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Competencies Demand From Young Engineers on the Energy Market in Poland

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ABSTRACT
Young engineers are developing various competencies during their education. It is important to explore the requirements of one of the main labour markets for them. The aim of this study is to explore the needs of competencies of young engineers in the labour market of polish energy sector as well as the trends among hard and soft skills. The exploratory approach of 110 job advertisements was performed using various tools (general descriptive statistics as well as statistical reasoning tools). The research confirmed that teamwork, electrical competencies as well as office software are the most often required competencies. It is also important, that the job is waiting for young engineers with various competency profiles. What is more, during their education, they cannot belittle soft skills.

Keywords: *competencies, energy market, young engineers*

1. INTRODUCTION

1.1 General overlook

There is no doubt that security within the energy market is crucial for every nation. Those are the efficiency and the development of the whole economy that are determined by the generation and transmission of electricity. With a forecast of the global economy growth rate of 2,8%, the global energy sector is to be grown around 1.1% annually. There is also an expectation of the growth decline of conventional energy sources such as coal and crude oil (0.4% growth annually), with a simultaneous rise of solar, wind and geothermal energy (7,4% growth annually).

The long-term EU strategy assumes the carbon neutrality will be achieved by 2050 [1,2,3], although it is an ambitious goal. The EU 2030 Climate and Energy Framework aims in achieving a balance between the sum of energy savings and use of renewables will overtake and the sum of all fossil fuels that will be imported [1,4]. As Poland's energy market is based on mined and imported coal from different sources (including Russia, Australia, Colombia, Mozambique) [5], this transition is a tremendous challenge for the sector as well as whole economy. As a consequence of that situation the optimization of a wide variety of processes in this sector is mandatory [6,7]. Those includes new core competencies beneficial to forming a competitive advantage.

The global employment in the energy sector reached almost 58 million in 2017, with nearly half the jobs connected with fossil fuels [8] and it is predicted to be grooving within the renewable energy sector (ISC, 2021). The decarbonatization and carbon neutrality transition has profound implications for a global employment.

Around 18 million jobs could be created worldwide by limiting global warming to 2°C by the end of the century [8].

All those predictions make the interdisciplinary competencies most valuable [9].

1.2. Competencies

R. White and DC McClelland introduced to the science term competencies in 1960s and 1970s. R. White [10] was responsible for introducing a specific human factor, competence. DC McClelland [11], on the other hand, claimed that there are several different factors than just intelligence that undoubtedly influence the job results and human behavior in general. In 1980s RE Boyatzis [12], proposed that factors such as professional reorientation, multifunctionality, multitasking and

learning are the critical factors for an organization success. Currently, the concept is considered from the two separate perspectives: an employee and a job position perspective. The American approach links competency with a specific person, while the British approach with the position.

The American concept was started in 1982 by RE Boyatzis [12] by focusing on the analysis of people achieving and their above-average results. Analysis was focused on characteristics such as personal traits and motives, skills, self-image and perception of social role, the scope of knowledge, etc.). British concept of competencies developed a bit later, because in 1987 [13]. It was connected with public education. The National Vocational Qualifications (NVQs) project was introduced to adjust educational programs in a better way to the needs of the labor market. It was focused on the workplace and both tasks and effects of work from the perspective of contractors. So according to the British approach, competencies are equal to characteristics of work with a goal to properly define the minimal standards for a given work. It is important to state that in contrary to American approach, British one is not connected with employees and is not focusing on any outstanding performance. American "competency" describes "how" results are achieved. And British “competence” describes "what" is measured [14].

Competencies are presented in the literature in the general view as employee's abilities that enable outstanding achievements during at workplace [12, 15, 16, 17, 28, 19]. Competencies from the detailed perspective describes the essential attributes of a person such as personality, education, knowledge, skills, and abilities, as well as their practical implications on a workplace [20,21]. They constitute the essential feature of an effectively functioning employee [22].

Competency components classification [23-25] proofs that “competencies” is a complex category. One of the interesting models divide competencies on hard and soft ones. Most authors describe hard competencies as those connected with technical and/or cognitive knowledge, and soft competencies are being connected with behaviors and values. Hard competencies may be acquired through education or trainings as they are task oriented. Soft competencies, on the other hand, are being developed by effective communication and interaction with other people [26]. Other definition of hard competencies describes them as technical or administrative skills that can be quantified and measured [27]. Soft competencies can be considered as an umbrella term for social skills. Soft skills are also defined as interpersonal, human, personal, or behavioral skills needed to apply skills and technical knowledge into the workplace [28]. The list of those competencies includes [19, 29, 30, 31]:

1. attitudes
2. personal characteristics
3. teamwork
4. cooperation
5. empathy
6. listening
7. reliability
8. communication
9. courtesy
10. responsibility
11. interpersonal skills
12. positive attitude
13. professionalism
14. flexibility
15. honesty
16. teamwork
17. work ethic
18. motivation
19. empathy

As it is presented, the concept of soft skills is not homogeneous and includes many different components.

