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## **PROJECT MANAGEMENT COMPETENCIES IN DIGITALIZATION ERA: EVIDENCE FROM SERBIAN MANUFACTURING INDUSTRY**

**Abstract:** Due to the intensification of competition and the development of new production technologies, manufacturing enterprises are required to formulate appropriate strategies and use applicable tools, machines and other work equipment. The implementation of advanced technology, which features the Fourth Industrial Revolution, provides significant improvements in the efficiency and effectiveness of production, but also, it requires new key competences and skills. Bearing in mind that project management competency is perceived as an ability to perform activities within dynamic environment that lead to the superior outcomes based on defined and accepted standards, the purpose of this paper is determining the level of knowledge and skills in applying project management activities. Using the sample of 64 manufacturing firms in Serbia, the main aim is to identify the employees' perception of readiness to implement projects within their organizations. According to previous studies, three particular categories of project management competencies are used: technical, behavioral and contextual. The obtained results can be used by managers as guidelines for the improvement of employees' readiness for contemporary issues and the implementation of advanced technology solutions.

**Keywords:** projects, project management, digital era, digitalization, manufacturing industry.

### **1. INTRODUCTION**

The beginning of the Fourth Industrial Revolution has announced the start of a wide range of changes and transformations in all areas of business in project-oriented organisation (PMI, 2017; Slavković & Simić, 2019a). Industry 4.0 as a main component (Marnewick & Marnewick, 2019) explains the vision of the Fourth Industrial Revolution that is the implementation of digital technologies, automation and information and communication technologies, in order to improve product quality, business performance and to reduce market entry timing (Brettel et al., 2014). There are special requests for manufacturing enterprises, which by replacing traditional business methods with contemporary digital tools, tend to overcome the shortcomings of existing business processes (Slavković & Simić, 2019b). Digitalisation has enabled traditional manufacturing enterprises to simplify data management, implement more efficient and customized solutions, increase process automation (Cakmakci, 2019).

The implementation of advanced technologies and generating the desired effects from their application has additionally highlighted project management activities (Slavković & Simić, 2019b). Since the vast majority of organizations do their business through projects, and also that the extend of digital readiness is usually perceived through the prism of the competence of the project manager and the project team members (Marnewick & Marnewick, 2019), projects are considered as main instruments of change, that enable adjustment to the requirements of Industry 4.0 (Silvius & Schipper, 2014). Bearing in mind that technological complexity increases, project results become more uncertain (Radujković & Sjekavica, 2017) and, project managers are faced with demands of permanent improvement and acquisition of new knowledge and skills (Ribeiro et al., 2021). Successful implementation of contemporary project management methodologies and techniques requires the development of new skills (Obradović, Montenegro & Bjelica, 2018). Considering the uniqueness of each project, there is a wide range of project management competences and numerous studies are undertaken to explore project manager most desired skills. On the one hand the importance of technical competences is highlighted (Win & Kham, 2018), while, on the other hand there are studies that have proved

that human factor and soft competences have relevant role in the implementation of project management activities in era of digital transformation (Pessl, 2017; Win & Kham, 2018;).

Most of previous studies have the purpose to identify the relevance of project management (PM) competences (eg. Silvius & Schipper, 2014; Attakora-Amaniampong, 2016) by mapping the key competencies of project managers (De Rezende & Blackwell, 2019, Takey & de Carvalho, 2015). There are sporadic evidences of the relevance of PM competences for the digital transformation (Obradović et al., 2018; Ribeiro et al., 2021). It is proved that both soft and hard skills are important (Pessl, 2017; Win & Kham, 2018; Ribeiro et al., 2021), but there is a lack of evidence that determine the level of project managers readiness for the implementation of solutions and opportunities provided by the new industrial era. Thus, the purpose of this paper is determining the level of knowledge and skills in applying project management activities. According to previous, this is the way to explore the level of readiness of project-oriented organization for digital transformation, since PM competences are one of the most important antecedents for successful implementation of advanced technologies (European Committee for Standardization (CEN), 2014). In addition, the research covers manufacturing enterprises, since the manufacturing sector is a pioneer in implementing the solutions and capabilities provided by Industry 4.0. In manufacturing enterprises robots and automation have replaced humans, that has influenced on the whole production process. Traditional project management approach is no more applicable (Ribeiro et al., 2021), hence project managers have to learn how to deal with permanent change in order to fulfil the demands related to quality and efficiency (Slavković & Simić, 2019b)

The results of the conducted research provide significant implications for the professional public and the creators of educational programs. Accordingly, the potential gaps in knowledge and skills of project managers could be identified, that is important for the development of educational and training programs. Apart from that, considering the research results it is possible to improve the level of employees' readiness for digital transformation.

