What competencies are needed in the production industry? The case of the Podlaskie Region

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A B S T R A C T

The article focuses on indicating a set of competencies required for production branches based on the data regarding the Podlaskie labour market. The data was collected using quantitative surveys (in the form of questionnaires). Then, the Authors used network analysis to visualise the collected data and indicate the most frequently indicated set of competencies. Based on the opinion of respondents, the most popular competencies were professional knowledge and technical skills. These two competencies were also the most popular combination. Communication, self-reliance, thoroughness/reliability, sharing knowledge and experience, and teamwork/collaboration also proved to be important. The entire set of the competencies is strongly linked, with professional knowledge and technical skills forming the foundation. Knowledge of foreign languages has also been identified as significant as well as decision making, which was, however, less frequently connected with the above. Despite the dominance of the two competencies attributed to the professional group, this group of competencies was the least numerous. Based on the example of the Podlaskie Region, the study informs about the set of competencies sought by manufacturing companies. Also, the most important competencies typical for individual branches are noted. This collection of competencies can serve as a basis for further theoretical considerations in the field of competency identification aimed at the production industry. In some cases, competencies indicated for different industries coincide, while in others they are divergent. The set of competencies indicated by the respondents informs job seekers in the area of production as well as institutions such as Voivodship Labour Office in Bialystok, whose task, among others, is to appropriately orientate the development of future employees.

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Introduction

The research presented in this article is based on the data collected in the project entitled "Employer needs in the scope of supporting lifelong learning for deficit professions in Podlaskie Voivodship", commissioned by the Voivodship Labour Office in Bialystok (Dębkowska et al., 2017). The main objective of the conducted research was identifying professions, qualifications and competencies that were deficit/sought after in the Podlaskie labour market, with a special concern for key sectors of the regional economy. The research was also focused on determining the possibility of supporting employers in lifelong learning within the identified structural mismatches. The research methodology involved conducting desk research, quantitative surveys (in the form of ques-

tionnaires), a qualitative survey (in the form of an FGI) and foresight surveys in the form of the STEEPVL analysis, scenario method, visualisation and network analysis as well as the Delphi method. Among other things, the conducted study incorporated a matrix of adequacy and multivariate statistical analysis (cluster analysis, K-means method, correspondence analysis, correlation analysis, and classifications trees). The details of the entire research, its methodology and the achieved results are available in the monograph (Dębkowska et al., 2017). One of the authors of this article was engaged in the project preparing visualisations that – in the form of networks – present sets of crucial competencies in each of the analysed fields, based on the answers provided by thesurveyed. The researched branches and sectors included: construction, machine production, metalwork production, woodwork production, production of rubber and plastic products, transportation, food processing, gastronomic and touristic branch, health care and social care sector and trade sector.

Considering their interests and trends signalled in the literature, the authors of this paper decided to take a closer perspective of competencies searched in the field of production branches. As of today, the widely debated transformation in the direction of Industry 4.0 makes essential production competencies uncertain. Iwański and Gracel claim that the transition to the level Industry 4.0 requires, for instance, greater investments in the education of managers and engineers as certain competencies are required to implement and maintain the latest technologies (Iwański & Gracel, 2016). According to the report (McKinsey Digital, 2016), one of the most significant barriers to implementing Industry 4.0 is the lack of the necessary talent, as emphasised by the producers at the first stages of implementation. Hence, the article focused on indicating a set of competencies required for production branches based on the data gathered during the delivery of the project mentioned earlier. Thanks to questions asked during the conducted research, it was possible to take an outlook on the competencies needed at present and in the period of the following five years (2018−2022). To achieve the formulated objective, from among the data that concerned the branches analysed during the delivery of the project, the authors selected information obtained from representatives of five production branches (machine production; metalwork production; woodwork production; production of rubber and plastic products; and food processing). Based on the selected data, the authors prepared visu-

alisation depicting sets of competencies that are vital for the production branch today. The visualisation is expressed in the form of a network, thanks to which it was possible to illustrate not only the most important competencies in the eyes of the respondents but also their coexistence.

