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THE IDENTIFICATION OF TRAINING NEEDS FOR HUMAN CAPITAL QUALITY IMPROVEMENT IN POLAND – A STATISTICAL APPROACH

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ABSTRACT

The Ministry of Science and Higher Education has launched the Competency Development Programme in the form of additional financial means for activities to equip students with unique, the so-called soft skills necessary in scientific careers and on the labour market. Courses developing skills such as team work ability, leadership, creativity, independent thinking and innovative approach to problem solving will be financed.

For that purpose, a thorough analysis of needs is necessary. Existing databases describing the quality of human capital in Poland should be analysed in order to identify those competencies that graduates of universities are missing.

The arsenal of possible statistical tools applicable for that purpose covers a wide range of techniques, from the simplest methods of descriptive statistics to advanced multivariate statistical analysis.

The study will attempt to identify the missing soft competences based on existing statistical data, e.g. Polish human capital database.

Key words: soft competencies, human capital, statistical methods.

1. Introduction

The European and National Qualification Frameworks define the output of education in terms of knowledge, skills and personal attitudes. Although there is no direct indication on weights attributed to those three groups of teaching and learning results, one may expect some kind of equilibrium. The reality in higher education (and similarly in other segments of education and training system) is such that students are assessed mainly for knowledge than for skills, and in a minimal degree for acquired personal attitudes (here referred to as soft skills).

On the other hand, employers declare a completely opposite hierarchy of expected employee's characteristics. The most important are soft skills, than skills,

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and knowledge, although desirable, is considered as additional, supplementary criterion. In a 2015 survey, 77 percent of employers surveyed by CareerBuilder said they were seeking candidates with soft skills, and 16 percent of the respondents considered such qualities more crucial than hard skills (see for example *The 10 Unique Soft Skills ...* (2015), *Why Attitude is more Important ...* (2015). Similar results for Polish employers have been found in Dziechciarz et. al (2006), Kurkliński and Maszybrocki (2008), Maszybrocki (2010). An extensive literature review on the topic may be found in *Getting Youth ...* (2013).

In response to this challenge, the Ministry of Science and Higher Education launched in mid-2015 the Competency Development Programme in the form of additional financial means for activities to equip students with unique, the so-called soft skills necessary in scientific careers and on the labour market. Courses developing skills such as teamwork ability, leadership, creativity, independent thinking and innovative approach to problem solving will be financed.

To guarantee the Competency Development Programme is a success, a thorough analysis of needs is necessary, including the assessment of compliance (convergence) of the declared level (self-assessment) of possessed soft competences with the declared employer's needs (demand – supply analysis). Existing databases describing the quality of human capital in Poland should be analysed in order to identify those competencies that graduates of universities are missing.

The possible approach to assess the level of soft skills is to measure it in tests proving that a person is able to use an individual skill, (on a given level. Such objective measurement is extremely expensive and time-consuming, and requires frequent updates of results. This is the reason that the most widespread mode of the assessment of the level of soft skills is the subjective approach. The respondent declares to which extend she/he is able to use an individual soft skill.

The natural arsenal of tools for the purpose of looking into large database of self-assessment statements is the multivariate statistical analysis framework, starting with basic descriptive statistics, along with correlation and dependence measures, factor and correspondence analysis, to classification techniques.

2. The objective of the analysis

The objectives of the analysis of compliance (convergence) of the declared level (self-assessment) of possessed soft competences with the declared employer needs (demand – supply analysis) are the following.

- Identifying the desired (by employers) competence profile and its confrontation with the declared (by potential employees) possession level of soft skills.
- Assessment of compliance (convergence) of the declared needs for soft competences (demand, employers' declarations) with the declared possession of soft competences (supply, potential employee declarations).
- Credibility assessment of respondents' declarations.

And additionally:

- Priority setting, whether demand or supply determines the directions of trainings.
- Decomposition (identification) of convergent and divergent indications.
- Testing of the applicability of selected multivariate statistical analysis tools and techniques for the purpose of soft skills analysis.