The strategic importance of energy sector makes it mandatory to focus on competencies, that employees in this sector should present and be aware of, in order to fully meet the job requirements. The diagnosis of employer expectations towards young engineers’ competencies in the energy market in Poland is important from both, the point of view of current situation on the market and challenges affecting the energy sector in Poland.

The aim of the article is to analyze the expectations of employers towards young engineers concerning the competencies in the energy market in Poland.

1.3. The energy market in Poland

A group of entities creating subsystems within the National Power System (NPS). They provide the continuity and stability supplies of energy. NPS combines of separate energy companies all of them subjected to independent institutions and regulations. There are two subsystems within the NPS generation subsystem as well as transmission and distribution network. Numerous legal acts created at the international level (European Union) and national government regulates the energy sector. The main and most important for energy sector in Poland, is the Energy Law from April 10, 1997 [32]. It considers the directives of the European Communities. Article 16 of this Act concerns energy companies, which means all entities conducting economic activity in the scope of: a) production, processing, storage, transmission, distribution or trade of

fuels or energy, or b) transmission of carbon dioxide, or c) reloading of liquid fuels.

1. The generation subsystem includes:
2. system power plants
3. industrial power plants
4. heat and power (CHP) plants
5. local CHP plants
6. hydro plants
7. wind plants
8. solar plants
9. biomass and biogas power plants.

Energy generated by abovementioned plants is distributed through the transmission network: 750 kV, 400 kV, and 220 kV power lines and stations.

The Polish energy sector is traditionally based on fossil fuels. It is mainly because of the extensive resources that are located in Poland – considered to be the 9th largest deposits in the world. Hard coal and lignite are two primary fuels that play a crucial role in energy production [33]. It does not mean that Polish energy sector is not developing towards renewable fuels. Power plants' capacity is increasing when it comes to the renewable energy sources (Table 1).

Table 1. Gross installed capacity of power plants (in MW).

Year	Thermal power plants[1]	Hydroelectric power plants	Wind and solar PV power plants	Total
2010	32648	2280	1286	36214
2011	33347	2276	1972	37595
2012	33207	2281	2715	38203
2013	32818	2289	3564	38671
2014	32985	2301	4057	39343
2015	33048	2306	5030	40384
2016	32970	2319	5977	41266
2017	35002	2392	6113	43507
2018	35523	2385	6405	44313
2019	37592	2384	7461	47437

[1] public thermal power plants using: hard coal, lignite and non-public thermal power plants.
Source: own study based on the Statistical Yearbook [34,35,36,37].

At the same time, the importance of fossil fuels is systematically decreasing (Table 2). In 2010, it was over 90% of production power, in 2019 it is already less than 78 %.

Table 2. Electricity balance (in GWh).

Year	Supply	from domestic sources — generation	public thermal power plants	hydroelectric power plants, wind and solar PV power plants[1]	Imports	Use	Domestic consumption	Exports	Losses and statistical differences
2010	163968	157658	144541	5152	6310	163968	144453	7664	11851
2011	170328	163548	149242	6469	6780	170328	147668	12022	10638
2012	171942	162139	146480	7841	9803	171942	148415	12643	10884
2013	172381	164580	146665	9791	7801	172381	149812	12322	10247
2014	172566	159058	139771	11354	13508	172566	150974	11342	10250
2015	179403	154076	142804	13350	14459	179403	154076	14793	10534
2016	180651	166634	140971	15333	14017	180651	159138	12018	9495
2017	183736	170465	140614	18108	13271	183736	162756	10984	9996
2018	183855	166840	140010	15487	13816	183855	166840	8121	8894
2019	181858	165662	129006	15764	17868	181858	165662	7245	8951

[1] Until 2014, the statistics included biogas plants instead of solar plants. In the comparison from 2013, the category was defined as "water (together with other renewable sources)."

Source: own study based on the Statistical Yearbook [34,35,36,37].