1. LITERATURE REVIEW

The notion of competency is an issue that sparked interest in the scientific literature already at the beginning of the 20th century (Volpentesta & Felicetti, 2011). The colloquial, everyday approach uses the notions of competencies, skills, qualifications, authorisations and duties interchangeably. The enumerated terms are treated as synonyms. However, these notions are not identical. On the contrary, they remain in a certain relation (Kubat, 2014). It is also problematic to make a clear-cut differentiation among competencies, knowledge and qualifications (Kinkel et al., 2017). Fig. 1 illustrates the relation among these three notions according to Hertle, Siedelhofer, Metternich, and Abele. Moreover, in the presented approach, the authors indicated four classes of competencies: (1) technical and methodological, (2) social and communicative, (3) personal and (4) activity and implementation.

A competency may be understood as a relation between an individual and tasks to be done within professional work; consequently, it is knowledge and skills that are required for effective execution of a specific task (Volpentesta & Felicetti, 2011). Kinkel et al. claim that a competency is "the individual dispositional ability and readiness to act successfully and self-organised when facing novel, unstructured or complex situations or tasks and the ability to develop solutions for future situations" (Kinkel et al., 2017, p. 324). According to Filipowicz, the simplest possible understanding of a competency is interpreting it as a disposition within knowledge, skills and approaches that allow for executing professional tasks at a proper level (Fig. 2). Such a notion of a competency means that it is expressed in the readiness for a specific sort of behaviour (Filipowicz, 2011). Literature also mentions fundamental features of competencies, such as their relation towards a specific task or professional activity; their changeability, which means their susceptibility to development (competencies are not stable features, they change together with experience as well as professional and personal
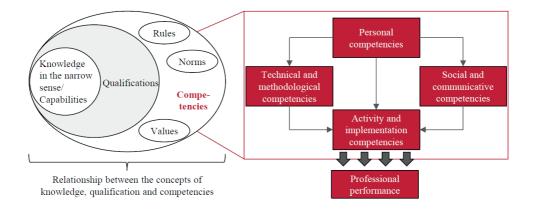
Fig. 1. Concept of competency and its relationship to knowledge and qualification
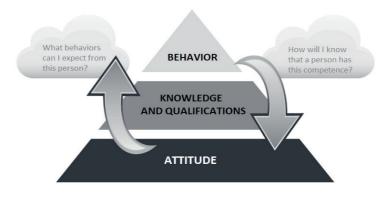Source: (Hertle et al., 2015).

Fig. 2. Definition of competency
Source: (Filipowicz, 2011).

development) and measurability, namely aptitude for measurement (measuring competencies is a complex process itself but most theoreticians agree with the fact that it is possible to make an objective measurement of a competency) (Kubat, 2014; Filipowicz, 2011).

Competencies can be identified with the use of various methods. These methods can be grouped into five categories: (1) quantitative methods, such as tests, surveys, interviews or regular observations, (2) qualitative methods focusing on the social features of an individual (these include unstructured observations or biographical methods), (3) comparative descriptions, e.g. competency biographies highlighting retrospective events that are relevant for a professional competency development, (4) the use of a simulative device (replacing real experiments to record competencies) and (5) work samples, which are used in order to focus on an individual and the work environment. While identifying competen-cies, it is recommended to combine quantitative and qualitative methods into a hybrid (Hertle et al., 2016).

Filipowicz and his team of researchers developed a universal model of competencies (a map of competencies) that constitutes a certain closed set of competencies that can be used as a good starting point in the process of their measurement. Based on the analysis of competency-oriented description of posts and sets of competencies in various companies, they developed a list of the most frequently used professional competencies. The entire set of competencies was divided into four categories (Tab. 1).

The skills and knowledge of design team members and engineers are very important. Thanks to their participation in various projects, they develop specific skills which should be aimed at achieving a certain optimal level. Only core competencies require continuous improvement and development, which nonetheless requires time and resources (Durkacova et al., 2012).