The fifth edition of the Study of Human Capital in Poland was selected as the main source of statistical data. The details of the study and the source data are available on the web page of the study (<http://en.bkl.parp.gov.pl>). The study will be referred to as BKL in further text. The database used contains information coming from a large number of respondents (<http://bkl.parp.gov.pl/bazy-danych14>). It covers over 64,000 employers and 70,890 of potential employees³. The database used for analysis in this article was created during the implementation of the 2014 edition of the Project *Study of Human Capital in Poland*. The database will be referred to as BKL2014 in further text.

2. Soft competencies

The classification of soft competencies, developed for the purposes of the Study of Human Capital in Poland, consists of twelve groups, both for employees and for employers. The list includes the following soft competences:

Table 1. The classification of soft competencies developed for the purposes of the Study of Human Capital in Poland

Symbol		Soft competency description
C01	Z01	Seeking and analysis of information, and drawing conclusions
C02	Z02	Technical imagination, handling and repairing technical devices
C03	Z03	Performing calculations
C04	Z04	Working with computers and using the Internet
C05	Z05	Artistic and creative skills
C06	Z06	Physical fitness
C07	Z07	Self-organisation of work and showing initiative
C08	Z08	Contacts with other people
C09	Z09	Organisation and conducting office work
C10	Z10	Managerial skills and organisation of work
C11	Z11	Availability
C12	Z12	Fluent use of Polish language (linguistic correctness, wide vocabulary, ease of speaking)

Note: the symbols with description C refer to Employees, the symbols with description Z refer to Employers. The soft competencies for Employees are further classified into subcategories. The list of subcategories is given in Appendix.

Source. BKL <http://bkl.parp.gov.pl>.

³ Unfortunately, the database contains descriptions of variables only in Polish language.

2.1. Decomposition of competences in accordance with respondents' characteristics

In order to see the basic characteristics of the declared level of possessed soft competences, the simple plots have been used. The respondents with higher education diploma (least numerous group) manifest a relatively high self-assessment with low variability. Respondents with basic education show a much lower level of soft competences, accompanied with a much higher variability (figure 1).

As it was expected, the respondents with secondary education show a more optimistic picture of their soft competences than people with basic education and less favourable in comparison with those with higher education.

Such statements give moderate, cautious ground to assess that respondents carefully formulate their self-assessment, at least in accordance with the level of their education. It gives some reasoning for the use of subjective statements as the basis for analysis.

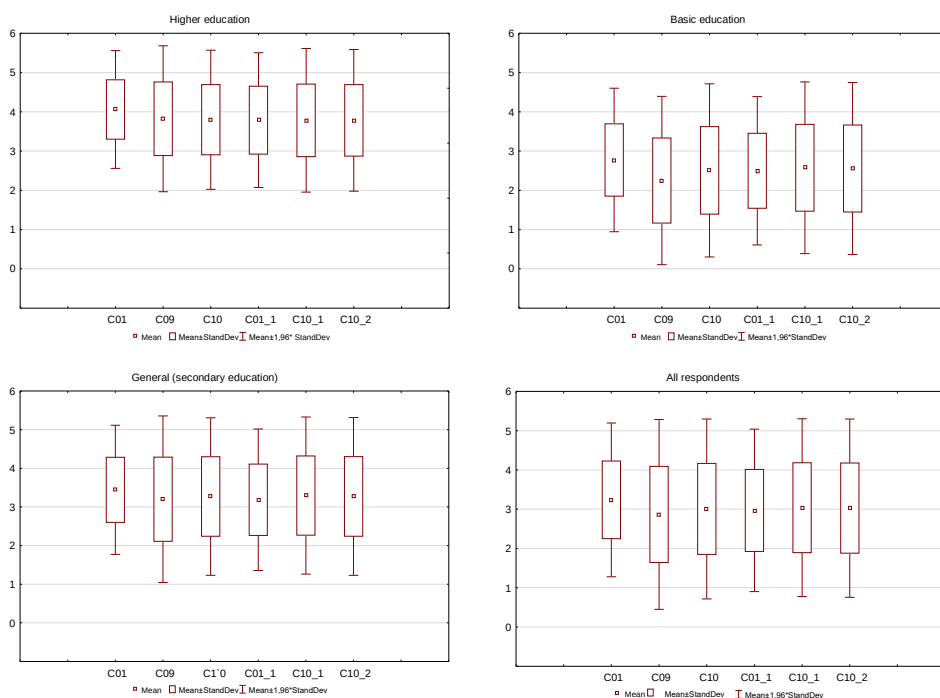


Figure 2. Box and whiskers plots, the level of possessed soft competences, declaration of potential employees broken down by educational groups

Source: Own calculation on data from BKL2014.