The abovementioned data proves that since 2015 the amount of electricity from the thermal power stations has been decreasing, although still over 70% of production is based on fossil fuels. What may be considered as a positive aspect, the energy produced by hydro, wind, and solar power plants i increased around three times between 2010 and 2019.

In Poland, around 130,000 people professionally work within the production and supply of electricity industry (table 4).

Table 4. Energy section - the context of the labor market.

Company	Employed persons in the section "Electricity, gas, steam and hot water production and supply" in thous.	Acceptance coefficient[1] for the section "Electricity, gas, steam and hot water supply" in%	Exemption factor for the section "Electricity, gas, steam and hot water supply" in%	Average monthly total gross remuneration in PLN	Average monthly gross remuneration in the section "Electricity, gas, steam and hot water generation and supply" in PLN	Employed in conditions of risk of harmful and hazardous factors in the section "Electricity, gas, steam and hot water supply" in%
2013	137.3	14.4	17.9	3659.40	6234.55	38.7
2014	130.5	8.0	12.8	3777.10	6353.66	18.3
2015	125.2	4.6	8.6	3907.85	6546.95	19.6
2016	123.2	5.7	7.3	4052.19	6763.53	13.9
2017	122.5	7.4	8.5	4283.73	7015.03	14.3
2018	124.1	10.6	9.3	4,589.91	7423.42	14.5

[1] "The hire (termination) rate is calculated as the ratio of the number of hires less the number of persons returning to work from child-care leaves (or the number of terminations less the number of persons granted child-care leaves) during a surveyed year to the number of full-time paid employees as of December 31 from the year preceding the surveyed year" [39]. Including sale of natural gas. [2] Per one track with connections.

Source: own study based on [39,40,41].

There is a visible decrease in a number of employees in this sector between 2013-2017, while in 2018, it increased slightly. The hiring rate in 2018 exceeded the layoff rate (mainly retirement and disability pensions). It proves that the sector is in a developing stage and needs new employees nowadays.

What is worth mentioning is that the average salary (per month) in this sector exceeds the monthly average wage in Poland, what is more, it is still growing. Energy sector trade unions are strong organizations - more than half of the employees participates in them. It provides stable growth of both wage and employment in comparison with different industries [42].

1.4. Competence expectations within the energy sector

Based on the directions of development of the whole sector there are several consequences for the companies in the context of competencies. There is a high need of innovative approach and highly qualified employees in order to meet the challenges [43,44]. In order to achieve this, companies demand competencies such as [45,46,47,48,49]:

1. Problem solving
2. Creativity
3. Active listening
4. Teamwork

5. Communication
6. Flexibility
7. Adaptability
8. Ligustic skills
9. Customer relationship management

Another important aspect that companies must be aware of are the competencies connected with a wide range of management tasks [7,50,51,52,53,54]. Those are:

1. Multitasking
2. Decision making
3. Organization of work
4. Strategy
5. Goals achievement
6. Competency development

There are also those competencies connected with innovative technologies, sustainable use of energy and ecology [55].

2. Materials and Methods

The paper presents the exploratory research with three main research questions:

What are the needs of competencies of the young engineers in the Polish energy labour market?

What is the structure of hard and soft skills within the labour market demands considering young engineers?

There were 110 job advertisements analysed in order to answer those research questions – all of them were the engineers job offers. Two sources of offers were used: job offer internet platform pracuj.pl as well as official websites of each of the companies. Most important data for the research were copied by the authors with a correction of doubling offers (available both on pracuj.pl website and home websites of the company). The research does not include any personal data neither the human being questioning.

During the research procedure authors decided to use 3 independent variables: company name, position level, required experience.

Company name – research was conducted among four big energy companies in Poland – PGE, Tauron, Enea, and Energa. Energa, as one of the biggest energies compa-nies in Poland in 2020, we're starting to merge with ORLEN GROUP, and the merging process is being continued. That's why in many reports, Energy Company is no longer present, but the company is still recruiting under its own name.

Position level – based on the job advertisements, researchers, decided to divide the type of a position into three categories (as they were declared by the employers). Operational workers, junior positions, middle positions, senior positions, specialist positions, experts, and managerial.

Participants were declaring their level of experience in years.

Several statistical methods were used to answer the research questions. One qualitative method – the Delphi method – used to group competencies based on specialist knowledge of researchers and to assign groups of competencies into hard or soft skills. For quantitative methods, there were:

1. General descriptive statistics
2. Shapiro-Wilk test of distribution normality
3. H Kruskal-Wallis's test for comparing more than 2 independent samples
4. U Mann-Whitney for comparing two independent samples
5. Spearman's Rho – for correlation check

All the research and calculations were prepared using SPSS 27 software.

