Key Managerial Competencies for Industry 4.0 - Practitioners', Researchers' and Students' Opinions

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This paper attempts to answer the following question: what competencies seem essential for future managers of Industry 4.0? The pharmaceutical and automotive sectors were selected for the purpose of the study. Both sectors are oriented toward the ongoing improvement of competencies. In the article a comparative analysis of the expectations of practitioners and visions of scientists, theoreticians and students was carried out.

Keywords: future competencies, Industry 4.0, managerial competencies.

1. INTRODUCTION

In the twenty-first century, the logistics industry faces a number of competitive and complex challenges. Such factors include, among others: possibly the quickest onset of action, high efficiency, as well as flexibility, whose main function is the maximal adaptation to customers' needs [1].

This paper is to answer the following question: what competencies seem necessary for future managers of Industry 4.0? The answer is crucial for research and teaching centres, whose aim is to educate future managers at the highest level of the specific competencies and skills.

The paper is divided into four main parts. The first main part is a theoretical introduction to the identification of Industry 4.0. The second main part is a theoretical introduction to identification of core managerial competencies. It presents three basic categories of competence: technical, managerial and social. The next part presents the methodology of the research conducted and shows and interprets the results.

2. INDUSTRY 4.0

Dynamic development of manufacturing Industry 4.0 is a result of some processes, for example: internationalization, information technology development, and also hyper competition. The term Industry 4.0 is often referred to as the fourth industrial revolution [2]. Various names have been proposed on a European level, catchword is "Factories of the Future", "Industrial Internet" in the USA and "Internet +" in China [3]. The concept of Industry 4.0 describes the increasing digitization of the entire value chain and the resulting interconnection of people, objects and systems through real time data exchange [4, 5, 6]. Industry 4.0 predominately regards production areas related to other technological concepts, such as M2M communication, RFID technology, CPD, IoT and Cloud Computing [7, 8].

3. COMPETENCIES OF FUTURE MANAGERS

Knowledge is considered to be the most precious asset of modern organizations. It constitutes specific cultural capital which presents much higher value than material goods. Knowledge becomes the key determinant of the development potential of enterprises [9]. A competency is more than just knowledge and skills. It involves the ability to meet complex demands by drawing on and mobilising psychosocial resources (including skills and attitudes) in a particular context [10]. According to the literature, the authors identified three main categories to classify core managerial competencies.

Firstly, technical competencies comprise all job-related knowledge and skills for example media skills, coding skills, knowledge management, and statistical command. Technical skills are abilities an individual acquires through practice and learning [11].

Secondly, managerial competencies include all skills and abilities for general problem solving and decision making for example: analytical and research skills, conflict and problem solving, creativity. Thirdly, social competencies include an individual's social values, motivations for example: ability to transfer knowledge, leadership skills, ability to work in a team. Social competence is the foundation upon which expectations for future interaction with others are built, and upon which individuals develop perceptions of their own behaviour [12].

The study is focused on exploring the technical, managerial and social competencies of future managers. Based on existing studies and analyses, a total of eight competencies were identified [13,14,15,16,17,18,19,20,21,22,23,24,25,26]. Competences, discussed and selected for analysis, are presented below.

3.1. TECHNICAL COMPETENCIES

IT knowledge and abilities – Information technology is a growing field. Commonly referred to as IT, there are many job titles in the field.

Knowledge Management – Good knowledge management does not just happen. To ensure that organizations can acquire, create, organize, share, use and build on the knowledge that is needed for their successful performance requires the right skills.

Computer programming/coding abilities – One of the basic skill sets an employer will look is the ability to write code. Writing code takes more than just proficiency with the coding language, it requires logical thinking, problem solving, integrating different technology, and having a broad understanding of information systems.

Data and information processing and analytics – Data science and analytics are among the most in demand and fast growing disciplines. However, due to the fact that the field straddles boundaries of many disciplines and its skill set continues to evolve, it is often difficult to delineate its specific skill set and competencies.

Specialized knowledge of manufacturing activities and processes – Specialized knowledge must be expressed in terms of 'common knowledge'.

Organizational and process understanding – Important competencies include a strong command of business workflow, knowledge management, feasibility assessment, data-driven change leadership, and business impact assessment.

Interdisciplinary / generic knowledge about technologies – Expert performance draws on knowledge that is hard to express and structure explicitly. Information and knowledge have dimensions which are never recorded, but which are powerful determinants of organizational behaviour.

Statistical knowledge – Statistical Analysis refers to the core capability of analyzing data for insights and solutions that address business challenges. Typically, this is done using advanced knowledge of statistics, data visualization, and some algorithmic programming.

