

Key competences of research and development project managers in high technology sector

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Abstract

Activities related to research and development work are of great importance to the growth and development of enterprises, in particular those from the advanced technology sector, which operate at the interface between science and economy. A significant part of research and development work is carried out in the form of design work, and one of the factors proving the success thereof is a well-selected and competent project team and the competences of R&D project managers, who play a key role in the process of project task implementation. The aim of the article is to identify the competences of an R&D project manager based on the example of a selected high-tech enterprise. Despite numerous scientific studies verifying key managerial competences, there is a lack of research on the competences of R&D project managers. Data has been gathered via a single cross-sectional survey with a structured questionnaire based on a group of 67 employees of PREVAC Sp. z o.o., a company in the high-tech sector. Exploratory factor analysis has been used to analyse the empirical results of the study. The results of the study indicate that social and intrapersonal competences are the most desirable among the key competences of the R&D project manager, while the remaining ones complement this model.

Keywords

competences, project management, research and development, advanced technologies, high-tech

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Introduction

In a dynamic market environment, companies need to react quickly to changes. Enterprises need to assess market changes in a quick and accurate manner and reduce

time-to-market by, for instance, accelerating the flow of knowledge through the collaborative network. It seems to be particularly important for high technology enterprises

which, in the rapidly changing environment, play a special role in the process of increasing the competitiveness of economies (Sindhu and Mor, 2022). Broad knowledge and highly qualified personnel are essential to implementing the development strategies of these enterprises (Korpus and Banach, 2017). High technology enterprises strive to obtain, make the best possible use of and develop these resources, and research and development (R&D) is their key activity. Research and development projects are increasingly often treated not only as complementary to most of the implemented processes, but they are also the key element in the functioning of high-tech organisations, whose structures are often transformed into project structures, including those which are virtual or distributed (Kratzer et al., 2006). The use of projects in the activities of an organisation increases its flexibility and adaptation capabilities, enabling a faster response to changes and improving the capability of an organisation to meet market requirements. One factor in the success of a project is having the right team that is responsible for achieving the objective within the set time, scope and budget (Ammeter and Dukerich, 2002). Social and intrapersonal competences also seem to be important in the management of research and development projects. The effectiveness of the work performed will largely depend on the degree of development of the team leader's competences.

Due to the dynamics of changes, the management of research and development projects is often an activity which is more complex in terms of the subject and process than the management of "traditional" projects; therefore, the modern approach to research and development projects should be related to all the organisational activity and the processes implemented therein. It requires interdisciplinary knowledge and the cooperation of teams with various professional qualifications (Kisielnicki, 2017). Employees, associates, and project personnel are a fully-fledged – and at

the same time the most important – pillar of professional project management. A design culture based on competence, tolerance in the team, an inclusive decision-making process, transparent communication within the project team, trust and responsibility for the implementation of tasks are the basis for building effective project teams (Mainga, 2017). Project implementation is based on team work, in which elements such as cooperation between individual members are of vital importance (Ammeter and Dukerich, 2002; Luo et al., 2021); the project manager is undoubtedly a key figure whose competences often determine the effectiveness of the entire project team and the success of the project. Given the deliberations presented, the aim of the paper is to identify the competences of an R&D project manager in the high technology sector based on the example of PREVAC Sp. z o.o.

1. Literature review

1.1. R&D projects in the design activities of high technology enterprises

High technology industries are those whose business activity depends strongly on innovation in science and technology (Medcof, 1999). Two indicators are used to identify high-tech industries: research intensity (total R&D expenditure divided by total sales) and total R&D expenditure (Medcof, 1999; Zakrzewska-Bielawska, 2010; OECD Science). High technology enterprises are innovative entities that convert science into new technologies while at the same time attempting to commercialise it. These entities are science-intensive entities that create, collect and disseminate new knowledge; therefore, it can be stated that innovation affect the organisational solutions of these enterprises (Zakrzewska-Bielawska, 2012). The high technology sector is distinguished by advanced technology, high research and development intensity, as well as a high level of innovation (OECD Science). There are two

main approaches to identifying technology intensity in this field: the sector approach and the product approach (EUROSTAT). Other factors may also play an important role (e.g. scientific and technical personnel, technology included in patents, licences and know-how, strategic technical cooperation between companies, rapid obsolescence of current knowledge, fast replacement of equipment, etc.) (Trajtenberg, 2001; Hatzichronoglou, 1997). Hejduk (2005), while defining high technology enterprises, points to characteristic features such as a short life cycle of developed products and technologies, and high dynamics of changes in the technical infrastructure used. Increased cooperation with research centres and competition help them solve industrial problems (Ismail et al., 2020; Cygler and Sroka, 2017). The rapid diffusion of innovation, growing demand for highly qualified personnel, as well as large capital expenditure and high investment risk become the distinctive features thereof. Large enterprises carried out intensive in-house R&D, whilst R&D carried out by SMEs depend more on collaboration and external knowledge sources (Ratinger et al., 2020).

Nevertheless, the “intensity” of research and development activities is one of the basic criteria determining whether a given field of a company’s activity can be classified as belonging to the high technology sector (Zakrzewska-Bielawska, 2012). It is usually assumed that the high-tech sector includes enterprises whose research and development expenditure as a share of revenue ranges from 8% to nearly 15% (Lantz and Sahut, 2005; Karahan, 2015). In addition to the criterion of high science-intensity and the intensity of research and development, the key characteristics of these enterprises also include a high level of innovation, rapid diffusion of technological innovations and aging of developed products and technologies, high capital expenditure, high investment risk, and intense, strategic national and international cooperation with other high-tech enterprises

and research centres (Lantz and Sahut, 2005). To sum up, for the purposes of the article it was assumed that high-tech enterprises are enterprises of high research and development intensity, high technology and a high level of innovation¹, the uniqueness of which is based on knowledge and the learning process related thereto.

Research and development, which should be understood as creative work systematically undertaken to increase the amount of knowledge, as well as to find new applications for this knowledge, is a specific activity characteristic of high technology enterprises. R&D activity differs from other types of activity by means of a noticeable element of novelty and elimination of scientific and/or technical uncertainty, i.e. a solution to a problem that does not obviously result from the current state of knowledge. Research and development work is carried out in the form of design activities. Kezsborn and Edward (2001) call project management the “vehicle” of the 21st century, pointing out that this process allows enterprises not only to build a competitive advantage, but above all enables them to survive in a rapidly changing environment. The significance of projects as well as project management continues to grow. The activities of enterprises on both the operational and strategic level increasingly focus on projects due to the specific features thereof, such as uniqueness, complexity, focus on results, adapting solutions to the specific requirements of recipients and the need to comply with constraints defined as determinants of project success (time, deadline, budget limits and quality of results) (Trocki et al., 2012). Research and development projects are one of the most difficult project categories and the most significant for the development of

¹ The innovativeness of enterprises is defined as their ability to create inventions and the effective implementation of inventions on the market (as cited in: Dosi, 1998). The innovativeness of enterprises is basically measured by the number of innovations manufactured or the number of patents obtained by an enterprise (R&D output) (as cited in: Karbowski, 2015).

an organisation and society. High technical, organisational and economic risk emphasises their uncertainty and even a high risk of not being fully implemented (Trocki, 2016).

