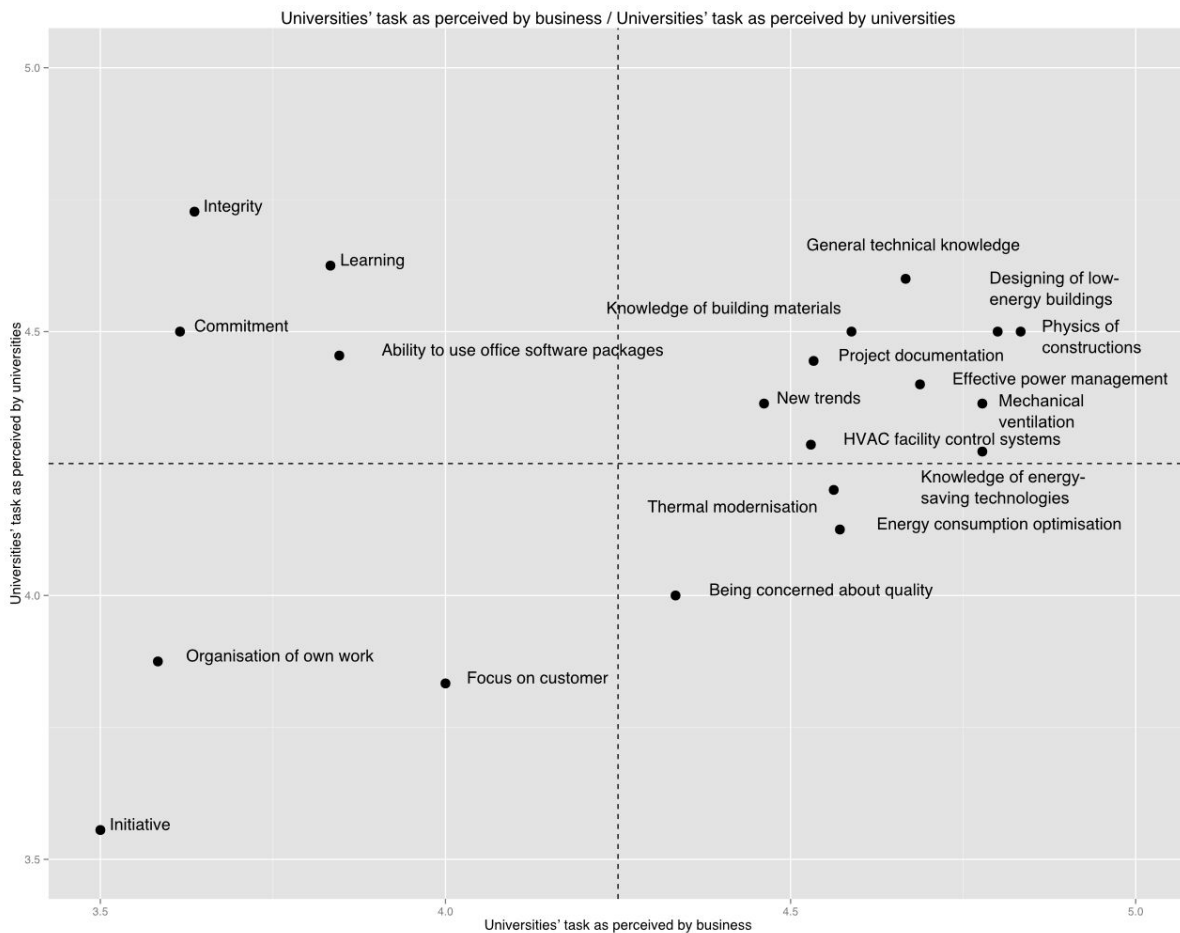


Figure 25. Matrix illustrating differences in the perception of development of certain competences as a universities' task by representatives of business and of universities for the 20 competences of key importance for the sector. Limited scales (from 3.5 to 4.5)) is used in the graph for better clarity.

As regards the understanding of the tasks of universities in the context of specialist knowledge (Fig. 26), the differences in opinions between universities and companies are quite strong. Both parties agree that the competences should be taught at universities, but they do not agree to what extend these competences should be actually taught. The deepest differences occur with respect to **knowledge of architecture and electrical installations**, which – in most cases – is a result of the nature of researched fields of study. A greater weight should be attached to the controversy as to the responsibility for teaching of **knowledge of energy-saving technologies**.

In case of specialist skills (Fig. 27) companies assign greater responsibility to universities, related to **designing of energy-saving buildings and power consumption optimisation**. A reverse situation occurs with regard to the **reporting of analysis results and tightness tests**: universities are of the opinion that these are their task to the extend that is not expected by companies.