3.2. MANAGERIAL COMPETENCIES

Creativity – Creativity is becoming the key focus area for employers looking for the 21st century employee. Creativity is characterized by the ability to perceive the world in new ways, to find hidden patterns, to make connections between seemingly unrelated phenomena, and to generate solutions. We are naturally creative and as we grow up we learn to be uncreative. Creativity is a skill that can be developed.

Entrepreneurial thinking – Entrepreneurial thinking skills refer to the ability to identify marketplace opportunities and discover the most appropriate ways and time to capitalize on them. It is more like a state of mind that opens your eyes to new opportunities.

Problem solving – Solving problems involves both analytical and creative skills. Analytical or logical thinking includes skills such as comparing, evaluating and selecting. It provides a logical framework for problem solving. Creative thinking is a divergent process, using the imagination to create a large range of ideas for solutions. Problem solving is an essential skill in the workplace and personal situations.

Conflict solving – Resolving conflicts is the key part of the manager's role. Managing and resolving conflicts requires emotional maturity, self -control, and empathy. Resolving conflicts in a positive manner is a skill than can be developed and practiced.

Decision making – Decision making is the process of making choices by identifying a decision, gathering information, and assessing alternative resolutions. Decision-making is an integral part of modern management. Essentially, rational or sound decision making is taken as the primary function of management. According to the Oxford Advanced Learner's Dictionary the term decision making meansthe process of deciding about something important, especially in a group of people or in an organization.

Analytical skills – Analytical skills are the thought processes required to evaluate information effectively. Analytical skills are the ability to visualize, gather information, articulate, analyze, solve complex problems, and make decisions.

Research skills – Research skills can be from need to be able to use reliable sources for continuous learning in changing environments. Being able to provide in depth information and advice on a given topic is an important skill. Doing research in the world of work is all about stepping back from your day-to-day work and looking at ways you can improve. The most successful people tend to develop research skills early and use them consistently.

Efficiency orientation – An 'efficiency' approach is the one that stresses the efficient use of resources as the main determinant decision and action. Efficiency orientation is inevitable.

3.3. SOCIAL COMPETENCIES

Until recently, the manager's and engineer's work only required technical and economical competence, but with the continuous professional development, social competencies play increasingly important role. Social competence is included in the so-called soft skills and it generates social behaviour that allows and facilitates establishing and maintaining positive interpersonal relationships.

Intercultural skills – Intercultural competences are response to the existence of cultural diversity; can be understood as resources put to work during intercultural dialogue (to use various forms of communication). Knowledge of many cultures allows for effective negotiations. Intercultural skills are important especially when we are dealing with specific cultural circles, e.g. trade partners from Japan, where negotiations are significantly longer than e.g. in the USA.

Language skills – Language skills allow for establishing cooperation with foreign partners, which increases the possibilities for the company growth through internationalization.

Communication skills – Communication skills belong to the most important competencies. It is the ability to listen without prejudice and send convincing messages. Especially important thing here is the so-called emotional intelligence, which every manager should develop.

Leadership skills – Leadership skills are focused on inspiring employees, directing them, as well as mastering the methods of effective persuasion by managers.

Ability to be compromising and cooperative – Ability to be compromising and cooperative is experiencing feelings from the point of view of other employees and trade partners. It is also an active interest in their concerns, anxieties and worries.

Ability to work in a team – Ability to work in a team is primarily the ability to secure cooperation between all members of the group to achieve a collective goal.

Ability to transfer knowledge – The ability to transfer knowledge is one of the most difficult ones to achieve. It is also the ability to sense the need for growth in other people and to develop abilities in employees.

Accepting change – Accepting change is related to the ability to initiate changes or to manage them. It is also mediating in implementation of changes, so as not to cause disputes.

4. METHODOLOGY

In 2017 a questionnaire survey was conducted amongst selected experts in pharmaceutical sector and automotive industry. These experts are high qualified managers employed in transnational companies. Respondents were asked to indicate the importance of the selected competencies. There were 20 experts who filled in the questionnaire.

The pharmaceutical and automotive sectors were selected for the purpose of study. The choice was motivated primarily by their specific characteristics. Pharmaceutical industry is one of the most rapidly growing industrial sectors both in Poland and across the world. It is characterized by a growing degree of automation, robotization and computerization. The automotive sector relies on novel technologies, and product and process innovations. Also, both sectors search for and employ qualified personnel. Furthermore, they are

oriented toward ongoing improvement of competencies [25,27].

In January 2018 a questionnaire survey was conducted amongst selected experts in scientists of supply chain and Industry 4.0. These scientists are highly qualified specialists. There were 20 experts who filled in the questionnaire. Respondents were asked to indicate selected competencies.