The paper consists of several sections. After the introductory part, literature review is presented, in which the basic concepts of Industry 4.0 and the implications of the Fourth Industrial Revolution on project management activities are explained, highlighting the changes in the field of PM competencies. Then, the research methodology is presented, which includes an explanation of the research sample and the methods of data collection, as well as the analyzes that were conducted according to the purpose of the paper. Finally, discussion is presented and relevant conclusions are drawn.

## 2. LITERATURE REVIEW

The Fourth Industrial Revolution has noted the development of the Internet, creating cyber physical systems, usage of sophisticated software and hardware and the ability of machines to learn and collaborate. The terms that explain contribution of the Fourth Industrial Revolution are "Industry 4.0", "Smart factory", "Intelligent factory", "Factory of the future" (Salkin et al., 2018)). A contemporary factory will be able to use sensors, machines and IT systems, autonomous robots, Internet of Things (IoT). Employees will have to manage big data and deal with problems related to cybersecurity (Hirman et al. 2019). In a nutshell, the Industry 4.0 factories will have to be much more intelligent, flexible, dynamic and agile in order to survive at marketplace. Thus, new industrial paradigm indicates the need of development and usage of new management tools, while managers have to adapt to the implementation of new technologies to enable the efficient performing business activity (Ribeiro et al., 2021).

The Fourth Industrial Revolution contributes to numerous changes in the dynamics of project management activities, organizational structure in project-oriented organisations, as well as the responsibilities and roles of project managers (PMI, 2017). According to Simion et al. (2018), project management in new industrial era is characterised by digitisation, virtualisation, trans-nationalisation, professionalisation, implementation of agile approach. On the one side, Industry 4.0 enables greater flexibility, mass customization, improving quality and productivity, while on the other side, projects will permanently grow in scale, complexity, and uncertainty (Ribeiro et al., 2021).

In order to overcome the Industry 4.0 challenges, the important role in the transformational process have humans (Cakmakci, 2019). Although Industry 4.0 is usually used as synonym for the use of robots and artificial intelligence, the human role in this industrial period cannot be neglected. Highly qualified employees are essential component of sustainable organisation (Rodriguez et al., 2002), that are determined to exploit the full potential of implemented technological solutions. In accordance, project managers and project team members should be more efficient, more flexible, and more agile. Thus, employees engaged in realizing project activities have to accept new roles and be ready to develop their own skills, as a priority, PM competences, that are intrinsic to Industry 4.0 (Cerezo-Narvaez et al., 2017).

Project managers as carriers of PM competences have central position in the process of digital transformation, hence, it is evident why their knowledge and skills have strong influence on the sustainability of organizations in digital era (Silvius & Schipper, 2014). PM competencies are used to develop flexible but quality strategies to overcome the consequences of poor schedule performance such as delay penalties (Ford & Bhargav, 2006). It is proved that project managers with extensive knowledge in managing relationships with project stakeholders are more successful (Zhao & Tseng, 2003), so it is more likely to achieve higher level of satisfaction of project clients (Attakora-Amaniampong, 2016).