The National Science Foundation (NSF) defines three types of research and development projects, namely basic research, applied research and development research. The underlying objective of basic research is acquiring more complete knowledge about the problem and understanding the subject of a study, not its practical application. Currently, a broader concept of research and development projects is used; such projects are often defined as a combination of research, aimed at specific economic objectives in relation to products, processes or services, and development activities that systematically use the knowledge acquired during research, and which aim to produce materials, equipment, systems or methods, including the design and development of prototypes and processes (Kisielnicki, 2014).

1.2. The role of a project manager

A project management process includes five stages: project initiation, planning, implementation, control and closure, which require the project manager to perform three roles: interpersonal, informing and decision making (Baker and Baker, 1998). This means that project managers are obliged to meet numerous requirements. They must have suitable skills and competences that allow them to efficiently achieve their objectives and adapt to a given situation and their role in the team.

The literature on the subject presents a variety of approaches to defining the concept of 'competences' (Moore et al., 2002; Kaszowska-Mojca, 2020). As part of studies conducted during the 1970s on the factors determining the achievement of professional success, McClelland (1973) found that success was determined not so much by intelligence quotient or academic performance, but by factors which he called com-

petences. Research by Boyatzis (1982) defines competences as the fundamental basic quality, ability, or characteristics of a person which result in efficiency and/or better performance of professional duties (Boyatzis, 1982). Over time, competences have acquired a more complex meaning. Some authors, such as Milkovich and Newman (1999), refer to problems when trying to answer what competences actually are and what their special meaning is. In the literature, the concept of qualifications is mentioned next to the concept of competence. Despite the fact that the terms have been used interchangeably in practice, which may suggest that these two terms are unambiguous, authors increasingly often attempt to define the difference in meaning between the two concepts. In their study, Mikła et al., (2020) define competences as a combination of skills, knowledge, personal qualities and behaviour necessary for the effective performance of the assigned work, while qualifications are defined as the potential ability to function in given conditions. Therefore, qualifications make an employee capable of performing the assigned tasks, and competences ensure that such tasks will be performed in the expected manner. This means that before an employee has acquired the expected competencies, he or she must first demonstrate a certain type and level of qualifications (Stor, 1995). Also, Butkiewicz (1995) indicates that competences are "the scope of knowledge, skills and responsibilities, authorisation and powers to act", and qualifications "are the structure of knowledge, skills and attitudes conditioning the performance of professional tasks", thus emphasising that qualifications consist of factors such as general education, professional knowledge, or professional skills, while the rest are attributes of competences. The combination of professional knowledge, the ability to make the right decisions at the right time, cooperation, experience and compliance with ethics and culture principles guarantees authority enabling one to man-

age a very diverse structure and culture in a skilful manner (Kurowska-Pysz, 2014; Szczepańska-Woszczyzna, 2020; Szczepańska-Woszczyzna and Dacko-Pikiewicz, 2014; Meekaeuwkunchorn et al., 2021; Zabolotniaia et al., 2019). These definitions are particularly significant in relation to a project manager, who undoubtedly plays a central and key role in the team; their personality traits, knowledge and skills are perceived as the most important success factor, determining the effectiveness of the entire project team. The relationship between the characteristics of a project manager and the course of work in a project team has therefore become the subject of a number of studies. Research by Ammeter and Dukerich (2002) carried out among the most effective teams in the engineering and construction industry confirms the relationship between the behaviour of the project manager and the effectiveness of the entire team. More than two-thirds of the project team members surveyed pointed to the strong influence of the project manager on the results. The most significant traits of a leader were the ability to communicate goals and values, and to shape attitudes that promote friendliness and communication. The authors point to a significant relationship between the behaviour of a leader and project effectiveness, measured both by the subjective assessment of employees and an objective measure, namely the cost of project implementation (Ammeter and Dukerich, 2002). Spałek's (2014) research on success factors in project management shows that the factors that most affect the success of an implemented project include appointing a project manager (93% of the impact on project success), the competences of the project manager (88%) and the high level of authority of the project manager among the members of the project team (85%). Research by Dreyfus (2008) conducted among R&D project managers shows which features distinguish a group of exceptionally effective managers from a typical R&D project man-

ager. The main features that distinguish these two groups from each other are taking the initiative, managing a group process, self-confidence, knowledge management, adaptation skills, delegating, helping, and setting and managing goals. Additionally, more effective managers also had greater interpersonal and social sensitivity (Dreyfus, 2008). Müller and Turner also compared the competencies of project managers with a control group of managers (Müller and Turner, 2010). Research shows that project managers tend to be slightly more analytical, sensitive and conscientious, and less communicative and development-oriented compared to the control group of other managers. Research by Chipulu et al., (2013) based on an analysis of 2,306 job offers in the UK, the USA, Canada, China, India, Hong Kong and Singapore specified six groups of expected project manager competences: 1) industry and general skills compared to knowledge/specialisation in the field of project management; 2) knowledge/experience in project management before industry and general skills; 3) managerial skills (in the case of Senior Project Managers); 4) (positive) personality traits; 5) experience and professional qualifications in the field of project management methodology; and 6) risk management throughout the project life cycle. In research conducted by Alvarenga et al. (2020), the key competences of project managers which determine the success of a project included leadership, self-organisation, interpersonal competences, communication, technical competences, productivity and managerial competences.

The growing popularity of project management, as one of the key processes in high technology enterprises and the results of scientific research, confirm that organisations need competent project managers who will be able to professionally manage the implementation of projects. The literature on the subject broadly describes the profile of a project manager, focusing not only on the types and division of compe-

tences of a person holding this position, but also the determinants on the part of the enterprise and its business environment that affect the style of project management. Attention is also paid to the versatility of tasks that must be fulfilled by a manager. The desired competences of a project manager are described by global standards, including: IPMA Competency Baseline (IPMA, 2006) – a project manager competency model created by the International Project Management Association; Project Manager Competency Development Framework (PMI, 2007) – a competency model created by the American Project Management Institute; National Occupational Standards for Project Management, or NOS PM (ECITB, 2003) – a competency model created by the British Engineering Construction Industry Training Board; and Professional Competency Standards for Project Management (AIPM, 2008) – an Australian model of project competences created by the Australian Institute for Project Management.