In June 2018 a questionnaire survey was conducted amongst selected students. There were 18 students who filled in the questionnaire. These students are extramural, and all of them study and work simultaneously. They study logistics and transportation at The University of Business and Economics in Poznań. Respondents were asked to indicate selected competencies.

5. THE RESEARCH RESULTS

5.1. TECHNICAL COMPETENCIES

Technical competencies are underestimated. These competencies are assessed by experts at a very low level (Fig. 1). The greatest diversity was noted in the assessment of IT competencies. Researchers and students versus pedagogues look at the question of IT competencies in different ways. However, each time they emphasize the necessity of their acquisition or consolidation. But it turns out that in practice, these skills are not the most important. The assessment computer programming/coding abilities is below the average, especially in the opinion of practitioners. Other

competencies are on medium level; it seems that these three groups are compatible. One would say that researchers are more conscious of the need for technical competencies, than students as future workers or practitioners who have stabilization of employment.

5.2. MANAGERIAL COMPETENCIES

D In the group of management competencies, these three groups of respondents are characterized by similar evaluations of selected managerial competencies (Fig. 2). This applies in particular to competencies related to entrepreneurial thinking, analytical skills, conflict solving, decision making and efficiency orientation. The greatest diversity was noted in the assessment of research skills and creativity. It demonstrates that business views are in sharp contrast to those of the scientists. Universities and students generally consider these two competences as natural and very important, but maybe it could be better communicated to industry. The challenge for universities is to better align them to a commercial environment, especially as students are interested in getting knowledge of these competencies.
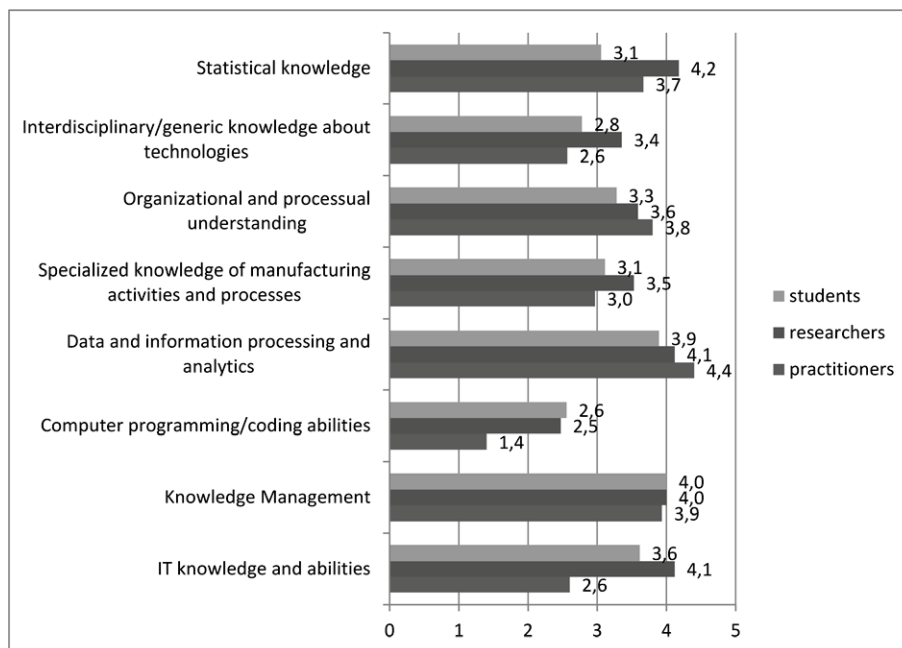

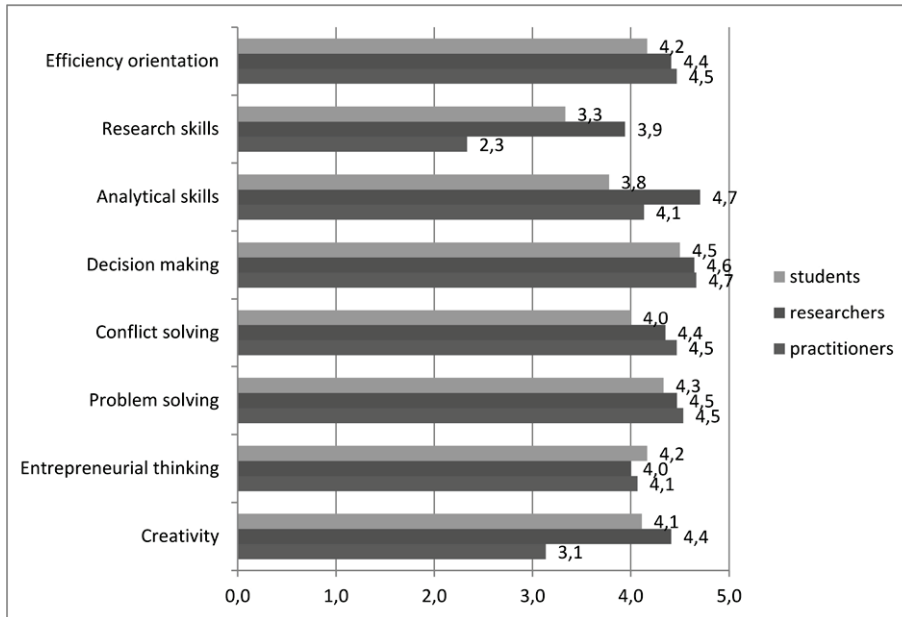Fig. 1. Technical competencies; own work.