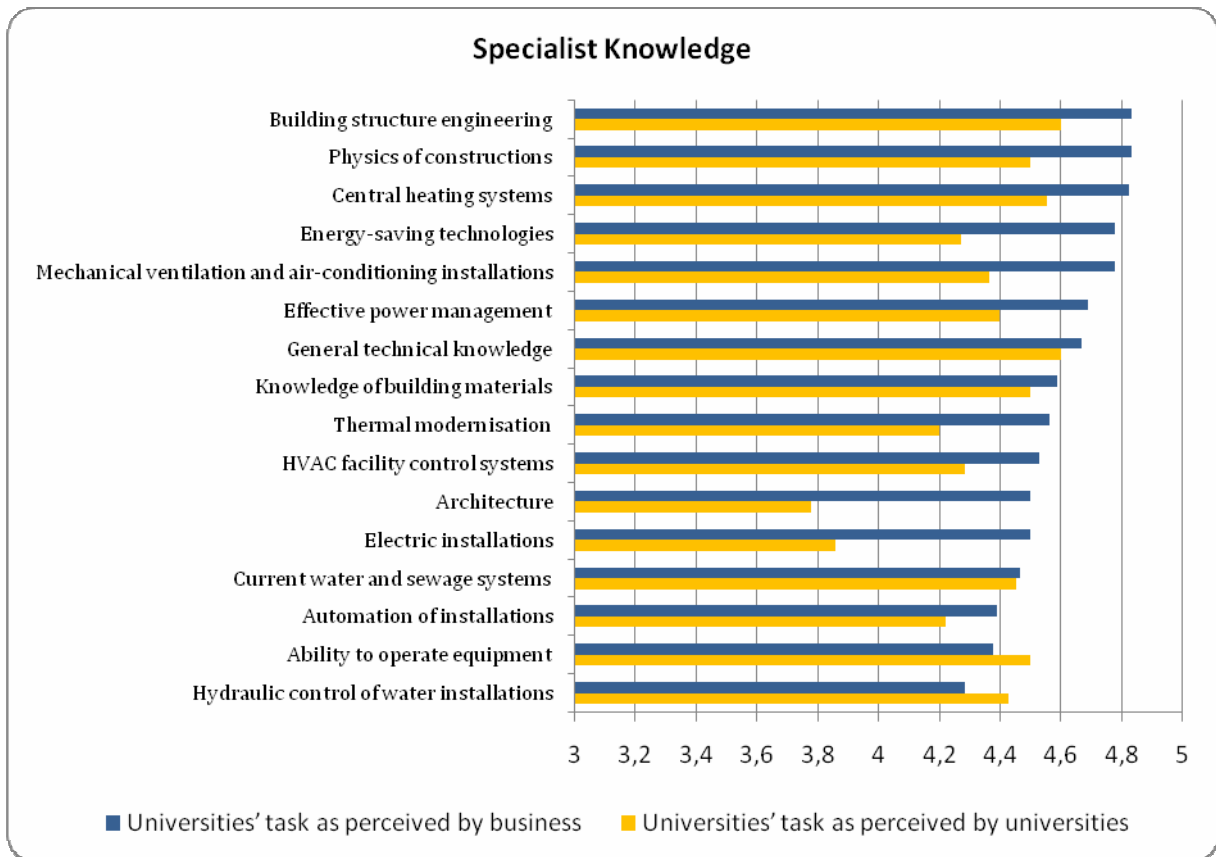


Figure 26. Perception of the role of universities in developing competences in the area of “Specialist knowledge”.