In order to identify soft competences, which have a tendency to strongly correspond with the level of education, the PROFIT analysis (*PRO*perty *FIT*ting) has been used. The results of multidimensional scaling approach are illustrated in Figure 2. The obtained preference map is the basis for the assessment of the rela-

tions and interdependence between the objects and the respondents. PROFIT analysis creates the vector preference map, combining the perceptual map obtained by multidimensional scaling with the data on the preferences towards the surveyed objects from the point of view of their characteristics. This method puts together the results of multidimensional scaling and multiple regression analysis (see, e.g. Zaborski, (2013); Walesiak and Gatnar, (2004)).

A disquieting issue coming from the results is an observation on respondents with higher education. It shows that the level of education has a prevailing role in the self-assessment of the soft skill level. It would be more credible, provided young academics judge their skill in more moderation.

The labour market situation of a respondent (employed, unemployed) does not differentiate declarations of soft skills self-assessment.

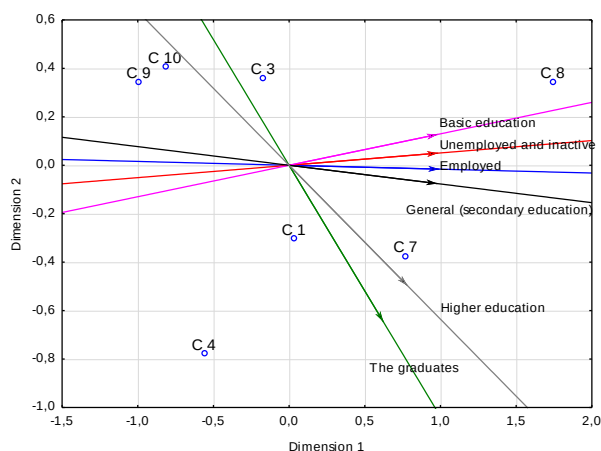


Figure 1. Evaluation of the level of competencies by employment and education

Source: Own calculation on data from BKL2014.

In order to identify soft competences, which have a tendency to strongly correspond with the age groups and level of education, the correspondence analysis has been performed. The upper part of Figure 2 illustrates the coincidence of the respondents' education level (4 categories) combined with the age of respondents (3 categories), along with a subjective evaluation of her/his soft competences.

In the case of all three analysed competencies, the achieved percent of total inertia described in the two first dimensions reached a value of around 99%, individual inertia vary from 83.41% to 90.36% for the first dimension; and 8.69% to 14.87% for the second dimension.

In the study, a variant of correspondence analysis for many nominal variables was used, i.e. with multi-dimensional contingency matrix. A comprehensive description of the algorithm of the correspondence analysis, computational details, and its applications can be found in the classic text by Greenacre, [1984] or other descriptions, e.g. Stanimir [2005]. The data that was used for calculations describes the situation in Poland in 2014; BKL2014 database, analysed data subset: study of working-age population (70890 respondents).