Tab. 1. List of competencies in the universal model of competencies

SOCIAL COMPETENCIES	PERSONAL COMPETENCIES	MANAGERIAL COMPETENCIES	PROFESSIONAL COMPETENCIES
building a relationship	pursuit of results (entrepreneurship)	building an efficient organisation	administering/maintaining documentation
sharing knowledge and experience	innovativeness and flexibility	team building	negotiating
identification with the company	analytical thinking	ability to delegate	orientation in business
communication	self-reliance	motivating	procedures - knowledge and application
customer orientation	decision-making	strategic thinking	IT skills
teamwork/team collaboration	troubleshooting	planning	technical skills
solving the conflict	thoroughness/reliability	leadership	professional knowledge
cooperation within the company	professional development/ readiness to learn	project management	process management
exert influence	managing each other	team management	knowledge of foreign languages

Source: (Filipowicz, 2016).

The authors of the article drew particular attention to the field of production and the aspect of competencies that are needed among production employees. With the advancing subsequent industrial revolutions, the issue of competencies sought within the field of production also changes. Despite the noticeable ongoing preponderance of technical competencies, it should be noted that technical basics are merely one of the attributes of the engineers of the future as they must be supplemented with skills so far perceived as soft ones (Gudanowska, 2017a). The aspect of competency development in the production sector is even more difficult since it takes place directly in work environment, at the production hall. And if it does take place in such environment, there is no mention of the formal framework of learning. The development of competencies in such a case is randomised and incalculable despite being systematic and stable. From this perspective, it seems crucial to support competency development at the production hall (Hertle et al., 2015).

The significance of competencies in the production branch is highlighted by the observation that developing employee competencies in a production enterprise is a key determinant of competitive, future-oriented production since it allows for quick problem solving and continuous improvement in the entire production process (Hertle et al., 2015). It is a capable human-being who makes rational decisions in the scope of improving the organisation of production and its optimisation, quality management or optimal settings in case of an automated production process. From such a perspective, employee competencies are ones of the most important resources in an enterprise that determine its competitive advantage (Wirkus et al., 2015; Krawczyk-Dembicka, 2017). Moreover, the fourth industrial revolution involves the impact on satisfying new customer requirements and applying advanced technologies, which in turn requires qualified human resources for today and in the future (Li et al., 2017).

2. CHARACTERISTICS OF THE SURVEYED AND THE RESEARCH METHOD

The analysis conducted in the publication that incorporates a set of competencies required in production enterprises was based on data gathered from 95 Podlaskie-based enterprises. Fig. 3 illustrates a breakdown of the researched enterprises into branches. The most numerous group, consisting of as many as 25% of the surveyed (24 enterprises), were organisations dealing with woodwork production. Another significant group that totalled nearly 21% of the surveyed subjects (20 enterprises) were food processing companies. A similar share (20% or 19 units) were enterprises from the machine production sector. The branches of the production of rubber and plastic products and metalworks production were
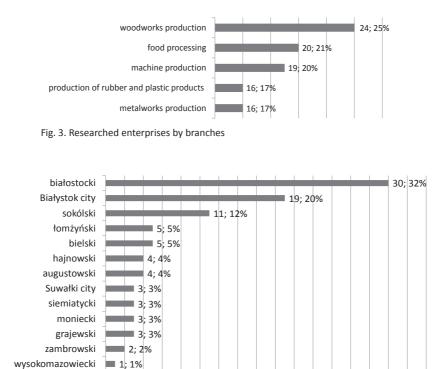
Fig. 3. Researched enterprises by branches

Fig. 4. Researched enterprises by county

analysed the last and represented by 16 enterprises (17%) each.

Fig. 4 illustrates the quantitative and percentage share of the researched enterprises with regard to the location of their business activity (county). Most of the surveyed companies were situated in Bialystok County and the City of Bialystok. These companies comprised more than half of the researched entities. Enterprises that represented Sokolka County constituted 12% of the population under study. The share of enterprises from other counties was significantly smaller, where companies from Lomza, Bielsk Podlaskie, Augustow Counties numbered from 4% to 5% of the researched units. The companies from the remaining counties did not exceed 4% of the total number.

The resultant research study was diversified with regard to the period of a company's operation in the market (Fig. 5a). The majority or as many as 60% of the researched organisations operated in the market for more than 10 years. The less numerous group, 24% of the surveyed, was comprised of companies that operated from 3 to 10 years, and the remaining part – 16% – were the enterprises with less than 3 years of business operation.