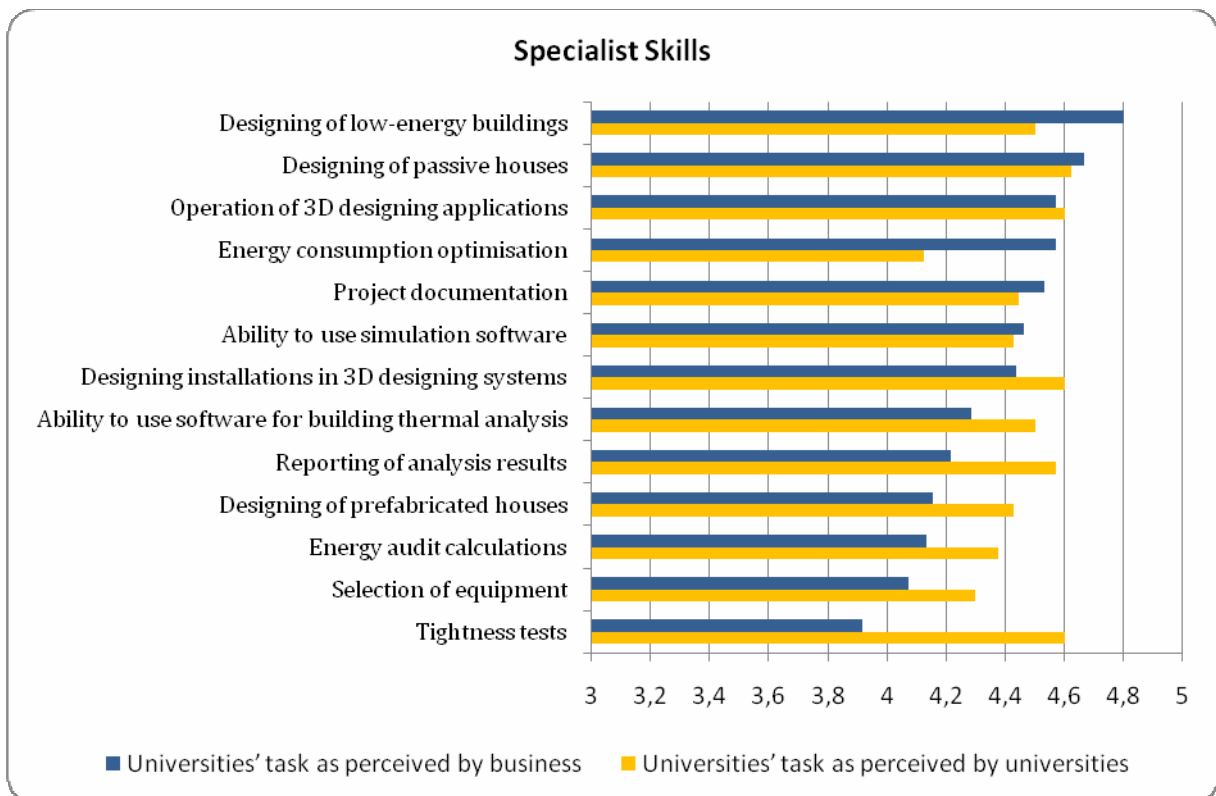


Figure 27. Perception of the role of universities in developing competences in the area of “Specialist skills”

Results related to business knowledge and skills are very interesting (Fig. 28) **Knowledge about new trends in the sector** as a task of universities got the highest ranks from both: universities and companies. The result indicates that both parties are convinced that universities are able to and should perform an important role in innovation with respect to the transfer of knowledge about the most recent discoveries and solutions. An opinion that the developing of competences related to **project management skills** should be a task of universities, is more common amongst businesses than amongst universities. What is particularly interesting is that such competences as: **knowledge of the sector, knowledge about public procurement, development of business offers and business etiquette** are considered by universities as their task to the extend that is broader than that expected by companies. 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 (universities and companies proposed many times that the format of apprenticeships for students and exchange of personnel should be precisely defined) or (on the other hand) a result of student's and graduate's own initiative.