Numerous authors propose different classifications for the critical competencies of project managers. According to Loo (2003) team building, communicating, demonstrating trust, and focusing on results among others were the highest

ranked skills for project success and characteristics for effective project. Katz (1974) highlights human skills that represent “the ability to work effectively as a group member and to build cooperative effort within the team”. According to classification IPMA (2006) contextual competencies have an important role in project management implementation. Contextual competencies cover the interaction of the project with its context and refer to contextual awareness; political awareness, adaptability, strategic alignments, networking. It is important to notice that apart from relevance of soft skills, conceptual skills and traditional project management knowledge, such as knowledge and experience in human resources management, resource management, requirement management, scope management, cost and finance management, procurement and contract management, time management are also very important (Ribeiro et al., 2021). Conceptual or organizational skills refers to planning, organizing, strong goal orientation, ability to see the project as a whole, ability to visualize the relationship of the project to the industry and the community, and strong problem orientation (El-Sabaa, 2001). Apart from that, project managers are expected to continuously keep tracking trends in the field of advanced technological solutions, in order to ensure the application of optimal technical solution (Slavković & Simić, 2019a). According to Win and Kham (2018) the most important hard skill for project managers is experience with innovative technologies and projects, big data analysis and predictive algorithms that will help them to manage projects correctly and focused on the objectives to be achieved.

Bearing in mind that the future of project management will be heavily influenced by technological development, the success of project managers depends on their ability to adapt to changes in organisational structure and culture, but also to accept changes, uncertainties and disruptions as a part of their life and career (Slavković & Simić, 2019a). Project managers have to be ready to lead virtual teams, as well as to accelerate communication processes within projects, by intensifying the use of human-machine and machine-machine communication in the execution of projects (Ribeiro et al., 2021). Previous evidences in literature indicate that project manager must have enhanced hard skills, but also soft skills to accomplish the complex and autonomous Industry 4.0 projects (Ribeiro et al., 2021; Win & Kham, 2018).

### 3. METODOLOGY

Data were collected using specially designed questionnaire to determine the digital readiness of the enterprises operating in Serbia. Items are formulated in accordance with the European Competence Framework 3.0, developed by the European Commission for Standardization. According to given framework among the necessary skills and knowledge required for the successful implementation of digital transformation, project and portfolio management competences are considered. Survey questionnaires were sent to managers in manufacturing enterprises, who are key actors in the process of digital transformation. Using the 5-point Likert scale they have expressed the extent of agreement with given statements, that reflects the level of readiness for digital transformation.

We have randomly selected 176 manufacturing firms, and the invitations to potential participants were sent via email with a link to the web-based survey questionnaire. A total of 71 surveys were received (40.34% response rate) and, after removing 7 incomplete surveys, the final study sample was 64 manufacturing firms. The reason why only manufacturing enterprises are involved is reflected in the fact that manufacturing sector was the first to be affected by the effects of Industry 4.0. Specifically, intensive use of robots and automation has been noted in manufacturing enterprises, which has had the greatest impact on redefining the role of humans engaged in these enterprises (Ribeiro et al., 2021). In order to face the challenges and meet modern requirements, managers are expected to formulate appropriate production strategies (Slavković & Simić, 2019b), which will enable the achievement of high product quality and the improvement of the production process.

The data analysis was conducted in SPSS - statistical package for social sciences. First, exploratory factor analysis was conducted to identify key categories of project management competences. After that, reliability analysis was performed, presenting the value of the Cronbach's alpha coefficient. Finally, descriptive statistical analysis was performed, which involves calculating the arithmetic mean and standard deviation for each category, but also for each statement separately, in order to determine the level of respondents' readiness to successfully perform project management activities in the era of digitisation.

### 4. FINDINGS

The first step is to perform an exploratory factor analysis, using the Principal Component method. The KMO indicator is 0.828, the Bartler specificity test is statistically significant ( $r = 0.000$ ), while 82.416% of the variability is explained by the given factors. Out of a total of 18 statements, 11 statements are grouped into three categories, which represent the certain categories of PM competencies needed in the digital age. (Table 1). The categories of PM competencies that are identified are: (1) behavioral (2) contextual, and (3) technical competencies. The given categorization is in accordance to the framework developed by IPMA (2006). The first category covers human skills of the project manager and readiness to create efficient relationships with project stakeholders (eg. leadership, engagement and motivation, result orientation, conflict and crisis, negotiation). Apart from soft skills, behavioral competences also include stakeholder management knowledge that is represented as hard skill. Secondly, contextual competencies include the importance of interaction of the project with its context, such as adaptability, strategic alignments, networking. Finally, technical competencies refer to ability to use project management tools, methods and techniques.