The territorial range of the activity of the researched enterprises is illustrated in Fig. 5b. Most of the surveyed enterprises operate in the international market (55%). The organisations that conduct business activity in the international market included those that cooperate with the European Union member states, Poland's Eastern neighbours and also those whose territorial range covers almost all continents. 21% of the researched companies localised their business activity in the domestic market. 16% of the surveyed enterprises function in the local market, and the remaining 8% operate on a regional or voivodship market.

The results of the surveys related to enterprises from the selected sectors of the Podlaskie Voivodship allowed indicating the sought employee competencies in the analysed branches. In the part of the survey dedicated to the identification competencies, the respondents indicated those competencies that were deficit/sought after in the represented branch. In the subsequent part of the survey, the surveyed defined their demand for deficit competencies in the period of the nearest five years (2018–2022) according to a scale from one to five, where one denoted very low demand and five – very high
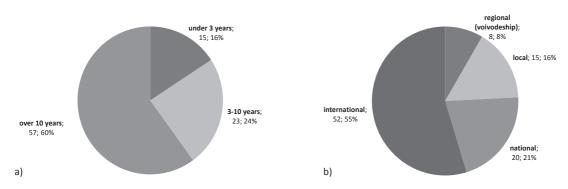
Fig. 5. Researched enterprises by the period of a company's operation in the market (a), the territorial range of the activity of the enterprise (b)

demand for a given competency. The authors of the survey assumed the list devised by Filipowicz (Tab. 1) as the starting list of competencies.

Based on the statement that the notion "competencies" usually appears in the plural form, similar to *glasses*, *trousers* or *scissors*, it is worth noticing that in deliberations on competencies, it is highly difficult to isolate a single competency and treat it as a completely independent feature that is separated from other dispositions. It is, hence, justified to analyse sets of competencies, in particular with regard to organisations that, in fact, employ many people (Filipowicz, 2016).

The authors used a network to present a set of sought competencies. Network analysis is considerably popular in the scientific world. It is an interdisciplinary research approach that is used while analysing complex systems and processing relational data (Wasserman & Faust, 1994). In fact, network analysis is present in almost every scientific field. Its essentials are comprised of graphs and mathematics, but also statistics and matrix algebra. This issue plays a vital role in the area of information and computer technologies as well as artificial intelligence, contemporary theories that concern free-market economy, geographic and transport networks, studies connected with analysing citations in bibliometrics or studies on social relationships (Gudanowska, 2017b). The authors decided to use a form of a network as the one that can reflect both the significance of competencies in the assessment of the surveyed, as well as their coexistence in choices made by a given respondent. Visualisation also included markings of the categories of specific competencies (according to the categorisation presented in Tab. 1).

3. RESEARCH RESULTS AND DISCUSSION OF THE RESULTS

One of the steps of the conducted analysis was the examination of deficit competencies pointed out by respondents, considering the aspect of their coexistence in the indicated area. Bearing in mind the previous statement that the competencies, required by employers do not occur individually but rather make a cluster of interconnected elements, the aim was to find the most preferred group of competencies in the field of production. Respondents could select competencies from the list or add others; however, none of the considered respondents added competencies to the list. This may suggest that the Filipowicz's model of competencies is somewhat complete.

The network (Fig. 6) case presents deficit competencies pointed out as such by at least 15% of respondents representing manufacturing industries. The size of an element stands for the percentage of employers from this sector, who thought a given competency was unprofitable. The larger the element, the more people considered the given competency as important in the field of their branch. Given next to each name, the percentage value indicates the number of times a competency was chosen.