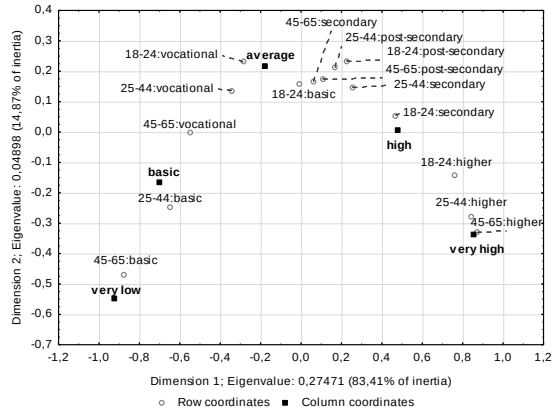
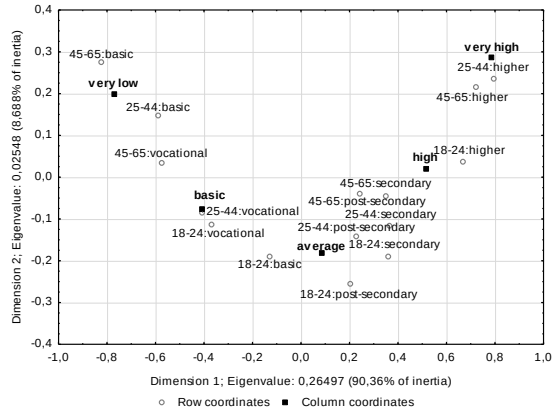
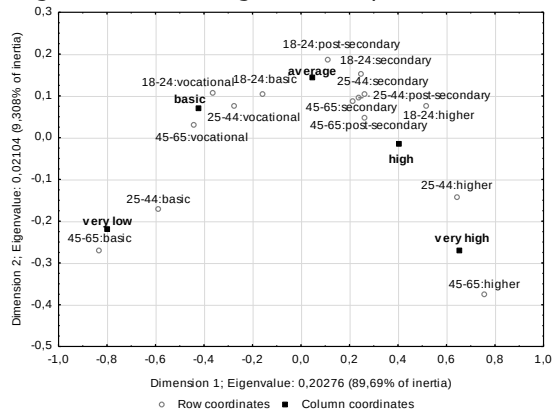
C01: seeking and analysis of information, and drawing conclusions**C09: organisation and conducting office work****C10: managerial skills and organisation of work**

Figure 3. Correspondence analysis of self-assessment of soft skills combined with education and age groups

Source: Own calculations on data from BKL2014.

The visualized output of correspondence analysis with multi-dimensional contingency matrix gives more ground for approving the respondents’ ability to a fair assessment of their soft competences. On may observe that the level of education and age groups strongly correspond with the declared level of soft competences. This correspondence is true for all three analysed competences.

2.2. Analysis for selected job type. Accountant

General inference for the whole sample of respondents may be used for general purposes only. The specific job type requires specific skills in general, and specific soft skills in particular. In Figure 4, a schematic match of the demand side with the supply side of competencies is shown. It this particular situation, the demand and supply of competencies for accountancy job.

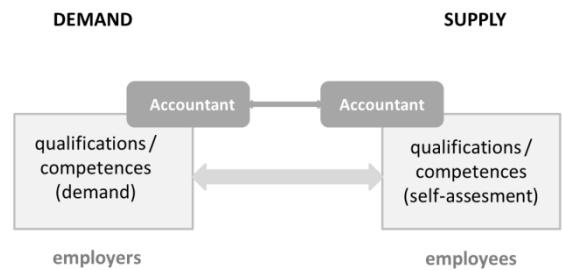


Figure 4. Schematic match of demand side with supply side of competencies
Source: Own elaboration based on BKL.

An attempt to compare expectations on the employers’ side with the employee’ judgement gives interesting insight into differences.

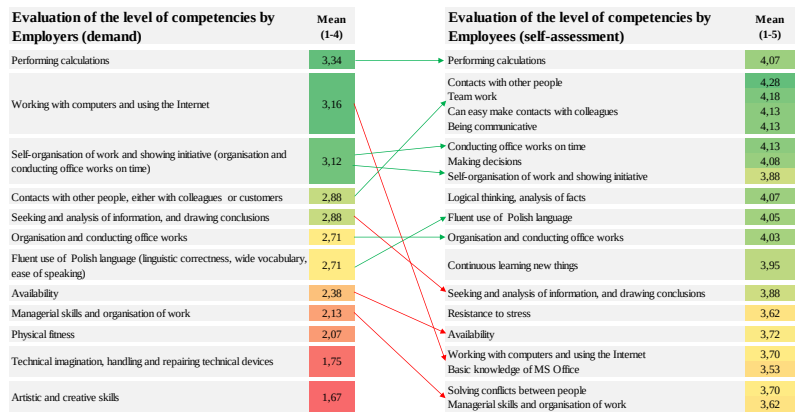


Figure 5. Importance of soft skills. Assessment by employers of accounting department and self-assessment by employees
Source: Own calculations on data from BKL2014.