The nature of project activities requires the project manager to focus on tasks related to the project implementation cycle, where technical and business competences are of crucial importance. However, during the project implementation, social competences such as motivation, supporting the team, assertiveness or conflict management (Nurick, 1993), as well as analytical problem-solving skills, innovation and creativity, self-direction and initiative, flexibility and adaptability, critical thinking, and communication and collaboration skills (Porter et al., 2007; Boyles, 2012) become more significant. It is also important to support the processes of cooperation and knowledge sharing, which means that a project manager is increasingly often required to have the competences characteristic of a line manager. A project manager is expected to be a good leader who can set and achieve goals, motivate and support the team. Interpersonal and social competences are also crucial, as

they condition the use of technical and conceptual competences and make it possible to influence employees. At the same time, they are the most difficult to learn, because numerous personality variables, such as the temperament, attitude, aspirations or motivation of each subordinate must be taken into account (Clarke, 2010; Chen and Lin, 2018). The variable environment of research and development projects, frequent exposure to failure in achieving objectives, high project risk and a high degree of complexity of such projects requiring a high level of motivation, good communication and a fast and effective process of transferring knowledge among the members of a project team will be of particular importance. Therefore, possessing and developing competence in this area is crucial for project managers. Models of management competences were developed by Boyatzis (1982) and Spencer and Spencer (1993), who perceive competences as a multidimensional creation composed of various elements (attitudes, knowledge, skills, personal qualities or social role) (Spencer and Spencer, 1993; Boyatzis, 1982), as well as Viitala's hierarchical model (1995). The base of models consists of the most difficult to measure and the most enduring interpersonal competencies, and the top level consists of technical competences that can be easily defined, classified, developed and changed.

To sum up, the competences required of a project manager are comprehensive, ranging from technical or business competences to social and interpersonal competences, and it seems that the latter will become more and more important. Therefore, in turn it is becoming important to conduct studies determining which of the competences are crucial in the opinion of project managers to discharge their role, as well as verification by means of conducting the same studies among project team members, treating the management competence models developed by Spencer and Spencer (1993) and Viitala (1995) as a starting point.

The following research questions were posed:

RQ1: Is it possible to identify the key competences of research and development project managers in high technology enterprises?

RQ2: Is there a difference between the profile of key competences of project managers and the employees of project groups?

RQ3: What are the key competences of R&D project managers in a selected high technology enterprise?

RQ4: Does age, experience and education level differentiate the competences of R&D project managers?

2. Methodology

The aim of the study is the identification of the key competences of a research and development project manager in the high technology sector based on the example of PREVAC Sp. z o.o, a high technology company, which is a world leader in the design and production of deposital and analytical scientific and research equipment used to create and test materials in high and ultra-high vacuum conditions. It has completed over 580 projects, mainly for world-renowned research and industrial centres with a high degree of technical and technological sophistication. The company conducts its own research and development by creating and offering products with a high level of technological complexity in the field of mechanics, biotechnology, electronics, mechatronics and automation, which are used in the production and analysis of modern materials used in industry, aerospace and medicine, among others. One of the sources of innovation, and at the same time the company's key activity, is research and development (R&D). PREVAC Sp. z o.o. has its own research and development facilities, such as laboratories or design departments.

In order to achieve the research aim, 60 variables were analysed – the competences

under study, grouped into competence types constituting the set of the most frequently demonstrated management competences in accordance with the models developed by D. McClelland, R.E. Boyatzis and R. Viitala, which were used as a starting point for further consideration on the competences of a research and development project manager. The data were collected in the period from 8 September 2021 to 9 September 2021.

The respondents were 68 employees of PREVAC Sp. z o.o., including 61 project team members and seven people responsible for managing the work of the teams. Nearly two-thirds of the respondents ($n = 40$) have a university education (including two people who additionally indicated doctoral studies). Nearly one in four ($n = 16$) had not completed university education, and approximately every sixth person ($n = 12$) had a secondary school education. The differences between managers and employees are not statistically significant, although it is worth noting that people with secondary education can be found only among employees. On average, the respondents are 35.3 years old (standard deviation = 6.8 years), and half of them were no more than 36 years old. The oldest person is 56 years old, and the youngest 23. The characteristics are similar for the employees ($M = 35.2$, $Me = 36$, $SD = 6.9$) and managers ($M = 36.1$, $Me = 35$, $SD = 7.1$). When it comes to work experience, half of the respondents have worked for at least six years, and the average length of service is 7.4 years ($SD = 5.5$), with a range of one to 24 years. In the case of the managers, it is slightly higher than for the employees (the average is 8.4 years for the first group compared to 7.3 years for the employees), although the median for both groups is the same – $Me =$ six years. Detailed data on the research group is presented in Table 1.

The assessment of competencies included the dimensions of knowledge (K), skills (S), and attitudes (A). An exploratory factor analysis (EFA) was used to perform a multidimensional analysis of NCO competencies, which

made it possible to assess the homogeneity of the scale for measuring competencies. The evaluation of correlation for the entire set of variables was done using KMO (the Kaiser-

Mayer-Olkin measure) – a value of this measure of above 0.5 is considered a threshold (if $KMO > 0.5$, the adopted set of variables is considered good; the maximum is 1).

Table 1. Structure of the research sample (N=67)

Age	Research and development project manager		Research and development project employee		Total	
	N	%	N	%	N	%
under 30 years	2	28.57%	14	23.33%	16	23.88%
30-40 years	2	28.57%	28	46.67%	30	44.78%
above 40 years	3	42.86%	18	30%	21	31.34%
total	7	100%	60	100%	67	100%
professional experience	N	%	N	%	N	%
up to 5 years	2	28.57%	24	40%	26	38.8%
5-10 years	2	28.57%	21	35%	23	34.33%
11-15 years	2	28.57%	10	16.67%	12	17.91%
above 15 years	1	14.29%	5	8.33%	6	8.96%
total	7	100%	60	100%	67	100%
education	N	%	N	%	N	%
secondary	0	0%	11	18.33%	11	16.42%
undergraduate	2	28.57%	14	23.34%	16	23.88%
master's	5	71.43%	33	55%	38	56.72%
doctoral	0	0%	2	3.33%	2	2.98%
total	7	100%	60	100%	67	100%

Source: own elaboration

3. Results and Discussion

Among all competences, five were rated the highest, for all of which the median is equal to the maximum score, i.e. 5. These are three intrapersonal competences, namely the ability to act under pressure ($M = 4.58$, $SD = 0.61$), commitment to work (project) ($M = 4.57$, $SD = 0.58$) and self-control ($M = 4.40$, $SD = 0.69$), as well as competence from the social group, i.e. cooperation (team work) ($M = 4.49$, $SD = 0.63$) and coordination of ac-

tivities ($M = 4.46$, $SD = 0.66$) from the management and supervision group. In the case of these competences, none of the respondents assigned a score lower than 3, and the highest option was dominant (as chosen by as many as two-thirds of the respondents). In general, intrapersonal competences are assessed highly – in the 'top 20' (out of 60 respondents, with two items in the same, 20th position) there were 10 competences from this group (out of 12); similar conclusions apply to social competences (seven out of 15 in the above-

mentioned top 20), as well as management and supervision (four out of nine in the top 20). In the top 20, apart from the competences in the above three groups, only a knowledge of foreign languages was present.