The existing connection between two competencies within the network means that the two competencies were chosen as valuable by the same responder. The more employers chose a certain pair, the stronger and more noticeable is the connection between them (marked with a darker and thicker line). Considering the density of connections within emerged networks as well as the clarity of figures, it was also assumed that for a connection to be visible, a pair of competencies had to be selected by least 15% of people.
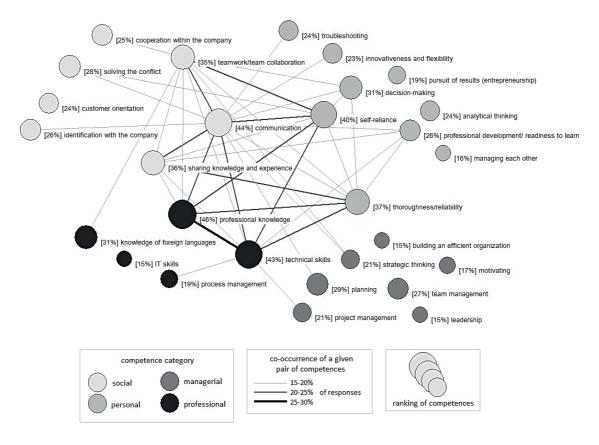
Fig. 6. Network of competencies sought after in production (in all analysed production branches) in the opinion of representatives of production enterprises in the Podlaskie Region

Source: author's elaboration on the basis of (Dębkowska et al., 2017).

The colouring of network elements is a result of their classification into four groups, namely, social, personal, managerial and professional. Furthermore, the meaning of the shading is described in the figure.

According to the respondents, professional knowledge and technical skills were the competencies that seemed to be the most sought after. It was also the most popular combination (chosen by over 25% respondents). Communication, self-reliance, thoroughness/reliability, sharing knowledge and experience, and teamwork/collaboration also proved to be important. The entire set of the competencies is strongly linked, with professional knowledge and technical skills forming the foundation (connections at 15–20% or 20–25% indications level). Knowledge of foreign languages has also been identified as significant (having the only connection with teamwork at 15–20%) as well as decision making, which, however, was less frequently connected with the above. The starting set of competencies had an equal number in each category. It is interesting to note that despite the dominance of the two competencies attributed to

the professional group, this group of competencies was the least numerous.

Analysing the respondent answers as to competencies to be required over the next five years (2018–2022) it was noticeable that the current set seems to have no tendency for change. The Authors prepared a corresponding network, this time saying that the connection between competencies should appear if a respondent thought a given pair of the competencies as of high or very high demand. Despite slightly different numeric results, it was apparent that relations between and the importance of certain competencies will remain unchanged. Consequently, the presentation of the described network would not bring any new perspective.

While analysing the obtained data regarding individual manufacturing industries, some differences can be noted as presented in corresponding networks prepared for the project "Employer needs in the scope of supporting lifelong learning for deficit professions in Podlaskie Voivodship", shown in (Dębkowska et al., 2017). A summary of respondent

choices regarding the extent, to which a given competency is sought after in certain industries (based on the level of indications in percentage) was presented in Tab. 2. Cells indicating the choice of at least at 40% of respondents from a given field are marked with the darkest colour. Cells representing a competency selected by at least 30% of respondents from a certain area are marked with a medium-dark shade.

The machine production sector had the densest network of deficit competencies. Thoroughness/reliability was the most sought-after competency in this branch. It was often selected together with strategic thinking, technical skills and teamwork. In this sector, there were several less connected competencies. The network of machinery production branch has a large number of nodes, which means that most of the proposed competencies were thought to be the sought after. Also, no category seems to be dominant. Metalworks production was the other analysed sector. Technical skills, professional knowledge and self-reliance were the most popular competencies. Also, they appeared to be the most strongly linked deficit competencies. Slightly fewer respondents suggested thoroughness/reliability and communication, which were also strongly connected with professional knowledge and technical skills. Problem solving and troubleshooting were also popular; however, these competencies were not as strongly linked with the others. Managerial competencies had the lowest number of mentions. The woodworks production sector was yet another analysed industry area. Technical skills and communication were thought to be the most important competencies, followed by professional knowledge, self-reliance, sharing knowledge and experience, and teamwork. The most strongly linked competencies included technical skills and self-reliance. Technical skills were often mentioned together with professional knowledge; however, the self-reliance was usually indicated together with teamwork. Deficit competencies in the field of production of rubber and plastic products comprised one of the smallest competency groups. Self-reliance was the most sought after. In this industry, job-seekers should also be thorough/reliable and able to troubleshoot. Decision making, teamwork, communication and professional knowledge were considered deficit competencies; however, they were less frequently paired with any other deficit competencies. Personal and social competencies were predominant. In the case of the food processing sector, the network had weakly-connected nodes. Nonetheless, half of the respondents chose professional knowledge as

a sought competency. Communication (linked to professional knowledge), team management and knowledge of a foreign language were also thought to be deficit (Dębkowska et al., 2017).