**Table 1:** Exploratory factor analysis

Items		Factors loading		
		1	2	3
<b>Behavioral competencies</b>				
DP29	I am able to delegate tasks to team members and monitor their achievements.	.846		
DP30	I am able to manage resources to achieve the project objectives..	.837		
DP31	I am able to create optimal project implementation plan, that is in line with the stakeholders' interests.	.789		
DP28	I am able to inform all stakeholders about the project progress, in terms of cost control, achieved results, quality control, changes in project specifications.	.741		
<b>Contextual competencies</b>				
DP35	I am able to define plan for the application of certain improvements in other business processes.		.889	
DP26	I am able to define the project implementation plan, in order to perceive the effects on doing business.		.888	
DP34	I am able to choose the appropriate technical solution, that will facilitate the work of project team members.		.767	
DP25	I am able to identify critical points, which significantly affect the results of project team members.		.718	
<b>Technical competencies</b>				
DP22	I actively use social networks for doing business, such as Yammer, Podio, eXo Platform, etc.			.897
DP23	I actively use professional social networks, such as LinkedIn, HR.com, etc.			.896
DP21	I actively use project management applications, such as Google Drive, Dropbox, etc.			.896

Source: Authors ' research

After that, the results of reliability analysis are depicted. The values of Cronbach's alpha coefficient are 0.934, 0.900, 0.910, which are very high values, so they can be completely accepted (Mallery & George, 2003). In addition, the calculation of arithmetic mean and standard deviation was performed, that represents the degree of respondents' agreement with the given statements, as well as the homogeneity of the respondents' attitudes (Table 2). The presented values of mean reflect the level of managerial competence in certain field. Thus, it is proved that the highest degree of agreement is noted in statements that refer to behavioral competencies, while the lowest value of the mean is recorded in the case of technical competencies.

**Table 2:** Descriptive statistical analysis and reliability analysis

Factors	Mean	Stand. deviation
<b>Behavioral competencies: Cronbach's alpha coefficient =0.934</b>		
I am able to delegate tasks to team members and monitor their achievements.	3.8125	.94070
I am able to manage resources to achieve the project objectives..	3.8594	.92354
I am able to create optimal project implementation plan, that is in line with the stakeholders' interests.	3.8438	.85855
I am able to inform all stakeholders about the project progress, in terms of cost control, achieved results, quality control, changes in project specifications.	3.7813	.91667
Sum	3.8242	.83176
<b>Contextual competencies: Cronbach's alpha coefficient =0.900</b>		
I am able to define plan for the application of certain improvements in other business processes.	3.8438	.89476
I am able to define the project implementation plan, in order to perceive the effects on doing business.	3.5156	.90838
I am able to choose the appropriate technical solution, that will facilitate the work of project team members.	3.8750	1.03126
I am able to identify critical points, which significantly affect the results of project team members.	3.4687	.92528

Sum	3.6758	.82577
<b>Technical competencies: Cronbach's alpha coefficient =0.910</b>		
I actively use social networks for doing business, such as Yammer, Podio, eXo Platform, etc.	2.1875	1.15298
I actively use professional social networks, such as LinkedIn, HR.com, etc.	2.4063	1.35364
I actively use project management applications, such as Google Drive, Dropbox, etc.	2.5781	1.29474
Sum	2.3906	1.16920

Source: Authors' research

## 5. DISCUSSION AND CONCLUSION

This research consists of two parts. Firstly, the categories of PM competences were identified, that are crucial for the implementation of the achievements of the Fourth Industrial Revolution. Secondly, the assessment of PM competences was conducted among managers in manufacturing enterprises.

According to the results of exploratory factor analysis it can be concluded that there are three important categories of PM competencies. The soft skills are highlighted, especially those that are related to building and maintaining interpersonal relationships with project stakeholders. Apart from that, contextual competences are pointed out, that cover convergence between activities related to certain project and other organizational processes in regard to the implementation of other projects. The obtained results indicate that technical competences are also perceived as important for the realization of digital transformation in manufacturing enterprises. In previous studies it is proved that technical skills in project management are the least important, but that in some sectors their relevance is growing, such as telecommunications and banking (Obradović et al., 2018).