A median at level 4 applies to 49 out of 60 competences examined, and a mean of above 4 to half. Among the competences in the area of “knowledge management”, the greatest importance was assigned to acquiring new information (M = 4.16, SD = 0.59, 23rd place); from the business group – problem analysis (M = 4.16, SD = 0.70, 22nd place); from the cognitive group – analytical thinking and professional and managerial professionalism, which are equally important (M = 4.07, SD = 0.80, items 27-28); and among the technical ones, the use of a computer for professional purposes was also assessed as important (use of an ERP system, MS Office packages, etc.) (M = 4.10, SD = 0.81).

Business competences – predicting the market situation, identifying market problems, shaping the organisational culture, and efficiency orientation – were among the competences that were considered the least important. For all of them, the median is 3, meaning that half of the respondents rated them no higher than 3. However, at the end of the ranking are technical competences – the ability to remember numbers

(Me = 3, M = 2.88, SD = 0.94). The “bottom five” also included one of the intrapersonal competences, namely spontaneity (Me = 3, M = 3.13, SD = 0.83). Influencing others (intrapersonal), influencing the decisions of others (management and supervision), implementing improvements at work (technical), and predicting the behaviour of others (social) are also considered less important (with means of below 3.5).

It is worth noting that the responses are somewhat homogeneous for all 60 surveyed competences – the standard deviation is not more than one-third of the mean. The most homogeneous are the responses concerning competences assessed higher (for the top 20, the standard deviation is only a dozen or so percent of the mean), and for competences with lower scores, the responses were slightly more differentiated, albeit slightly in this case as well. The distributions of responses are also characterised by a fairly weak skewness (only for single competences does the skewness coefficient exceed 1 in terms of absolute value). Taking the fact that the measurement was made using a five-item Likert scale into account as well, it allows for the analysis of the distributions of the variables, treating them as quasi-quantitative. Detailed results of the assessment of individual competence components are presented in Table 2.

Table 2. Assessment of competences (full set)

Description		Number of responses					Statistics			
		1	2	3	4	5	Me	M	SD	S
Technical (TC)	Specialist (industry) knowledge	1	1	16	30	20	4	3.99	0.86	-0.71
	Using a computer for professional purposes (ERP system, Microsoft Office packages)	.	3	10	32	23	4	4.10	0.81	-0.71
	Foreign language skills	.	1	8	34	25	4	4.22	0.71	-0.60
	Ability to remember numbers	6	14	32	14	2	3	2.88	0.94	-0.21
	Implementing improvements at work (process improvements)	2	8	23	27	8	4	3.46	0.95	-0.40
Cognitive (CC)	Analytical thinking	.	3	13	31	22	4	4.07	0.80	-0.50
	Conceptual thinking	.	3	22	30	13	4	3.78	0.81	-0.10
	Professionalism	.	1	16	28	23	4	4.07	0.80	-0.32

Description		Number of responses					Statistics			
		1	2	3	4	5	Me	M	SD	S
Business (BC)	Conducting negotiations	.	5	14	31	18	4	3.91	0.88	-0.51
	Setting goals	.	1	18	32	17	4	3.96	0.76	-0.13
	Problem analysis	.	1	9	36	22	4	4.16	0.70	-0.50
	General knowledge (process knowledge, substantive knowledge)	.	.	21	34	13	4	3.88	0.70	0.17
	Forecasting the market situation	3	14	29	18	4	3	3.09	0.94	-0.07
	Assessing the impact of tasks on the company's results	.	7	24	25	12	4	3.62	0.90	-0.05
	Identifying market problems	2	18	22	22	4	3	3.12	0.97	-0.04
	Shaping the culture of the organisation	.	9	30	25	4	3	3.35	0.79	0.03
	Performance orientation	2	5	31	20	10	3	3.46	0.94	-0.15
Productivity	.	.	24	32	12	4	3.82	0.71	0.27	
Knowledge management (KMC)	Learning new information	.	.	7	43	18	4	4.16	0.59	-0.04
	Sorting and organising information	.	3	10	39	16	4	4.00	0.75	-0.65
	Generating ideas	.	8	19	31	10	4	3.63	0.88	-0.28
	Critical analysis of ideas	.	3	17	30	18	4	3.93	0.83	-0.34
	Finding information	.	3	14	31	20	4	4.00	0.83	-0.49
Developing the skills of subordinates	1	7	16	27	17	4	3.76	0.99	-0.54	
Management and supervision (LC)	Influencing the decisions of others	2	13	18	28	7	4	3.37	1.01	-0.35
	Motivating others	.	3	8	31	26	4	4.18	0.81	-0.86
	Coordinating activities	.	.	6	25	37	5	4.46	0.66	-0.81
	Conflict resolution	.	5	7	31	25	4	4.12	0.87	-0.93
	Task delegation	.	3	9	36	20	4	4.07	0.78	-0.72
	Predicting the consequences of decisions	.	.	7	29	32	4	4.37	0.67	-0.58
	Independence in making decisions	.	1	5	32	30	4	4.34	0.68	-0.84
	Managing group processes	.	3	13	31	21	4	4.03	0.83	-0.54
Using authority taking the needs of co-workers into account	.	5	20	31	12	4	3.74	0.84	-0.24	
Social (SC)	Oral productive skills	.	1	6	32	29	4	4.31	0.70	-0.78
	Writing skills	.	1	7	30	30	4	4.31	0.72	-0.79
	Understanding others (problems and random situations faced by subordinates)	.	1	10	29	28	4	4.24	0.76	-0.64
	Objectivity of perceiving situations and problems	.	.	6	35	27	4	4.31	0.63	-0.34
	Presentation skills (work progress, research results, scope)	.	1	10	33	24	4	4.16	0.78	-1.06
	Listening to others	.	.	6	30	32	4	4.38	0.65	-0.57
	Ability to maintain and strengthen contacts	1	2	19	32	14	4	3.82	0.85	-0.57
	Focus on customer service	.	6	21	26	15	4	3.74	0.91	-0.18
Involvement in the affairs of the organisation	.	2	20	25	21	4	3.96	0.85	-0.21	