For the employer, the ability of effective work goes first. The employee looks for a good working atmosphere. The most substantial difference one may see in a high position of *working with computers and using the Internet* competence, ranked very high in employers' hierarchy, and low in employee's hierarchy. The difference in other direction is manifested by competence: *contacts with other people, either with colleagues or customers*. As shown in Figure 5, it is very high in employees' hierarchy, and considered not so important by employers (the discussed competence is divided into sub-competences on the side of the employee, details in Appendix).

2.3. Comparison of the assessment of competencies

Evaluation of self-assessment of competencies for various positions gives insight into the way employees consider their ability to take responsibility working on particular positions. In order to identify soft competences, which have a tendency to strongly correspond with the job type illustrated in Figure 6 and 7, the PROFIT analysis has been used once more. In Figure 6 the supply (employee) side is shown. One may easily see groups of jobs (e.g. customer advisor, HR specialist) with set of soft competencies (subcategories, the list in Appendix).

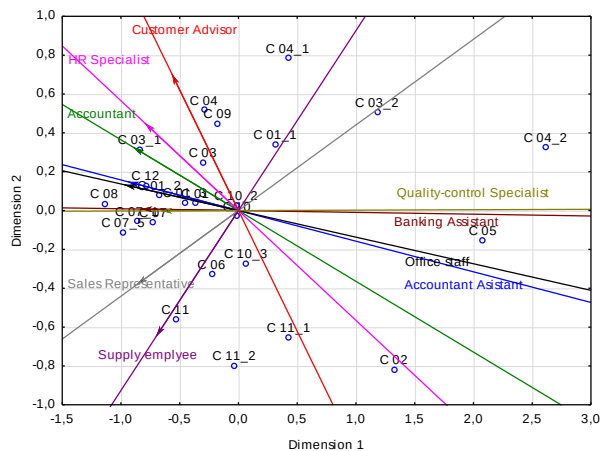


Figure 6. Evaluation of competencies for various positions (self-assessment, supply side; (subcategories, list in Appendix)

Source: Own calculations on data from BKL2014.

Evaluation of competencies for various positions required by employers gives insight into the way employers consider the set of skills needed to take responsibility working on particular positions. One may easily see groups of jobs with a set of soft competencies. To large extent, the sets shown in Figure 6 and 7 are the same (similar), but some differences might be seen in the assessment of job requirements with

respect to soft skills.

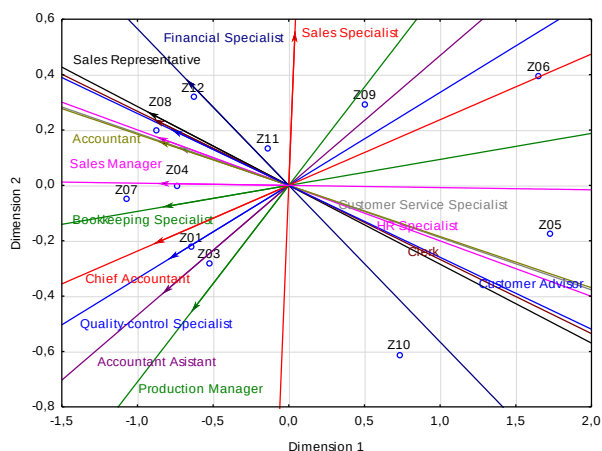


Figure 7. Evaluation of competencies for various positions (employer; demand side)

Source: Own calculations on data from BKL2014.

2.4. Classification of soft competencies

For more formalised insight into the similarities and differences of demand and supply side assessment, the classification study has been performed. The competences that are most needed to perform the position of an accountant were used as an exercise example. For classification, the hierarchical agglomerative method was used. This method proved to be most efficient in the sense of the carried out simulation experiment, Walesiak, Dudek, (2009). The technique provides a large homogeneity of identified classes. Due to the variable nature, the Generalized Distance Measure (GDM) technique for non-metric data was applied. Dist.GDM procedure of the platform R was used from clusterSim package. Dist.GDM procedure calculates Generalized Distance Measure for variables measured on ordinal scale or metric scale (ratio & interval). GDM2 method was used for variables measured on ordinal scale. Average method was employed for the classification. This hierarchical agglomeration technique is available in the hclust (stats package) of program R. As a result, a dendrogram was obtained.