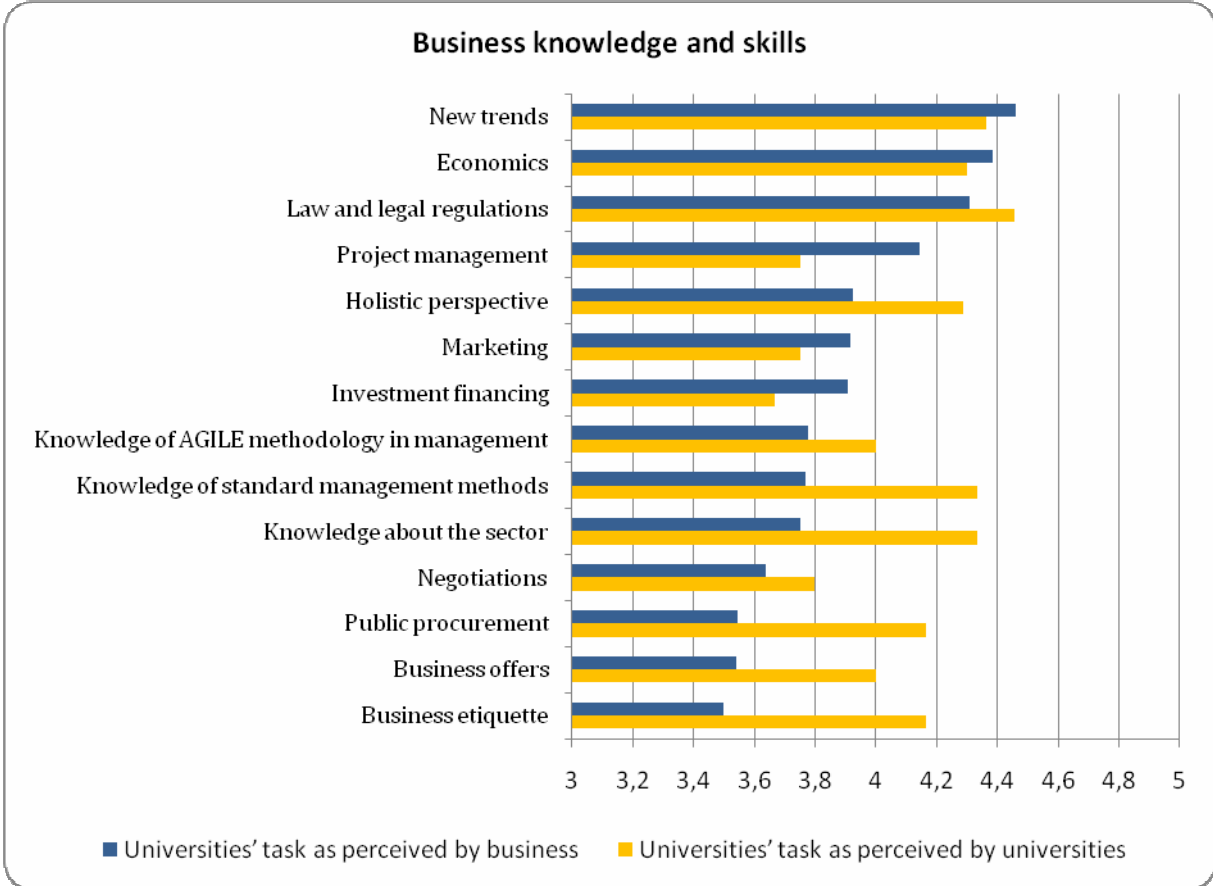


Figure 28. Perception of the role of universities in developing competences in the area of "Business knowledge and skills".

The results related to the perception of the role of universities in developing soft skills are surprising. **Concern about quality, analytical skills and focus on customer** are the only competences that are designated by companies as tasks of universities in a greater degree than

by the universities alone. In all other cases the representatives of companies are of the opinion that teaching of the competences should be a task of universities, but their expectations 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 2012²⁶.

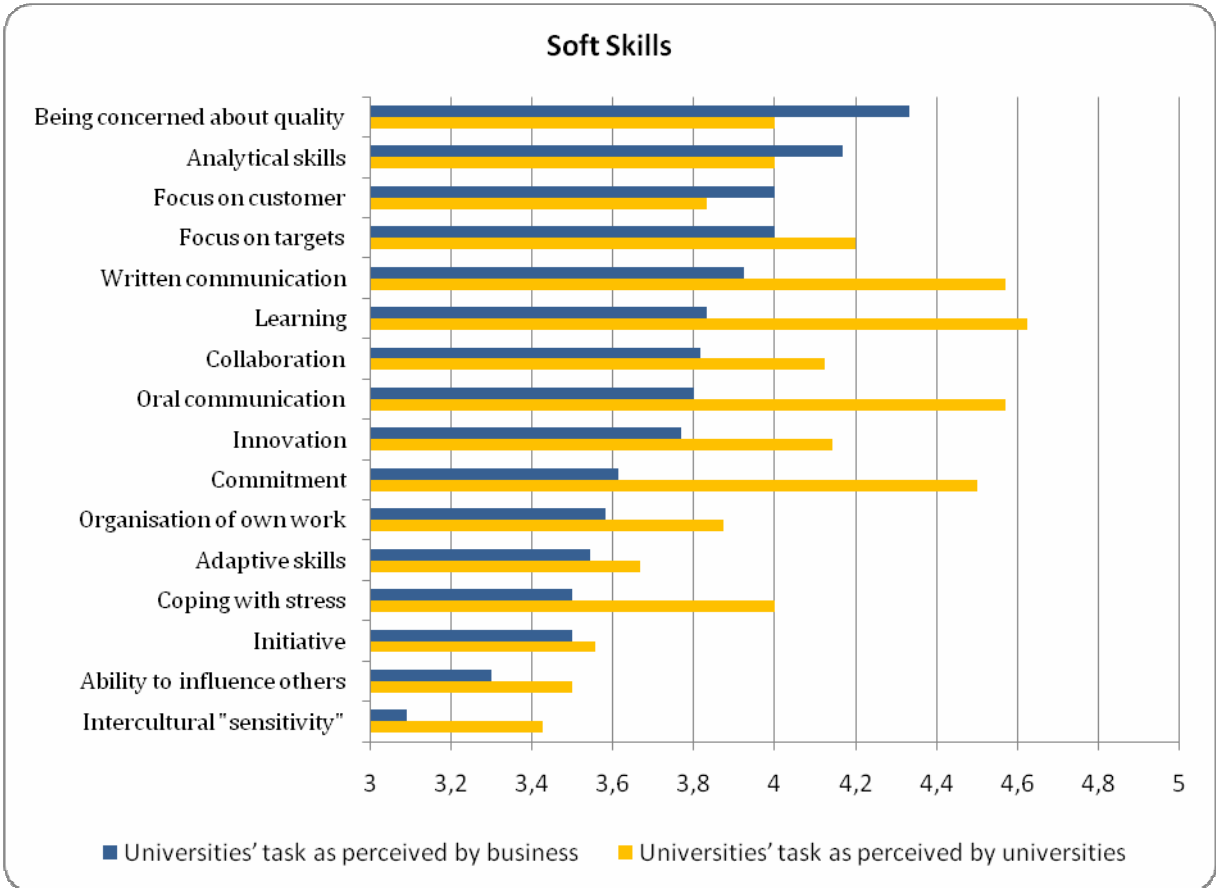


Figure 29. Perception of the role of universities in developing competences in the area of "Soft skills"