	Description	Number of responses					Statistics			
		1	2	3	4	5	Me	M	SD	S
	Cooperation (team work)	.	.	5	25	38	5	4.49	0.63	-0.85
	Empathy	2	2	19	29	16	4	3.81	0.93	-0.73
	Predicting the behaviour of others	.	8	24	28	8	4	3.53	0.85	-0.09
	Using help	.	1	19	37	11	4	3.85	0.70	-0.07
	Influencing others	2	12	18	34	2	4	3.32	0.91	-0.70
	Building relationships	1	4	15	36	11	4	3.78	0.85	-0.77
Intrapersonal (IC)	Readiness to overcome difficulties	.	.	10	29	29	4	4.28	0.71	-0.46
	Ability to act under pressure	.	.	4	20	43	5	4.58	0.61	-1.16
	Time management	.	.	7	30	31	4	4.35	0.66	-0.54
	Self-control	.	.	8	25	35	5	4.40	0.69	-0.72
	Self-confidence	.	.	8	40	20	4	4.18	0.62	-0.13
	Flexibility	.	1	18	28	21	4	4.01	0.80	-0.21
	Involvement in the case (project)	.	.	3	23	42	5	4.57	0.58	-1.00
	Ability to control emotions	.	1	11	30	26	4	4.19	0.76	-0.55
	Perseverance	.	1	5	37	25	4	4.26	0.66	-0.67
	Spontaneity	.	14	36	13	5	3	3.13	0.83	0.56
	Courage in making decisions	.	.	6	38	24	4	4.26	0.61	-0.22
	Assertiveness	.	.	5	40	23	4	4.26	0.59	-0.13

M – mean, Me – median, SD – standard deviation, S – skewness; . – no responses

Source: own elaboration

The assessment of competences by employees in managerial positions is mostly analogous to those in non-managerial positions (Table 3). Out of 60 competencies, 24 of them are rated almost the same by both groups; 16 are rated slightly higher by employees than managers (this applies in particular to technical, business and knowledge management competences); and in the case of the remaining 20, the rating by managers is slightly higher (especially intrapersonal competences, social competences, and management and supervision).

The Mann-Whitney test, applied due to large discrepancies in the sizes of the com-

pared groups, shows that the assessment of only five competences differs significantly: at the significance level of 0.05 the assessment of only two competences differs (specialist knowledge and task delegation), and at the significance level of 0.10 the group also includes conducting negotiations, forecasting the market situation and coordinating activities. Specialist knowledge and the abovementioned two competences from the business group were rated higher by the employees, while the abovementioned two competences from the management and supervision group were rated higher by project team managers.

Table 3. Competence assessment (full set) – comparison of people working in managerial and non-managerial positions

Description		Employees		Managers		Mann-Whitney test results	
		M	Me	M	Me	p	Significant differences
Technical	Specialist (industry) knowledge	4.08	4	3.14	3	0.005	***
	Use of a computer for professional purposes	4.07	4	4.43	4	0.300	
	Foreign language skills	4.25	4	4.00	4	0.291	
	Ability to remember numbers	2.92	3	2.57	3	0.366	
	Implementing improvements at work	3.48	4	3.29	3	0.449	
Cognitive	Analytical thinking	4.03	4	4.43	4	0.233	
	Conceptual thinking	3.79	4	3.71	4	0.754	
	Professionalism	4.05	4	4.29	4	0.518	
Business	Conducting negotiations	3.98	4	3.29	3	0.081	*
	Setting goals	3.97	4	3.86	4	0.696	
	Problem analysis	4.15	4	4.29	4	0.721	
	General knowledge	3.92	4	3.57	4	0.230	
	Forecasting the market situation	3.16	3	2.43	2	0.059	*
	Assessing the impact of tasks on the company's results	3.66	4	3.29	3	0.234	
	Identifying market problems	3.16	3	2.71	2	0.229	
	Shaping the culture of the organisation	3.34	3	3.43	3	0.786	
	Performance orientation	3.41	3	3.86	4	0.267	
	Productivity	3.84	4	3.71	4	0.759	
Knowledge management	Learning new information	4.18	4	4.00	4	0.362	
	Sorting and organising information	4.03	4	3.71	4	0.348	
	Generating ideas	3.61	4	3.86	4	0.518	
	Critical analysis of ideas	3.90	4	4.14	4	0.505	
	Finding information	4.02	4	3.86	4	0.517	
	Developing the skills of subordinates	3.82	4	3.29	4	0.182	
Management and supervision	Influencing the decisions of others	3.33	4	3.71	4	0.402	
	Motivating others	4.16	4	4.29	5	0.424	
	Coordinating activities	4.41	5	4.86	5	0.078	*
	Conflict resolution	4.11	4	4.14	4	0.768	
	Task delegation	4.00	4	4.71	5	0.013	**
	Predicting the consequences of decisions	4.38	4	4.29	4	0.755	
	Independence in making decisions	4.31	4	4.57	5	0.370	
	Managing group processes	4.00	4	4.29	4	0.455	
Using authority taking the needs of co-workers into account	3.72	4	3.86	4	0.730		

Description		Employees		Managers		Mann-Whitney test results	
		M	Me	M	Me	p	Significant differences
Social	Oral productive skills	4.30	4	4.43	5	0.562	
	Writing skills	4.30	4	4.43	5	0.587	
	Understanding others	4.25	4	4.14	4	0.630	
	Objectivity of perceiving situations and problems	4.31	4	4.29	4	0.982	
	Presentation skills (work progress, etc.)	4.15	4	4.29	4	0.684	
	Listening to others	4.38	4	4.43	4	0.964	
	Ability to maintain and strengthen contacts	3.80	4	4.00	4	0.580	
	Focus on customer service	3.69	4	4.14	4	0.206	
	Involvement in the affairs of the organisation	3.97	4	3.86	4	0.693	
	Cooperation (team work)	4.43	5	5.00	5	0.016	
	Empathy	3.79	4	4.00	4	0.622	
	Predicting the behaviour of others	3.51	4	3.71	4	0.492	
	Using help	3.89	4	3.57	4	0.240	
	Influencing others	3.28	4	3.71	4	0.246	
Building relationships	3.73	4	4.14	4	0.216		
Intrapersonal	Readiness to overcome difficulties	4.26	4	4.43	4	0.652	
	Ability to act under pressure	4.55	5	4.86	5	0.201	
	Time management	4.34	4	4.43	4	0.867	
	Self-control	4.44	5	4.00	4	0.131	
	Self-confidence	4.16	4	4.29	4	0.679	
	Flexibility	4.02	4	4.00	4	0.906	
	Involvement in the case (project)	4.56	5	4.71	5	0.538	
	Ability to control emotions	4.18	4	4.29	4	0.879	
	Perseverance	4.28	4	4.14	4	0.562	
	Spontaneity	3.18	3	2.71	3	0.154	
	Courage in making decisions	4.26	4	4.29	4	0.982	
	Assertiveness	4.26	4	4.29	4	0.999	

M – mean, Me – median, p – probability in the Mann-Whitney test, * p < 0.10, ** p < 0.05, *** p < 0.01

Source: own elaboration

Competences are also assessed similarly for people with different levels of education (Table 4). At the significance level of 0.05, only the perception of self-confidence differs significantly (in the Kruskal-Wallis test, $p = 0.029$); on average, people who had not completed university education have a high-

er score, and those with university education the lowest. At the significance level of 0.10, it can be concluded that the higher the level of education, the lower the score assigned to spontaneity, persistence, sorting and organising information, productivity and specialist knowledge; the opposite is true for the identi-

fication of market problems. Customer service orientation is ranked highest among people with secondary education, and lowest by people who have not completed tertiary educa-

tion; the opposite regularity applies to independence in making decisions. When it comes to understanding others, the lowest scores are given by people with university education.