Fig. 2. Managerial competencies; own work.

5.3. SOCIAL COMPETENCIES

In the case of social skills (Fig. 3), language skills and communication skills, the ability to work in a group and accepting change were assessed the highest, which fully reflects the requirements concerning candidates for managers in each group, practitioners, students and scientists. Ability skills to be compromising and cooperative were assessed a little bit low in each group. The diversity was noted in the assessment of intercultural skills. Scientists focused on intercultural skills, because in their opinion workers, especially leaders need to be competent at working with foreign business partners. Students take intercultural skills for granted. It comes from international migration of workers. Since their employees will be working with people from different cultures, they'll need to leverage the unique skills of all. On the other hand for scientists not important enough are leadership skills as they are for experts, managers, and students. Practitioners know that the winners of tomorrow will be those organizations with strong leaders who demonstrate agility and authenticity. Young people are very enthusiastic and brave at the beginning of their career, even if they don't have too much experience. They expect a good job and possibility to develop skills very fast.
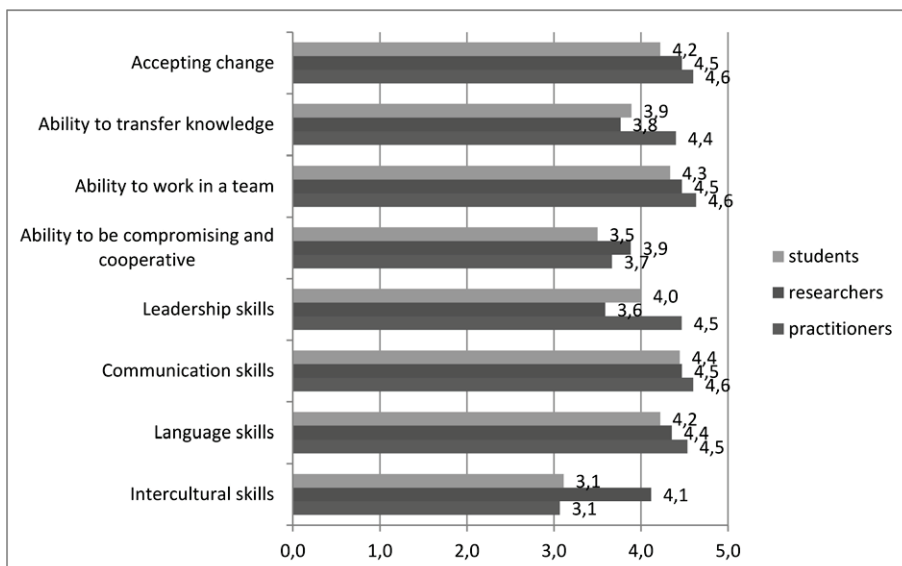

Fig. 3. Social competencies; own work.

6. SUMMARY

At this moment a large change in industry is taking place, the so called fourth industrial revolution. Fast technology development, combined with the globalization and fast changes in customer demand, implies that a competitive advantage of a company can be only temporary [28]. Enterprises have to react very quickly to challenges and opportunities of the business world [29]. This revolution involves advances in underlying technologies, e.g. production and ICT, changes in the business models of firms, and is likely to have a deep impact on our society. New manufacturing technologies, extensive digitization, interweaving of machines and organizations (Internet of Things) have a huge impact on industry. In Industry 4.0, dynamic business and engineering processes enable last-minute changes to production and deliver the ability to respond flexibly to disruptions [30, 31]. It means that also social capital must change its multi-disciplinary perspective. In the industry 4.0 it is increasingly important for managers, workers, and young adepts to develop their social, managerial and technical competencies. The system of high education will have to face an increased demand for putting an emphasis on professional development of their students to achieve the best set of competencies. That is why they exactly know what type of learning they need. Students don't just want to learn from books but they demand more practical elements during lectures.

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