Two experiments has been done. The results of classification on the demand side, employer, are displayed in Figure 8. Nine variables describing the assessment of the importance of competences formulated by employers were used for the classification.

The symbols in Figures 8 and 9 stand for: 1 – *Seeking and analysis of information, and drawing conclusions*; 2 – *Performing calculations*; 3 – *Working with*

computers and using the Internet; 4 – Self-organisation of work and showing initiative (organisation and conducting office work on time); 5 – Contacts with other people, either with colleagues or customers; 6 – Organisation and conducting office work; 7 – Managerial skills and organisation of work; 8 – Availability; 9 – Fluent use of Polish language (linguistic correctness, wide vocabulary, ease of speaking).

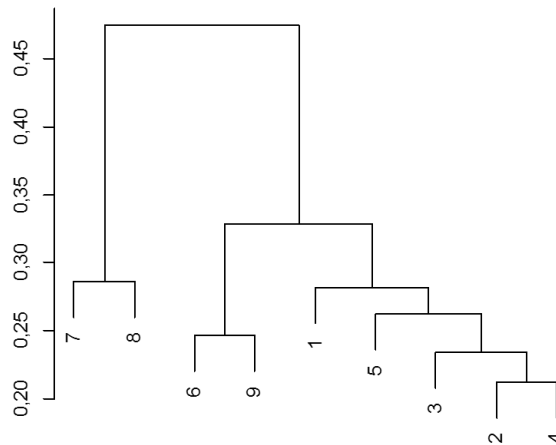


Figure 8. Dendrogram build on variables depicting employers' evaluation of the level of importance for soft competencies (demand side)

Source: Own calculations.

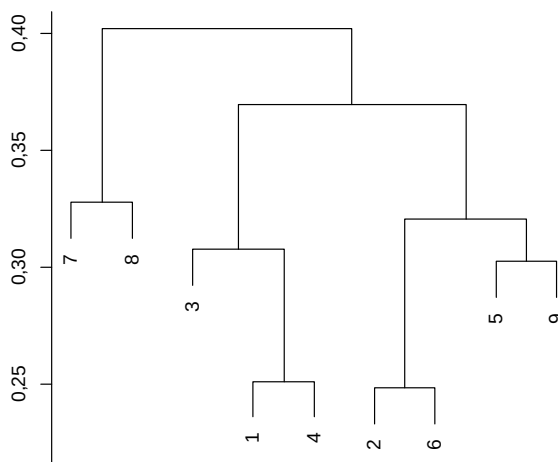


Figure 9. Dendrogram built on variables depicting employees' self-assessment of the level of possession of soft competencies (supply side)

Source: Own calculations.

From the results, it might be seen that despite differences the classifications are relatively similar. It has consequences for training design, and for recruitment policy.

3. Conclusions

In conclusion, it might be stated that, on the general level (for all respondents), there exists substantial compliance (convergence) of the declared level (self-assessment) of possessed soft competences with the declared employer's needs (demand side). This statement is also true for specific job types.

It means that in practice the competence profile desired by employers finds fulfilment in the declared (by potential employees) possession level of soft skills.

The statements on compliance are true conditionally, depending on the level of credibility assessment of respondents' declarations. Inferences drawn from statistical analysis give ground for a careful acknowledgement that the statements contained in self-assessment may be considered true.

An important question on priority setting, whether demand or supply determines the directions of trainings, may be answered by saying that due to substantial similarity between statements on demand and supply side this question proved to be not crucial.

The identification of divergent indications should be done on a disaggregated level. Individual job types may produce such divergent indications, especially in situations in which the employee stresses the importance of work atmosphere, and the employer seeks for work efficiency and effectiveness.

For solving the listed research problems, selected multivariate statistical analysis tools and techniques proved their applicability, especially for the purpose of soft skills demand and supply analysis.

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REFERENCES

- BERNAIS, J., JĘDRALSKA, K., (eds.), (2015). *Uniwersytet w perspektywie kształcenia przez całe życie* [University in the Lifelong Learning Perspective]. UE Katowice.
- BILANS KAPITAŁU LUDZKIEGO [HUMAN CAPITAL BALANCE], (2014). PARP, Warszawa; <http://bkl.parp.gov.pl>.