Table 4. Assessment of competences (full set) – comparison by level of education

Description	Secondary		Incomplete university		Master		Kruskal-Wallis test results		
	M	Me	M	Me	M	Me	p	Significance of differences	
Technical	Specialist (industry) knowledge	4.50	4.5	3.94	4.0	3.85	4.0	0.055	*
	Use of a computer for professional purposes	4.42	4.5	3.94	4.0	4.08	4.0	0.333	
	Foreign language skills	4.17	4.0	4.19	4.0	4.25	4.0	0.975	
	Ability to remember numbers	2.75	3.0	2.94	3.0	2.90	3.0	0.790	
	Implementing improvements at work	3.58	3.5	3.50	4.0	3.40	3.5	0.904	
Cognitive	Analytical thinking	4.25	4.0	4.00	4.0	4.05	4.0	0.681	
	Conceptual thinking	4.00	4.0	3.63	4.0	3.78	4.0	0.450	
	Professionalism	4.00	4.0	4.06	4.0	4.10	4.0	0.951	
Business	Conducting negotiations	4.33	4.0	3.88	4.0	3.80	4.0	0.183	
	Setting goals	4.00	4.0	4.19	4.0	3.85	4.0	0.329	
	Problem analysis	4.25	4.0	4.44	4.0	4.03	4.0	0.160	
	General knowledge	3.83	4.0	3.88	4.0	3.90	4.0	0.966	
	Forecasting the market situation	3.17	3.0	3.00	3.0	3.10	3.0	0.843	
	Assessing the impact of tasks on the company's results	4.00	4.0	3.38	3.5	3.60	4.0	0.239	
	Identifying market problems	2.50	3.0	3.13	3.0	3.30	3.5	0.067	*
	Shaping the culture of the organisation	3.42	3.0	3.50	4.0	3.28	3.0	0.524	
	Performance orientation	3.17	3.0	3.81	4.0	3.40	3.0	0.158	
	Productivity	4.08	4.0	4.00	4.0	3.68	4.0	0.096	*
Knowledge management	Learning new information	4.33	4.0	4.06	4.0	4.15	4.0	0.520	
	Sorting and organising information	4.42	4.5	3.94	4.0	3.90	4.0	0.074	*
	Generating ideas	3.92	4.0	3.63	4.0	3.55	4.0	0.476	
	Critical analysis of ideas	4.08	4.0	3.69	4.0	3.98	4.0	0.387	
	Finding information	4.17	4.0	4.06	4.0	3.93	4.0	0.574	
	Developing the skills of subordinates	4.17	4.0	3.75	4.0	3.65	4.0	0.328	

Description		Secondary		Incomplete university		Master		Kruskal-Wallis test results	
		M	Me	M	Me	M	Me	p	Significance of differences
Management and supervision	Influencing the decisions of others	3.00	3.0	3.56	4.0	3.40	3.5	0.279	
	Motivating others	4.25	4.5	4.06	4.0	4.20	4.0	0.718	
	Coordinating activities	4.50	5.0	4.50	5.0	4.43	5.0	0.909	
	Conflict resolution	4.00	4.0	4.06	4.0	4.18	4.0	0.860	
	Task delegation	4.08	4.0	4.13	4.0	4.05	4.0	0.983	
	Predicting the consequences of decisions	4.25	4.5	4.44	4.5	4.38	4.0	0.883	
	Independence in making decisions	3.92	4.0	4.56	5.0	4.38	4.0	0.077	*
	Managing group processes	4.17	4.0	4.19	4.0	3.93	4.0	0.448	
	Using authority taking the needs of co-workers into account	3.83	4.0	3.88	4.0	3.65	4.0	0.550	
Social	Oral productive skills	4.25	4.5	4.50	5.0	4.25	4.0	0.391	
	Writing skills	4.08	4.0	4.50	5.0	4.30	4.0	0.442	
	Understanding others	4.42	5.0	4.50	5.0	4.08	4.0	0.096	*
	Objectivity of perceiving situations and problems	4.42	5.0	4.31	4.0	4.28	4.0	0.623	
	Presentation skills (work progress, etc.)	4.17	4.0	4.13	4.0	4.18	4.0	0.780	
	Listening to others	4.50	5.0	4.63	5.0	4.25	4.0	0.122	
	Ability to maintain and strengthen contacts	3.83	4.0	3.88	4.0	3.80	4.0	0.831	
	Focus on customer service	4.17	5.0	3.44	3.0	3.73	4.0	0.089	*
	Involvement in the affairs of the organisation	4.42	5.0	3.81	4.0	3.88	4.0	0.109	
	Cooperation (team work)	4.67	5.0	4.31	4.0	4.50	5.0	0.289	
	Empathy	3.75	4.0	3.50	4.0	3.95	4.0	0.289	
	Predicting the behaviour of others	3.42	3.5	3.38	3.0	3.63	4.0	0.487	
	Using help	3.92	4.0	3.81	4.0	3.85	4.0	0.836	
	Influencing others	3.17	3.5	3.25	3.0	3.40	4.0	0.620	
Building relationships	3.92	4.0	3.60	4.0	3.80	4.0	0.347		
Intrapersonal	Readiness to overcome difficulties	4.58	5.0	4.13	4.0	4.25	4.0	0.187	
	Ability to act under pressure	4.58	5.0	4.81	5.0	4.49	5.0	0.198	
	Time management	4.50	5.0	4.38	4.0	4.30	4.0	0.503	
	Self-control	4.67	5.0	4.31	4.0	4.35	4.5	0.240	
	Self-confidence	4.25	4.0	4.50	4.5	4.03	4.0	0.029	**
	Flexibility	4.17	4.0	3.94	4.0	4.00	4.0	0.614	
	Involvement in the case (project)	4.58	5.0	4.44	4.5	4.63	5.0	0.544	
	Ability to control emotions	4.58	5.0	4.06	4.0	4.13	4.0	0.104	
	Perseverance	4.58	5.0	4.31	4.0	4.15	4.0	0.092	*
	Spontaneity	3.42	3.0	3.31	3.0	2.98	3.0	0.097	*
	Courage in making decisions	4.17	4.0	4.31	4.0	4.28	4.0	0.860	
	Assertiveness	4.25	4.0	4.31	4.0	4.25	4.0	0.932	

M – mean, Me – median, p – probability in the Kruskal-Wallis test, * p < 0.10, ** p < 0.05

Source: own elaboration

A comparative analysis of the assessment of competences as well as age and seniority shows very interesting results. The assessment of competences reveals that the analysis of problems and understanding other people is significantly negatively correlated with age and seniority – younger people and people with less professional experience rate them higher. Similar conclusions apply to the relationship between age and the assessment of listening to others and the ability to act under pressure, as well as the relationship between seniority and the assessment of conceptual thinking. On the other hand, the assessment

of identifying market problems, influencing others and creating relationships is significantly positively correlated with age and seniority – older people and those with longer professional experience rate them higher. Similar conclusions may be drawn when it comes to the relationship between age and predicting the market situation and influencing the decisions of others, as well as the relationship between seniority and the competence to coordinate activities, presenting (e.g. work progress) and readiness to overcome difficulties. The results of this analysis are presented in Table 5.