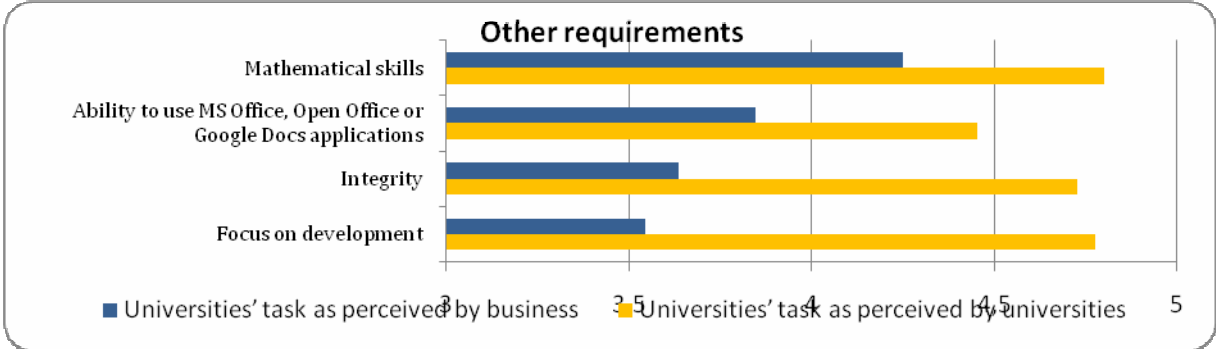


Figure 30. Perception of the role of universities in developing competences in the area of "Other requirements."

²⁶ Balance of Competences in BPO and ITO in Kraków. <http://www.krakow.pl/zalacznik/1165>

FINAL CONCLUSIONS AND RECOMMENDATIONS

The development of the sector should be **one of the most important components of the city development strategy**, due to social, economic and promotional benefits that such development may offer. Kraków has a huge and sufficient potential on the part of both: universities and businesses, to become one of the leaders in the area in Poland. The results show that the **increase of the importance of the passive and low-energy building sector** in future is predicted even by companies whose activities are only marginally related to the sector. Employers are quite optimistic about the growth of employment and recruitment of graduates from Kraków's universities.

The situation of the sector is not free from problems, though. Apart from barriers related to legislation and general economic situation of the building sector, the passive and low-energy building sector as defined in this report, faces also considerable challenges related to competences of university graduates acquirable on the market. Briefly saying, the most important findings of the research relating the demand for competences in the passive and low-energy building sector are presented in Table 9.

Key findings of the Study of Competences for the passive and low-energy building sector (summary)	
Key competences currently looked for by employers (as stated by employers)	Integrity, knowledge of energy-saving technologies, effective power management and general technical and engineering knowledge, knowledge about building materials
The most considerable relative growth in importance of competence over 5 years (as stated by employers)	Designing of energy-saving buildings, designing of passive houses, ability to use simulation engineering applications, ability to operate equipment, ability to use 3D designing applications, English language (including technical English)
Important competences which are the least available on the labour market (as stated by employers)	Designing of energy-saving buildings, HVAC facility control systems, initiative, power consumption optimisation, effective power management, general technical and engineering knowledge.
Important competences which are the most available on the labour market (as stated by employers)	Integrity, learning, ability to use MS Office, Open Office or Google Docs
The most often educational results important for employers (in universities' opinion)	General technical and engineering knowledge, knowledge about building materials, new trends, mechanical ventilation and air-conditioning installations, learning, integrity, ability to use office software packets.
Universities' task as perceived by business	Designing of low-energy buildings, physics of constructions, mechanical ventilation and air-conditioning installations, knowledge of energy-saving technologies, general technical and engineering knowledge, designing of energy-saving buildings.
Universities' task as perceived by universities	Integrity, learning, general technical and engineering knowledge, knowledge of building materials

Table 9 Synthetic summary of the Study of Competences findings for the passive and low-energy building sector in Kraków

Co-operation between universities and the representatives of businesses is gaining its momentum, although the co-operation may be said to be potential and informal rather than to have any systemic dimension. More and more R&D initiatives appear, for instance the Małopolska Energy-Saving Building Centre at the Kraków University of Technology. A number of post-graduate studies are arranged in co-operation between a university and external sector organisations.

Employers who took part in the survey indicated a number of shortages in the competences of graduates from Kraków's universities. What is of particular importance is that the results of quantitative and qualitative analysis of universities indicate that in most cases the representatives of universities agree as to the essence of this diagnosis. **Employers indicated shortages related to practical skills and specialist knowledge. Shortages relate to soft skills and command of technical language.** In this context we should also remember about considerably high diversity of companies as to the quality of their strategic human resources management: **employers often seem to forget of the importance of the orientation of employees (onboarding) in the work of the company and expect fully prepared candidates.**

Considering the potential of the two largest technical universities in Kraków, there is not a problem related to the number of graduates who could work in the sector. However, the problem lies in the quality of competences acquired by them. Students do not acquire several competences important for the sector at more general fields of studies related to construction engineering and designing. Anyway, it is impossible to acquire all such competences at these fields of studies. It seems that **the present trend to open specialist post-graduate studies that may tailor all their curricula to the requirements of the sector, is a good solution.** In the context of the development of the sector, it would be important that – to the extend possible – the curricula of the fields of studies educating future candidates to work in the sector, are complemented with specific competences required by Kraków's entrepreneurs, and that the development of post-graduate studies and specialist university supplementary courses is continued. The inclusion of technical foreign languages, particularly – technical English and German into curricula – is worth consideration in the context of post-graduates studies.