- BORG I., GROENEN P., (2005). *Modern multidimensional scaling. Theory and applications*. Springer, New York.
- DZIECHCIARZ, J., (2012). System jakości kształcenia [The Quality of Education], in: Dziechciarz, J., Błaczowska A., Grześkowiak, A., Król, A., Stanimir, A., *Analiza wybranych aspektów wyników egzaminu gimnazjalnego* [Analysis of selected aspects of lower secondary school exam results], UE Wrocław.
- DZIECHCIARZ, J., (2015). Pomiar i wycena wiedzy, umiejętności i kompetencji nabytych w formalnych i nieformalnych formach kształcenia [Measurement and Valuation of Knowledge, Skills and Competence Acquired in the Formal and Informal Education Forms], in: Wdowiński, P., (ed.), *Nauczyciel akademicki wobec nowych wyzwań edukacyjnych* [Academic Teacher's new Educational Challenges], Uniwersytet Łódzki. pp. 25–43.
- DZIECHCIARZ, J., (2015). Measurement of Rate of Return in Education. Research Directions, in: Velencei, J., (ed.), *Business, Management and Economics*, Obuda University, Budapest, pp. 39–56.
- DZIECHCIARZ, J., (2015). O pojęciu jakości w pomiarze efektów pracy uniwersytetu [The Concept of Quality in the Measurement of the University Performance], *Ekonometria*, No. 4, pp. 79–92.
- DZIECHCIARZ, J., (2015). O pomiarze efektywności nakładów na edukację i szkolenia w kontekście kształcenia przez całe życie [On the Measurement of the Efficiency of Investment in Education and Training in the Context of Lifelong Learning], in: Bernais, J., Jędralska, K., (eds.), *Uniwersytet w perspektywie kształcenia przez całe życie* [University in the Lifelong Learning Perspective], UE Katowice, pp. 42–52.
- DZIECHCIARZ, J., BŁACZKOWSKA, A., GRZEŚKOWIAK, A., (2009). Econometric Evaluation of Education Systems; in: Rinderu, P., (ed.), *Creating an Observatory on Europe-wide Transparency of Academic Qualifications*, Editura Universitaria Craiova; Craiova, pp. 112–131.
- DZIECHCIARZ, J., DZIECHCIARZ–DUDA, M., KRÓL, A., TARGASZEWSKA, M., (2015). Various Approaches to Measuring Effectiveness of Tertiary Education, *Archives of Datascience*, 2015/1, pp. 1–25.
- DZIECHCIARZ, J., et al. (eds.), (2006). *Rynek pracy aglomeracji wrocławskiej. Stan i perspektywy* [The Labour Market of the Wrocław Agglomeration. Status and Prospects], AE Wrocław.
- DZIECHCIARZ–DUDA, M., DZIECHCIARZ, J., (2016). Multivariate Statistical Analysis in Missing Skills Identification, in: Michelberger, P., (ed.), *Management, Enterprise and Benchmarking in the 21st Century*, Óbuda University, Budapest, pp. 109–122.
- DZIECHCIARZ–DUDA, M., KRÓL, A., (2012). Próba zastosowania modelu Mincera do oceny wpływu wyższego wykształcenia na poziom wynagrodzeń [An Application of Mincer Model in the Analysis of Higher Education Influence on the Wages' Level], *Ekonometria*, No. 3 (37), pp. 56–69.