The research sample was collected between May 24 and June 7, 2021. All the job offers were issued by one of the four leading energy companies in Poland: PGE (35 job offers), Tauron (45 job offers), Enea (9 job offers), and Energa (21 job offers).

3. Results

The exploratory research revealed 103 different competencies that were required by the employers. Table 5 present the mostly appearing competencies. It is important to state that only competencies that acquired more than 25 indications were presented in the table (it stands for 25% of job offer indications).

Table 5. Mostly demanded competencies

Competency	Number of indications	Percent of indications
Teamwork	65	65
Electric competencies	46	46
Office software	46	46
Development	36	36
English language	32	32
Goal orientation	31	31
Communication	30	30

Technological knowledge	28	28
Precision	26	26
Initiative	26	26

Source: Own source

One competency – teamwork – was required in 65% of the researched job offers. Two other competencies: electric competencies and office software were required in 46% of offers. Those three are the most demanded competencies. Four other competencies were required in more than 30% of job offers. Those were development (36%), English language (32%), goal orientation (31%) and communication (30%).

As the number competencies was high, in order to make the research results more readable authors decided to use Delphi method to group competencies and continue the study. Five different groups were created: IT competencies, electric qualifications, general competencies, intrapersonal competencies, working with machines, working with documents, working with people and organizational competencies. The example of the competencies from each group is presented in table 6.

Table 6. Group of competencies

Competence	Number of indications	Percent of indications
IT	IT system administration	Planning networks
	SQL	Online work
	AutoCAD	Dedicated software
	DCS systems	Coding
	LTE monitoring	RPA platforms
	MSOffice	SAP
	IT Tools usage	UX
	Computer usage	VBA
Electric qualifications	E1	SEP
	E2	
General competencies	Driving license	Thematic qualifications
Intrapersonal	Curiosity	Creativity
	Determination	Decency
	Accuracy	Motivations
	Availability	Responsibility
	Readiness to grow	Punctuality
	Initiative	Self-reliance
Working with people	Building and maintaining relations with employees and clients	Teamwork
	Verbal communication	Shift work
	Written communication	Negotiating
	Client-oriented approach	
Project	Methodical management	Project settlement
	Prioritizing	Financial knowledge
	Planning	Management
	Budgeting	
Working with documentation	Technical drawings	Technical documentation
	Creating documents	Protocols
	Schemas	

Working with machines	Use of electric machines	Railway licence
	Technology and machine testing	Technical knowledge
	Licenses for forklifts and truck equipment	Electric network knowledge

Source: Own study

The widest represented group is connected with information technology. There are 16 main competencies that were required by employers. The second-largest group of competencies is the one associated with intrapersonal competencies. It is essential to state that this group is mainly connected with the intrapersonal approach and personal competencies. The third-largest group is connected with working with people and is represented by 7 main competencies. Working with people is based on an interpersonal approach and working within the professional environment, and projects competencies are based on hard management skills and financial knowledge.

There are also 6 different competencies in the working with machines group, that mostly comprise licenses and heavy machinery tasks. Working with documents group is connected with reading, creating, and maintaining all the legal aspects of work. The most minor groups are those associated with electrical qualifications and general competencies. It is crucial to state that those are only examples of competencies that were indicated by employers, but their number reflects the complete structure of those groups.

Each group was firstly assessed by summing the elements in each group. The general results are presented in Table 7.

Table 7. Indicators of competencies within the groups. Descriptive statistics.

	N	Minimum	Maximum	Mean	Std. Deviation
Intrapersonal	110	0	10	3.32	2.258
Working with machines	110	0	6	1.70	1.487
General competencies	110	0	5	1.48	1.202
IT	110	0	6	1.22	1.309
Working with people	110	0	3	1.16	.784
Electric qualifications	110	0	2	.59	.654
Organizational comeptencies	110	0	3	.35	.656
Working with documents	110	0	1	.15	.354

Source: Own study

The average job offer for young engineers in polish energy market is equal to 10 competencies. More than three of them relate to Intrapersonal competencies (3,32). Four competencies: working with machines, general competencies, IT and working with people have more than one representative. Three others are in less than one job offer.

In order to describe the labour market in more detailed way, a various of different test were conducted. The Shapiro-Wilk normality test results were equal to $p<0,001$ for each of the competency's groups, that is why non-parametric test are to be used.