The representatives of universities indicated that the level of student's education is fairly uneven. There appear opinions that if graduates achieved all the desired educational results after a relatively short training, they would be very well prepared to work in the sector. The problem seems to be related to the attitude of some students, i.e. their lack of commitment and dedication to their personal development. The phenomenon is seemingly particularly noticeable in two cases: the development of soft skills, which – to a considerable degree – is a side effect of the main educational process and without an initiative on the part of those interested, it can be hardly taught and enforced. The other case is the development of practical skills that require additional activities, training etc. In the latter case, certain actions of the university are possible (modification of the scoring/credit system, etc.), that might help to improve education level. **The system of practical training is a huge problem.** In the opinion of the representatives of both milieus, the system does not fulfil its goals. And here lies the greatest potential for improvement in a relatively short time. The representatives of both parties: business and universities declare, on the one hand, that they are ready to co-operate on this problem, on the other hand, they are not convinced as to the real intentions of the other party. **A broader co-operation should make it possible to reach an agreement as to division of responsibilities and tasks,**

namely: what competences should be taught at universities and what competences should be developed by businesses at their own, and which competences should be examined more closely in relation to the teaching at under-university levels of the system of education. The results of the study show that stereotypes of views not always are confirmed by practice.

Universities, companies and the Kraków City Hall should care about the promotion of the passive and low-energy building sector amongst students. In this context, universities while co-operating with companies, may achieve the improvement of educational results of teaching and – additionally – improve their images. Examples demonstrated by the power sector show that co-operation with universities facilities gives companies access to best graduates and facilitates the recruitment process. In this respect, co-operation between business and universities should be directed beyond focus on employer branding.

Apart from attempts to find effective solutions of the aforementioned problems, it would be important from the perspective of the sector that the Kraków City Hall gets more active. **The representatives of companies and – to some extent – also of universities emphasised that the Kraków City Hall acting as an investor and an important actor in social life could play a very positive educational and promotional role by increasing the awareness of prospective individual and institutional investors (including local governments) of the importance and value of the application of energy-saving solutions.**

APPENDIX 1 LIST OF COMPETENCES AND EDUCATIONAL RESULTS

Specialist Knowledge			
Item No.	Name	Competence description	Educational result
1	Architecture	Knowledge about architecture and designing of buildings	The student possesses knowledge about architecture and designing of buildings
2	Automation of installations	Knowledge about the automation of internal installations in buildings and of building intelligent management control systems (BMS systems)	The student possesses knowledge about the automation of internal installations in buildings and of building intelligent management control systems (BMS systems)
3	Effective power management	Knowledge about effective management and processing of energy.	The student possesses knowledge about effective management and processing of energy.
4	Physics of constructions	Knowledge about heat flow in the building and physical properties of materials.	The student possesses knowledge about heat flow in the building and physical properties of materials.
5	Central heating systems	Knowledge about designing of central heating systems.	The student possesses knowledge about designing of central heating systems.
6	Electric installations	Knowledge about electrical installations	The student possesses knowledge about electrical installations.
7	Mechanical ventilation and air-conditioning installations	Knowledge about designing of mechanical ventilation and air-conditioning installations, including heat recuperation and ground heat exchangers (GWC/GPWC)	The student possesses knowledge about designing of mechanical ventilation and air-conditioning installations, including heat recuperation and ground heat exchangers (GWC/GPWC)
8	Current water and sewage systems	Knowledge about designing of current water and sewage systems	Student possesses knowledge about designing of current water and sewage systems.
9	Building structure engineering	Knowledge about engineering of building structures of various types which helps to understand and prepare technical documentation.	The student possesses knowledge about engineering of building structures of various types which helps to understand and prepare technical documentation.
10	General technical knowledge	Systematic knowledge about processes and effects related to physics, chemistry and mathematics applicable to the work in the sector.	The student possesses systematic knowledge about processes and effects related to physics, chemistry and mathematics applicable to the work in the sector.
11	Hydraulic control of water installations	Knowledge about hydraulic control of water installations	The student possesses knowledge about hydraulic control of water installations
12	HVAC (Heating, Ventilation and Air-Conditioning) facilities control systems	Practical knowledge about control algorithms for HVAC installations control	Student possesses practical knowledge about control algorithms for HVAC installations control
13	Thermal modernisation	Knowledge about thermal modernisation of existing buildings.	The student possesses knowledge about thermal modernisation of existing buildings.