Table 5. Age and professional experience for competence assessment

Competences	Age	Professional experience
Specialist knowledge	-0.057	-0.017
Use of a computer for professional purposes	-0.024	-0.148
Foreign language skills	0.142	0.077
Ability to remember numbers	0.052	0.019
Implementing improvements at work	0.053	-0.048
Analytical thinking	0.057	-0.001
Conceptual thinking	-0.045	-0.206*
Professionalism	0.117	0.188
Conducting negotiations	0.019	-0.002
Setting goals	0.048	0.019
Problem analysis	-0.222*	-0.273**
General knowledge	-0.170	-0.039
Forecasting the market situation	0.277**	0.025
Assessing the impact of tasks on the company's results	0.025	-0.002
Identifying market problems	0.390***	0.234*
Shaping the culture of the organisation	-0.035	-0.077
Performance orientation	-0.046	-0.013
Productivity	-0.089	-0.164
Learning new information	-0.053	0.006
Sorting and organising information	0.024	0.018
Generating ideas	0.026	-0.137
Critical analysis of ideas	0.019	-0.189
Finding information	0.032	-0.052
Developing the skills of subordinates	0.075	-0.087

Competences	Age	Professional experience
Influencing the decisions of others	0.314***	0.200
Motivating others	0.159	0.059
Coordinating activities	0.179	0.236*
Conflict resolution	0.164	0.084
Task delegation	0.086	0.051
Predicting the consequences of decisions	0.155	0.029
Independence in making decisions	0.034	-0.183
Managing group processes	-0.026	-0.088
Using authority taking the needs of co-workers into account	0.049	-0.035
Oral productive skills	-0.153	-0.130
Writing skills	-0.040	-0.060
Understanding others	-0.228*	-0.202*
Objectivity of perceiving situations and problems	-0.145	-0.161
Presentation skills (work progress, etc.)	0.107	0.255**
Listening to others	-0.244**	-0.057
Ability to maintain and strengthen contacts	-0.079	-0.134
Focus on customer service	0.006	-0.024
Involvement in the affairs of the organisation	-0.020	-0.084
Cooperation (team work)	-0.173	-0.133
Empathy	0.001	-0.158
Predicting the behaviour of others	0.171	0.094
Using help	0.028	-0.020
Influencing others	0.364***	0.289**
Building relationships	0.346***	0.269**
Readiness to overcome difficulties	0.187	0.220*
Ability to act under pressure	-0.231*	-0.163
Time management	-0.118	-0.208*
Self-control	-0.095	-0.020
Self-confidence	0.081	0.004
Flexibility	0.118	0.031
Involvement in the case (project)	-0.026	-0.118
Ability to control emotions	-0.020	0.168
Perseverance	-0.094	0.040
Spontaneity	0.031	0.006
Courage in making decisions	0.056	-0.118
Assertiveness	0.005	0.001

p – probability in the Kruskal-Wallis test, * p <0.10, ** p <0.05, *** p <0.01

Source: own elaboration

Correlation analysis for the full set of variables indicates a very strong correlation among some of them. The analysis of the inverse matrix to the correlation matrix shows that for the full set of some variables, the VIF amounts to even several hundred (while it should be lower than 10), which indicates a strong collinearity of some variables. The procedure for the reduced inverse to the correlation matrix was performed several times. This guaranteed satisfactory results in terms of the preconditions for exploratory factor analysis (in the Bartlett sphericity test $p < 0.001$, and the Kaiser-Mayer-Olkin measure $KMO = 0.599$). The analysis of factor loadings has shown that for many variables

they are low, not exceeding 0.5. This means that their usefulness in terms of competence assessment is low. Thus, they were excluded from the initial set of competences. The set of competences reduced in this way (to 25 variables) meets the preconditions for exploratory factor analysis much better. VIF for most of the variables are at the level of 2-3, and never exceed 4 (so they are well below the threshold value of 10). In the Bartlett sphericity test, $p < 0.001$, and $KMO = 0.734$ (thus exceeding the required 0.5). Following the Kaiser criterion and the Cattell criterion (scree plot – Figure 1), seven factors were distinguished, which together explain 66% of the latent variable (Table 6).