Conclusions

The success of a production company in realities of the 21st century is based on three pillars. Firstly, the rational and effective decision-making process considering management and functioning of the manufacturing industry. Secondly, innovative methods and tools, improving production processes, together with a constant improvement of production machines performance. Thirdly, improvement and continuous development of workers and their competencies (Wirkus et al., 2015). The knowledge of the competencies in a company – being one of the bases for the competitive ability of manufacturing industries – helps the company identify its qualities as well as market imperfections. The significance of issues related to competencies required in the industry 4.0 is even greater due to the change in working conditions as well as requirements for employees.

In the article, the Authors focused on the identification of the set of competencies sought after by modern companies. The identification of the set of competencies desired by employers from Podlaskie Voivodship was conducted using the data obtained from the project "Employer needs in the scope of supporting lifelong learning for deficit professions in Podlaskie Voivodship" (Dębkowska et al., 2017). The analysis revealed that workers should have a better professional knowledge as well as technical skills. Employees should have highly developed communications skills, be dedicated to precise task completion and be able to work autonomously as well as in a team. They should also be open to exchange and sharing of knowledge and experience. The article also presents competencies depending on representatives of each analysed manufacturing sector (machine production, metalworks production, woodworks production, production of rubber and plastic products and food processing).

In the Author's opinion, the comparison of competencies, which were indicated as important for the development of production sectors, and in the light of literature, the obtained results reflecting the opinion of the surveyed manufacturing enterprises can be considered an interesting direction for

Tab. 2. Percentage number showing the opinion of respondents from production enterprises in the Podlaskie Region regarding the extent to which a given competency is sought after

	Machine production [%]	Metalworks production [%]	Woodworks production [%]	Production of rubber and plastic products [%]	Food processing [%]
Social competencies					
building a relationship	21	0	8	13	20
sharing knowledge and experience	42	25	46	25	35
identification with the company	42	19	21	19	30
communication	42	38	54	38	45
customer orientation	21	38	17	25	25
teamwork/team collaboration	42	19	42	38	30
solving the conflict	32	25	29	25	30
cooperation within the company	32	31	17	19	30
exert influence	5	0	4	13	5
Personal competencies					
pursuit of results (entrepreneurship)	16	19	17	25	20
innovativeness and flexibility	32	31	17	19	20
analytical thinking	42	19	17	25	20
self-reliance	26	50	46	56	25
decision-making	32	38	21	38	30
troubleshooting	26	38	17	38	10
thoroughness/reliability	63	38	25	38	25
professional development/ readiness to learn	37	31	17	19	30
managing each other	11	19	29	19	0
Managerial competencies					
building an efficient organisation	21	25	17	0	10
team building	16	6	8	13	20
ability to delegate	16	0	4	0	15
motivating	26	0	25	6	20
strategic thinking	42	13	17	6	25
planning	42	25	29	25	25
leadership	11	13	8	13	30
project management	21	31	21	13	20
team management	32	13	29	19	40
Professional competencies					
administering/maintaining documentation	16	13	4	0	5
negotiating	26	0	13	0	5
orientation in business	16	19	4	6	10
procedures - knowledge and application	21	13	0	0	20
IT skills	11	31	17	6	10
technical skills	37	56	54	31	35
professional knowledge	42	50	50	38	50
process management	16	25	29	0	20
knowledge of foreign languages	42	25	25	19	40

Source: author's elaboration on the basis of (Dębkowska et al., 2017).

further research in the subject matter. From the perspective of the literature review, the aspect of competency measurement and proper assessment seems to be important as well. The development of this issue should enable the determination of key points in the area of employee development, underlining the importance of human capital.

Acknowledgements

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