Problem 1 – Do companies require different competencies?

In order to address this problem, the H Kruskal-Wallis's test was performed. Results are presented in table 8.

Table 8. Companies and competencies

Competence group	Kruskal-Wallis H	Df	Asymp. Sig.
IT	8.676	3	.034
Electric qualifications	7.795	3	.050
General competency	12.288	3	.006
Intrapersonal	8.694	3	.034
Working with machines	5.694	3	.127
Working with documentation	4.072	3	.254
Working with people	9.241	3	.026

Project	.595	3	.898

Source: Own study.

Companies are requiring different competencies within IT (H=8.676, p=0.034), electric qualifications (H=7.795, p=0.050), general competencies (H=12.288, p=0.006), intrapersonal (H=8.694, p=0.034), and working with people (H=9.241, p=0.026).

Problem 2 – Do different positions level require different competencies?

In order to check this hypothesis, the H Kruskal-Wallis's test was performed. Results are presented in Table 9.

Table 9. Level of positions.

Competence group	Kruskal-Wallis H	Df	Asymp. Sig.
IT	8.151	3	.017
Electric qualifications	15.651	3	.000
General competency	20.132	3	.000
Intrapersonal	0.424	3	.809
Working with machines	17.654	3	.000
Working with documentation	7.334	3	.026
Working with people	0.029	3	.986
Project	7.192	3	.027

Source: Own study.

The level of a position differs from the competence requirements, but it is important to state that those are junior positions that have the results of the U Mann-Whitney test statistically significant in comparison with other levels and based on results ($p<0.001$ or close to that level) are responsible for all variability. There is no statistically significant difference between middle and senior positions in any of the competency's groups.

Problem 3 – is there any correlation between the experience and the number of competencies?

In order to check this hypothesis, Spearman's rho test was conducted. The results did not indicate any statistically significant correlation (rs=-0.201, p=0.071.

The second research question was connected with the structure of soft and hard skills demand. The results are presented in table 10.

Table 10. Descriptive statistics of hard and soft skills within technical positions only.

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles 25th	50th (median)	75th
Hard	110	5.48	3.016	0	14	3.75	5.00	7.00
Soft	110	4.48	2.811	0	13	2.00	4.00	6.00

Source: own study.

Hard skills are required more often (M=5.48, SD=3.016, Md=5) than soft skills (M=4.48, SD=2.811, Md=4). It is confirmed by the results of Wilcoxon test: T=1757, z=-2.514, p=0.012.

4. Discussion

Teamwork is a very important competence in 65% of analyzed job offers. As engineers are working more and more with groups, such as other employees [56], they have a positive effect on the performance of whole organization [7,57] and working under pressure and during emerging situations [58]. There are electric competencies needed in 46% of job offers. It is not a surprising thing, especially when analyzing positions for young engineers. Digitalization is also a very widely described topic [51,85,86], that is why the knowledge of using office software is on such a high place (present in 46% of job offers).

The first problem addressed was about the homogeneity of a market need. In general, four main energy companies in Poland require different competencies. It is a positive information for young engineers – there is a need for engineers with various competency profiles. Both within the companies, and junior, middle, and senior positions.

Hard and soft skills results may be described as not surprising. Hard skills are more demanded from young engineers, but it is important to state, that soft skills as teamwork or will to develop competencies are still in a high demand, and students and young engineers cannot belittle them during their education period.

The conducted research is unfortunately subjected a couple of limitations. First one is that the data was collected within a thirty-day period. It is subjected to a bias of representativeness. It is possible that technology cycles require more engineering positions or more specific requirements on different time.

Second limitation is that there was a lack of qualitative data collection, so at the same time the lack of triangulation. Those were only public recruitments, whereas headhunting or internal recruitment was also possible for those positions.

As for future research, the topic might be expanded in various ways. From the perspective of methodology, it would be good to conduct longitudinal research to search

for trends on the market, as well as triangulation in both data collection and stronger triangulation of data analysis.

AUTHORS CONTRIBUTION

Conceptualization, M.T. and R.S.; methodology, R.S.; software, R.S.; validation, R.S.; formal analysis, R.S; investigation, R.S., S.W., A.D., M.K.; resources, M.T, U.B., A.D., S.W., M.K., R.S.; data curation, R.S.; writing original draft preparation, M.T., U.B., A.D., S.W., M.K., R.S.; writing review and editing, R.S, S.W.; supervision, M.T.

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