Fig. 1. Determining the number of factors – Cattell criterion

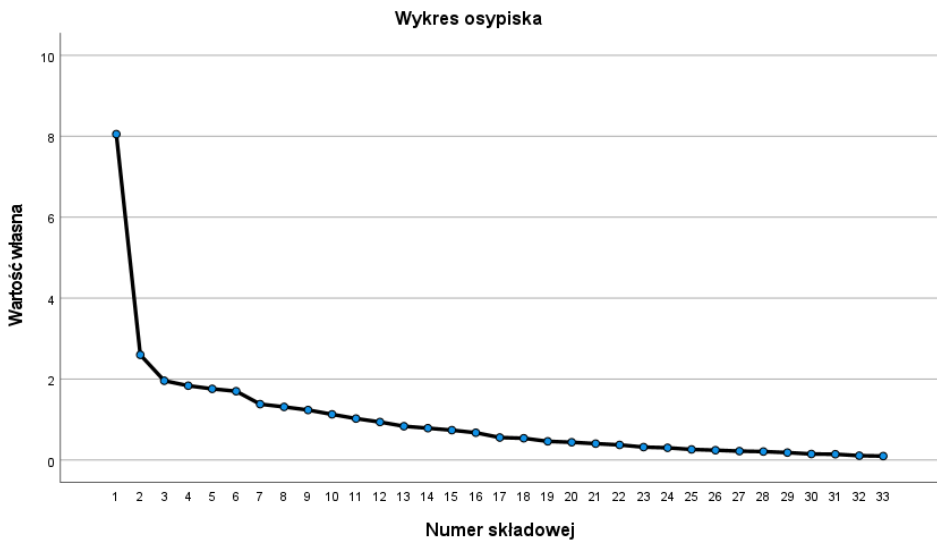


Table 6. Multidimensional analysis of competences

	C1	C2	C3	C4	C5	C6	C7
KMC – critical analysis of ideas	0.694	0.088	0.048	0.030	0.173	0.376	-0.015
KMC – generating ideas	0.694	0.068	0.052	0.238	0.108	0.068	-0.009
TC – Implementing improvements at work	0.656	0.185	0.338	-0.054	-0.112	0.015	0.178
CC – analytical thinking	0.646	0.137	-0.097	0.104	0.225	-0.047	0.332
KMC – developing the skills of subordinates	0.589	0.145	0.303	0.066	0.221	0.074	0.119
TC – specialist (industry) knowledge	0.504	-0.112	0.161	0.227	-0.321	-0.252	-0.238
SC – writing skills	-0.005	0.791	-0.095	0.190	0.095	0.052	0.165
IC – flexibility	0.128	0.730	0.217	0.143	0.160	-0.062	-0.061
IC – involvement in the case (project)	0.131	0.643	0.064	0.174	-0.100	0.510	-0.032
TC – use of a computer for professional purposes	0.219	0.590	0.172	-0.040	-0.249	0.120	0.013
LC – predicting the consequences of decisions	0.143	0.567	0.093	0.143	0.468	-0.060	0.038
BC – productivity	0.085	0.126	0.803	0.211	-0.061	-0.042	0.235
BC – performance orientation	0.077	-0.045	0.743	-0.089	0.014	0.286	-0.117
LC – using authority taking the needs of co-workers into account	0.238	0.182	0.692	0.341	0.194	-0.097	-0.102
BC – shaping the culture of the organisation	0.178	0.154	0.579	-0.215	0.193	0.155	0.432
IC – ability to control emotions	0.061	0.184	0.032	0.761	0.176	0.141	0.141
SC – listening to others	-0.088	0.227	0.222	0.668	0.305	0.275	-0.033
IC – perseverance	0.213	0.071	0.022	0.666	0.008	0.142	0.332
KMC – learning new information	0.404	0.159	0.039	0.627	-0.143	0.107	0.039
LC – task delegation	0.175	0.019	0.008	0.060	0.856	0.045	-0.019
LC – managing group processes	0.161	0.010	0.410	0.260	0.592	0.192	0.221
SC – involvement in the affairs of the organisation	0.033	-0.067	0.133	0.184	0.108	0.720	0.171
SC – cooperation (team work)	0.187	0.204	0.061	0.332	0.017	0.655	-0.204
BC – conducting negotiations	0.184	-0.081	0.212	0.274	0.047	0.038	0.734
TC – foreign language skills	0.040	0.523	-0.088	0.201	-0.003	-0.083	0.617
% of explained variance: for the factor	26.1	9.1	7.2	6.9	6.4	5.7	4.5
total	26.1	35.2	42.4	49.3	55.7	61.4	65.9

KMO = 0.734, sphericity test: p < 0.001

Source: own elaboration

The first factor (C1) includes six competences – critical analysis of ideas, generating ideas, implementing improvements at work,

analytical thinking, developing the skills of subordinates, and specialist (industry) knowledge. This factor is the most important

from the point of view of competence measurement, explaining 26% of the variability of the latent variable. The second factor (C2) includes five items: writing skills, flexibility, involvement in the case (project), use of a computer for professional purposes, predicting the consequences of decisions and explains 9% of the variability of the latent variable. The third factor (C3), on the other hand, includes productivity, performance orientation, the use of authority taking the needs of co-workers into account and shaping the organisational culture, explaining 7% of the variability of the latent variable. The fourth factor (C4) also includes four variables: the ability to control emotions, listening to others, perseverance, and acquiring new information (7% of the variability of the latent variable), while the next three factors include only two variables each (the degree of explanation of the latent variable for them is approximately 7%). The fifth factor (C5) includes task delegation and managing group processes, the sixth – involvement in the affairs of the organisation and cooperation (teamwork), and the seventh – conducting negotiations and foreign language skills. Each of the factors has a satisfactory level of reliability – the Cronbach's alpha mostly exceeds 0.7, while for three scales with only two variables this coefficient is slightly lower than this threshold value (although it is above 0.6, which is considered to be satisfactory). For the entire scale, the Cronbach's alpha is 0.871, and thus it confirms the reliability of the total competence measurement.

Conclusions

Out of the extensive set of 60 competences, 25 of them can ultimately be used in the analysis. They are not strongly correlated with other (which enables the avoidance of duplication of information provided by other variables). Secondly, they are not excessively weakly related to other competences, but also to the latent variable. Thus, the reduction of

the set used to measure competences enables the use of a simpler tool to measure them, without losing the quality of such a measurement. Within the competence scale, seven subscales can be distinguished, each of which is characterised by satisfactory reliability; the general score on a scale including 25 competences listed in Table 6 also has a high level of reliability. Using the research results, kinds of “clusters” which create specific competences (seven such clusters in all) were created. The individual elements of competences are interrelated. It is very difficult to specify individual elements, and even the separate ones, when they occur individually, do not affect the effectiveness of the actions of an individual. Individual elements must coexist with others, thus gaining a substantive foundation for themselves (e.g. knowledge in relation to skills), or strengthening the impact (knowledge and skills + traits and attitudes).

The dynamically developing sector of high technologies increasingly often achieves some or even all of its business goals on the basis of project teams. The growing number of projects requires qualified and competent project managers, which means that the issue of their competences arouses ever greater interest in the worlds of science and business. Despite the fact that it is impossible to build one perfect competence model for research and development project managers, mainly due to the fact that companies differ significantly in terms of their management policies, the level of project culture development and the specificity of projects depending on the industry, it is important to attempt to identify the competences that are of the greatest importance in the assessment of project teams. Summarising the results of the study, it can be stated that social and intrapersonal competences are the most desirable in the proposed competency model of a research and development project manager, while the remaining ones complement the model. The above analysis also leads to emphasising the importance of current assessment and a pro-

gramme of systematic development of the key competences of project managers employed in the organisation for the organisation. In order to gain a sustainable competitive advantage, continuous in-depth assessment and the ability to redefine the competency model of project managers depending on changes occurring inside the organisation and in the surrounding business world are needed.

The study contributes to the achievements of management sciences, in particular to the theory of human resource management, by creating a model approach to the competencies of a project manager in the high technology sector.

The issues discussed in the study require further research. From the cognitive side, future empirical research should include an in-depth analysis concerning both different types of organisation (taking into account the size of the enterprise, as well as the type of enterprise – production/service) and industries in which enterprises operate while taking into account the impact of external factors on innovative processes in an organisation. It would be valuable to conduct research based on an analysis of larger samples, especially among the best enterprises in innovation.

The limitations of this work are mainly related to the research method used in direct research. The interview, despite numerous advantages, is characterised by disadvantages that largely determine the quality of the results. Firstly, the information collected is based on the respondents' declarations and not on observing their actual behaviour. Moreover, the veracity of the answers obtained could have been influenced by the interviewer effect and the variable of social approval. The limitations also include the problem of completeness in the context of the literature review. The growing number of studies on competencies and innovation management makes it very difficult to conduct systematic reviews of the literature, which would undoubtedly increase the value of the work.

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