Specialist Knowledge			
Item No.	Name	Competence description	Educational result
14	Energy-saving technologies	Knowledge about technologies related to alternative energy sources (solar, photovoltaic, water and geothermal technologies, etc.) applied in designing of passive and/or low-energy buildings.	The student possesses knowledge about technologies related to alternative energy sources (solar, photovoltaic, water and geothermal technologies, etc.) applied in designing of passive and/or low-energy buildings.
15	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
16	Ability to operate equipment	Knowledge about installation equipment, its construction and operation.	The student possesses knowledge about installation equipment, its construction and operation.

Specialist Skills			
Item No.	Name	Competence description	Educational result
1	Selection of equipment	Ability to select equipment in compliance with requirements of the project in order to ensure optimal energy and economic performance of the project.	The student is able to select equipment in compliance with requirements of the project in order to ensure optimal energy and economic performance of the project.
2	Project documentation	Ability to develop and check – with respect to requirements and in compliance with laws – comprehensible and attractive graphic project documentation.	The student is able to develop and check comprehensible and attractive graphic project documentation so that it meets requirements and is compliant with laws.
3	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.
4	Ability to use software for building thermal analysis	Ability to use software for calculating heat leakage bridges	The student is able to use software for calculating heat leakage bridges.
5	Operation of 3D designing applications	Ability to use 3D designing applications (e.g. AutoCAD, Solid Edge, SolidWorks, ArchiCAD, 3D Studio Max, Revit)	The student is able to use 3D designing applications (e.g. AutoCAD, Solid Edge, SolidWorks, ArchiCAD, 3D Studio Max, Revit)
6	Ability to use simulation software	Ability to make energy calculations using software based on numeric simulation (e.g. EnergyPlus, ESP, DOE-2)	The student is able to make energy calculations using software based on numeric simulation (e.g. EnergyPlus, ESP, DOE-2)
7	Energy consumption optimisation	Ability to manage power so that energy consumption in buildings currently in use is optimised.	The student is able to manage power so that energy consumption in buildings currently in use is optimised.
8	Designing of installations in 3D designing systems	Ability to design project installations using 3D designing software (e.g. DDS-CAD, BIM)	The student is able to design project installations using 3D designing software (e.g. DDS-CAD, BIM)
9	Designing of low-	Possession of abilities that enable	The student is able to design low-

Specialist Skills			
Item No.	Name	Competence description	Educational result
	energy buildings	designing a low-energy building	energy buildings
10	Designing of passive houses	Possession of abilities that enable designing a passive building	The student is able to design passive buildings
11	Designing of prefabricated houses	Possession of abilities that enable designing a prefabricated building	The student is able to design prefabricated buildings
12	Reporting of analysis results	Ability to develop reports from analysis	The student is able to develop reports from analysis.
13	Tightness tests	Ability to carry out tightness tests of building of various types	The student is able to carry out tightness tests of building of various types

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 from 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.

Business Knowledge and Skills			
Item No.	Name	Competence description	Educational result
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.
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	Project management	Ability to effectively manage the activities of project teams	The student is able to effectively manage the activities of project teams.
13	Knowledge of AGILE methodology 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).
14	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 streamlining 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.
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 (focus on targets)	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.

Soft Skills			
Item No.	Name	Competence description	Educational result
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.
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		
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

Foreign languages and other requirements			
Item No.	Name	Competence description	Educational result
			generate knowledge.
18	Licences and authorisations	Licence to issue building energy certificates	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
Energy-saving technologies	4.84	4.82	3.73	54%	3.45	4.78	4.27
Effective power management	4.67	4.69	3.93	62%	3.50	4.69	4.40
General technical knowledge	4.65	4.50	3.81	77%	3.67	4.67	4.60
Knowledge of building materials	4.63	4.59	3.64	77%	3.91	4.59	4.50
Mechanical ventilation and air-conditioning installations	4.57	4.61	3.76	62%	3.67	4.78	4.36
Thermal modernisation	4.50	4.44	3.60	62%	3.40	4.56	4.20
HVAC facility control systems	4.42	4.50	4.13	15%	2.83	4.53	4.29
Physics of constructions	4.40	4.53	3.79	62%	3.45	4.83	4.50
Ability to operate equipment	4.33	4.56	3.80	62%	3.18	4.38	4.50
Central heating systems	4.29	4.28	3.40	31%	3.13	4.82	4.56
Automation of installations	4.25	4.44	4.00	31%	2.86	4.39	4.22
Building structure engineering	4.24	4.39	3.47	46%	3.33	4.83	4.60
Architecture	3.88	3.88	3.14	31%	3.14	4.50	3.78
Current water and sewage systems	3.84	3.88	3.42	46%	3.10	4.47	4.45
Electric installations	3.78	4.00	3.80	8%	2.17	4.50	3.86
Hydraulic control of water installations	3.47	3.60	3.54	38%	3.50	4.29	4.43