As it was mentioned before, the main aim of this paper is to carry out managers' self-assessment of possession of the certain PM competences. Using the questionnaire, respondents have the chance to rate the extent to which they think they possess specific skills. The majority of respondents consider that they have good behavioral skills. According to the obtained results, it can be concluded that managers in manufacturing enterprises consider that they are competent in maintaining interpersonal relationships with employees, but also with the external stakeholders. The lowest degree of agreement of the respondents with the given statements indicates their low level of readiness to efficiently use modern technological solutions, such as digital platforms and communication channels, which is in line with previous empirical evidence (Obradović et al., 2018).

The implementation of the achievements of the Fourth Industrial Revolution in manufacturing enterprises demands changes in almost every part of business. In other words, the implementation of advanced technologies and digital transformation have caused the changes, not only in the production process, but also in the terms of work quality and quantity. In order to ensure the success in these circumstances, enterprises must become digital, with the tendency to improve operations, establish new KPI's, but also to adopt new skills and knowledge. The demands for more efficient execution of project activities and risk minimization have pointed out the need for the development of PM competencies. The European framework has depicted key competences, that determine the level of digital readiness. According to previous, PM competencies represent a set of knowledge and skills that will enable maximizing the benefits of the implemented digital transformation.

In literature there are identified different categories of PM competences. However, there are sporadic evidences that prove the level at which managers possess specific competencies. Apart from the fact that Industry 4.0 will cause the changes related to the implementation of advanced technological solutions, the new trends will change the way of communicating, interacting, the speed and capacity of work. In addition, previous empirical evidences indicate that interpersonal relationships and convergence between the project and its environment are key skills of project managers in the digital era (Obradović et al., 2018; Ribeiro et al., 2021). The results presented in this paper indicate that managers perceive that they possess better behavioral and contextual competences in comparison to technical competences. Therefore, it is important that managers are ready to efficiently use and permanently improve their soft competences, that are one of the key building blocks for generating the benefits of Industry 4.0.

The relevance of conducted research is reflected in generating the guidelines for creators of educational programs. The conducted analyzes have shown that current managers do not consider themselves enough competent to apply digital platforms and advanced technological solutions, which would be desirable to overcome in the education of future staff. Apart from the development of interpersonal skills, emotional intelligence, leadership, assertiveness, future project managers need to be trained to effectively use technological solutions, platforms, software provided by the Fourth Industrial Revolution and be ready to apply digital solutions in everyday work. In this way, qualified human capital would be created that will be ready to implement digital transformation, which is a necessary antecedent for sustainable business.

## REFERENCES

Attakora-Amaniampong, E. (2016). Project management competencies of building construction firms: A structural equation model approach. *Architecture research*, 6(3), 68-79.