- DZIECHCIARZ–DUDA, M., KRÓL, A., (2013). On the non-monetary benefits of tertiary education, *Econometrics*, No. 3 (41), pp. 78–94.
- DZIECHCIARZ–DUDA, M., PRZYBYSZ, K., (2011). Rynek usług edukacyjnych dla osób starszych. Analiza cech studentów uniwersytetów trzeciego wieku [Educational Market for Elderly People – Analysis of University of the Third Age Students' Characteristics], in: Garczarczyk, J., (ed.) *Metody pomiaru i analizy rynku usług. Pomiar jakościowy. Zastosowania i efektywność* [The Methods of Measurement and Analysis of Services Market. Qualitative Measurement. Application and Effectiveness], UE Poznań, pp. 44–55.
- DZIECHCIARZ–DUDA, M., PRZYBYSZ, K., (2014). Wykształcenie a potrzeby rynku pracy. Klasyfikacja absolwentów wyższych uczelni [Education and Labour Market Needs. Classification of University Graduates], in: Jajuga, K., Walesiak, M., (eds.), *Taksonomia*, No. 22/327, pp. 303–312.
- Getting Youth in the Door: Defining Soft Skills Requirements for Entry-level Service Sector Jobs (2013). International Youth Foundation, Baltimore.
- GÓRNIAK, J., (ed.) (2015). (Nie)wykorzystany potencjał. Szanse i bariery na polskim rynku pracy [Opportunities and Barriers on the Polish Labour Market. (Not)Exploited Potential], PARP, Warszawa.
- GREENACRE, M., (1984). *Theory and Applications of Correspondence Analysis*, Academic Press, London.
- KURKLIŃSKI, L., MASZYBROCKI, M., (2008). Ocena kształcenia absolwentów studiów o kierunku ekonomia oraz finanse i rachunkowość a potrzeby rekrutacyjne instytucji finansowych [Economics, Finance and Accounting Graduates Qualification Evaluation versus Financial Institutions Recruitment Needs], *Związek Banków Polskich*, Warszawa.
- MASZYBROCKI, M., (2010). Praktyki w bankach i zakładach ubezpieczeń dla studentów kierunków ekonomicznych (wyniki badań ankietowych) [Internships in Banks and Insurance Companies for Business Students (Survey Results)], *Wiadomości Ubezpieczeniowe* 1/2010, pp. 139–148.
- ROUSSEEUW, P., STRUYF, A., HUBERT, M., (2015). Package 'Cluster', <https://cran.r-project.org/web/packages/cluster>.
- STANIMIR, A., (2005). Analiza korespondencji jako narzędzie do badania zjawisk ekonomicznych [Correspondence Analysis as a Tool for the Economic Phenomena Investigation], AE Wrocław.
- The Ten Unique Soft Skills Employers Desire in new Hires, (2015). <http://www.entrepreneur.com/article/234864>.
- WALESIK, M., DUDEK, A., (2009). Ocena wybranych procedur analizy skupień dla danych porządkowych [Finding Groups in Ordinal Data. An Examination of some Clustering Procedures], in: Jajuga, K., Walesiak, M. (eds.), *Taksonomia*, No. 16, pp. 41–49.

- WALESIAK, M., DUDEK, A., (2015). Package 'ClusterSim', <https://cran.r-project.org/web/packages/clusterSim>.
- WALESIAK, M., GATNAR, E., (eds.), (2009). *Statystyczna analiza danych z wykorzystaniem programu R [Statistical Data Analysis using the Program R]*, PWN, Warszawa.
- WDOWIŃSKI, P., (ed.) (2015). *Nauczyciel akademicki wobec nowych wyzwań edukacyjnych [Academic Teacher's new Educational Challenges]*; Uniwersytet Łódzki.
- WHY ATTITUDE IS MORE IMPORTANT THAN INTELLIGENCE, (2015). <http://www.entrepreneur.com/article/253095>
- ZABORSKI, A., PEŁKA, M., (2013). Geometrical presentation of preferences by using profit analysis and R program, *Folia Oeconomica*, 285, pp. 191–197.

APPENDIX

The classification of some of employees' soft competencies is further divided into subcategories.

Table 2. The subcategories of employees' soft competencies

Symbol	Description of soft competency subcategories
C01_1	quick summarizing large amounts of text
C01_2	logical thinking, analysis of facts
C01_3	continuous learning of new things
C03_1	perform simple calculations
C03_2	perform advanced mathematical calculations
C04_1	basic knowledge of MS Office package type
C04_2	knowledge of specialized programs, writing programs, Web pages
C04_3	use of the Internet
C07_1	independent decision making
C07_2	entrepreneurship, initiative
C07_3	Creativity
C07_4	resistance to stress
C07_5	timely implementation of planned activities
C08_1	cooperation within the group
C08_2	easy networking with colleagues
C08_3	being communicative
C08_4	resolving conflicts between people
C10_1	assigning tasks to other employees
C10_2	coordinating the work of other employees
C10_3	disciplining other employees
C11_1	frequent trips
C11_2	flexible working hours