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
Project documentation	4.56	4.65	3.75	54%	3.44	4.53	4.44
Energy consumption optimisation	4.53	4.59	3.88	38%	2.89	4.57	4.13
Designing of low-energy buildings	4.40	4.72	4.13	31%	3.33	4.80	4.50
Operation of 3D designing applications	4.33	4.53	3.60	62%	3.70	4.57	4.60
Designing of passive houses	4.28	4.69	4.23	31%	3.17	4.67	4.63
Energy audit (building energy performance) calculations	4.26	4.41	3.19	46%	3.20	4.13	4.38
Selection of equipment	4.25	4.21	3.71	46%	3.00	4.07	4.30
Ability to use software for building thermal analysis	4.22	4.25	3.77	31%	3.13	4.29	4.50
Reporting of analysis results	4.18	4.25	3.64	38%	3.29	4.21	4.57
Ability to use simulation software	4.00	4.60	4.08	31%	3.40	4.46	4.43
Tightness tests	3.85	4.21	3.73	15%	3.00	3.92	4.60
Designing of installations in 3D designing systems	3.68	4.29	3.80	38%	3.38	4.44	4.60
Designing of prefabricated houses	3.53	3.81	3.67	23%	3.25	4.15	4.43

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
New trends	4.50	4.57	3.77	92%	3.75	4.46	4.36
Project management	4.24	4.33	4.17	46%	2.88	4.14	3.75
Economics	4.22	4.33	4.09	54%	3.00	4.38	4.30
Law and legal regulations	3.94	4.21	3.91	85%	3.58	4.31	4.45
Knowledge about the sector	3.94	4.07	3.64	69%	3.36	3.75	4.33
Knowledge of standard management methods	3.75	3.64	3.78	8%	3.00	3.77	4.33
Business offers	3.69	3.71	3.67	23%	2.80	3.54	4.00
Holistic perspective	3.69	3.79	3.42	31%	2.88	3.92	4.29

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
Business etiquette	3.63	3.67	3.36	31%	2.57	3.50	4.17
Negotiations	3.60	3.92	3.89	15%	2.50	3.64	3.80
Investment financing	3.47	3.73	3.64	54%	3.22	3.91	3.67
Marketing	3.31	3.43	3.27	31%	2.83	3.92	3.75
Knowledge of AGILE methodology in project management	3.31	3.58	3.43	0%	2.00	3.78	4.00
Public procurement	3.20	3.42	3.67	31%	3.00	3.55	4.17

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
Being concerned about quality	4.60	4.57	3.58	46%	3.13	4.33	4.00
Organisation of own work	4.50	4.36	3.83	62%	3.56	3.58	3.88
Learning	4.50	4.50	3.08	62%	3.56	3.83	4.63
Customer-focused	4.46	4.33	3.80	46%	3.14	4.00	3.83
Initiative	4.44	4.46	4.00	54%	3.10	3.50	3.56
Commitment	4.43	4.36	3.55	46%	3.38	3.62	4.50
Collaboration	4.40	4.42	3.50	69%	3.50	3.82	4.13
Oral communication	4.38	4.25	3.18	77%	3.55	3.80	4.57
Analytical skills	4.38	4.36	3.42	54%	3.50	4.17	4.00
Goal-oriented	4.33	4.07	3.46	46%	3.29	4.00	4.20
Adaptive skills	4.33	4.25	3.18	46%	3.43	3.55	3.67
Innovation	4.29	4.27	3.83	69%	3.10	3.77	4.14
Coping with stress	4.21	4.27	3.40	31%	3.00	3.50	4.00
Written communication	4.07	3.93	3.33	69%	3.40	3.92	4.57
Ability to influence others	4.00	4.00	3.60	69%	3.08	3.30	3.50
Intercultural "sensitivity"	3.38	3.55	2.71	46%	3.14	3.09	3.43

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
Integrity	4.88	4.62	2.67	62%	3.60	3.64	4.73

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	4.61	4.40	2.33	92%	4.33	3.85	4.45
Readiness /ability to work various hours	4.31	4.27	2.73	-	-	2.50	-
Focus on development	4.20	4.36	3.31	62%	4.00	3.55	4.78
English	4.11	4.50	3.00	-	-	4.44	-
Technical English	4.11	4.50	3.63	-	-	4.31	-
Mobility	4.00	4.23	3.15	-	-	2.64	-
Mathematical skills	3.94	3.86	3.00	77%	3.91	4.25	4.80
Driving license	3.57	3.55	1.89	-	-	2.30	-
Technical English	3.25	3.86	3.91	-	-	3.77	-
German	3.19	3.86	3.82	-	-	3.69	-
Licences and authorisations	3.14	3.36	3.00	-	-	3.25	-
Russian	2.67	3.60	4.33	-	-	3.50	-
French	2.20	3.14	3.67	-	-	3.67	-
Chinese	1.92	3.63	4.80	-	-	3.43	-
Spanish	1.80	2.71	4.25	-	-	3.14	-
Italian	1.70	2.17	4.20	-	-	3.14	-
Japanese	1.60	2.50	4.80	-	-	2.67	-

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 skills, 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 assess 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 skills, business knowledge and skills, soft skills, other requirements – list available in Appendix 1, based on two criteria:

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