- Brettel, M., Friederichsen, N., Keller, M., & Rosenberg, M. (2014). How virtualization, decentralization and network building change the manufacturing landscape: An Industry 4.0 Perspective. *International journal of mechanical, industrial science and engineering*, 8(1), 37-44.
- Cakmakci, M. (2019). Interaction in Project Management Approach Within Industry 4.0. In *Advances in Manufacturing II*(pp. 176-189). Springer, Cham.
- Cerezo-Narvaez, A., Otero-Mateo, M., & Pastor-Fernandez, A. (2017, October). Development of professional competences for industry 4.0 project management. In *7th IESM Conference Proceedings. International Conference on Industrial Engineering and Systems Management* (pp. 487-492).
- De Rezende, L. B., & Blackwell, P. (2019). Project management competency framework. *Iberoam. J. Proj. Manag*, 10(1), 34-59.
- El-Sabaa, S. (2001). The skills and career path of an effective project manager. *International journal of project management*, 19(1), 1-7.
- European Committee for Standardization (CEN): *European e-competence framework 3.0* (2014). [http://ecompetences.eu/wp-content/uploads/2014/02/European-e-Competence-Framework-3.0\\_CEN\\_CWA\\_16234-1\\_2014.pdf](http://ecompetences.eu/wp-content/uploads/2014/02/European-e-Competence-Framework-3.0_CEN_CWA_16234-1_2014.pdf)
- Ford, D. N., & Bhargav, S. (2006). Project management quality and the value of flexible strategies. *Engineering, Construction and Architectural Management*, 13(3), 275-289.
- Hirman, M., Benesova, A., Steiner, F., & Tupa, J. (2019). Project management during the Industry 4.0 implementation with risk factor analysis. *Procedia Manufacturing*, 38, 1181-1188.
- International Project Management Association (2006) *IPMA Competence Baseline Version 3.0*. International Project Management Association, Nijkerk.
- Katz, R. L. (1974). Skills of an Effective Administrator, *Harvard Business Review*. Sep-Oct, pp. 91-93
- Loo, R. (2003). Project management: a core competency for professional nurses and nurse managers. *Journal for Nurses in Professional Development*, 19(4), 187-193.
- Mallery, P., & George, D. (2003). *SPSS for Windows step by step: a simple guide and reference*. Allyn, Bacon, Boston.
- Marnewick, A. L., & Marnewick, C. (2019). The ability of project managers to implement industry 4.0-related projects. *IEEE Access*, 8, 314-324.
- Obradović, V., Montenegro, A., & Bjelica, D. (2018). Digital era and project manager's competencies. *European Project Management Journal*, 8(1), 4-9.
- Pessl, E. (2017). "Roadmap Industry 4.0 – Implementation Guideline for Enterprises." *International Journal of Science, Technology and Society*, 5(6):193. <https://doi.org/10.11648/j.ijsts.20170506.14>
- Project Management Institute (PMI) (2017). *Agile Practice Guide*. Newtown Square, PA, USA: Project Management Institute.
- Radujković, M., & Sjekavica, M. (2017). Project management success factors. *Procedia engineering*, 196, 607-615.
- Ribeiro, A., Amaral, A., & Barros, T. (2021). Project Manager Competencies in the context of the Industry 4.0. *Procedia Computer Science*, 181, 803-810.
- Rodriguez, D., Patel, R., Bright, A., Gregory, D., & Gowing, M. K. (2002). Developing competency models to promote integrated human resource practices. *Human Resource Management: Published in Cooperation with the School of Business Administration, The University of Michigan and in alliance with the Society of Human Resources Management*, 41(3), 309-324.
- Salkin, C., Oner, M., Ustundag, A., & Cevikcan, E. (2018). *A conceptual framework for Industry 4.0. In Industry 4.0: Managing the digital transformation* (pp. 3-23). Springer, Cham.
- Silvius, A. G., & Schipper, R. P. (2014). Sustainability in project management competencies: analyzing the competence gap of project managers. *Journal of Human Resource and Sustainability Studies*, 2, 40-58
- Simion, C. P., Popa, S. C., & Albu, C. (2018, November). Project management 4.0–project management in the digital era. In *12th International management conference*. Editura ASE, Bucharest (pp. 93-100).
- Slavković, M. & Simić, M. (2019a). Спремност пројектног менаџмента за Индустију 4.0: мапирање критичних фактора успеха, *Forum*, 1(1-2), 45-65, ISSN 2683-5983, UDK: 005.8:330.342.23, <https://doi.org/10.46793/Forum19.045S>
- Slavković, M. & Simić, M. (2019b). Project Management Success Factors for Implementation of Advanced Manufacturing Technology, *SYM-OP-IS 2019 Međunarodni XLVI simpozijum o operacionim istraživanjima*, September 15-18, Kladovo, Serbia.

- Takey, S. M., & de Carvalho, M. M. (2015). Competency mapping in project management: An action research study in an engineering company. *International Journal of Project Management*, 33(4), 784-796.
- Win, Thee & Kham, Saing. (2018). Transformation of Project Management in Industry 4.0., *Proceedings of 12th International Conference on Project Management*, November 1st-2nd, 2018, Bucharest, Romania
- Zhao, T., & Tseng, C. L. (2003). Valuing flexibility in infrastructure expansion. *Journal of infrastructure systems*, 9(3), 89-97.