

PROJECT MANAGEMENT 4.0 - PROJECT MANAGEMENT IN THE DIGITAL ERA

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ABSTRACT

In this paper the characteristics of project management in the digital age are analyzed in terms of the influences specific to the fourth industrial revolution: projectification of society, digitalization, virtualization, coping with complexity, transnationalization, professionalization. These influences specific to the digital era and the fourth industrial revolution lead to a new stage in project management development, which we defined as Project Management 4.0 in the paper. This concept is defined as: project management specific to the Fourth Industrial Revolution; the fourth stage of project management evolution and a set of processes through which the projects are planned, organized, coordinated and controlled using mainly the technological tools specific to the fourth industrial revolution. Project Management 4.0 features are revealed in close connection with major project management components: time management, cost management, quality management, project team management, communication management, project risk management, procurement and resource management.

KEYWORDS: *digital, era, management, project.*

1. INTRODUCTION

The advances made in the IT industry have been taken up in various fields of activity and have become part of their development. Suggesting, from this point of view, is the concept of Industry 4.0 as a concrete expression of the manifestation of the fourth industrial revolution. Promoting for the first time on a large scale by the German state through the Ministry of Research and the Ministry of Economic Affairs, the Industry 4.0 concept became the symbol of the industrial future in developed countries.

The source of this new vision is the fourth industrial revolution materialized in technological fusion that goes beyond the boundaries between biological, physical and digital. The expansion of the fourth industrial revolution is marked by spectacular technological advances in a number of areas such as digitization, robotics, artificial intelligence, 3D printing, nanotechnology, biotechnology, the Internet of Things and the Industrial Internet of Things, autonomous vehicles. Unlike the other three industrial revolutions (which were technology-centered), the technological inflexion points of the fourth industrial revolution are and will be both technological and communication and connectivity with significant effects on the economy.

The emerging technologies of the fourth industrial revolution are those that have allowed Industry 4.0 to manifest its most conceivable form: digitizing technologies that enable organizations to use equipment that can communicate with each other over the Internet. This new approach to production processes, based on networks, control systems, robots, 3D printing and autonomous

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vehicles, has the effect of unprecedented amplification of functional and operational autonomy of organizations.

The Fourth Industrial Revolution and the Industry 4.0 concept are based on both human-machine communication and machine-machine communication. The emergence of cobots, robots working with humans and not necessarily in their place is one of the forms of manifestation of the fourth industrial revolution. It questions the pessimistic scenarios of the effects of the automation of production processes.

In this context, fundamental changes of industry, economy and society as a whole are legitimate questions:

- what will be the effects on projects in different fields of activity?
- how will project management change?
- the Industry 4.0 concept leads to the emergence of the Project Management 4.0 concept?
- what is Project Management 4.0?

These questions, as well as other questions about the future of project management in the fourth industrial revolution, are being addressed by research conducted within this article.

2. LITERATURE REVIEW

As in other areas and in project management, there have been a number of published research that have set out to discover how the changes brought by the emerging technologies of the Fourth Industrial Revolution will be manifested. Pruseth and Garimella (2017) considered that key components that will help project managers in India to cope with change are change management, technology, governance and capabilities. Finding that project management is in a process of evolution, Pruseth and Garimella (2017) believed that in the immediate future it would be affected by the following significant changes: focus on customer centricity, heterogeneous teams whose members would be in geographic areas at great distances, focus on innovation, the excellence of Agile methodologies in competition with Waterfall. The same authors drew attention to the need to deal with human resources that are predominantly of the Y generation and the Z generation that have radically different expectations with respect to previous generations.

In a paper published by Arup, the future evolution of construction project management until 2045 is presented. The main components of this development are presented in the following table.

Tabel 1. Evolution of project management in Arup conception

No.	Year	The change occurred
1.	2020	-Blockchain of project data emerges
2.	2025	- Social Responsibility becomes the chapter of PMBoK
3.	2030	- Each company in the top 100 has a professional project management
4.	2035	- Project management is part of the national curriculum (in the UK) - Neuro-technologies become common in project environments
5.	2040	- Smart algorithms prove to be better than expert assessments
6.	2045	- Virtual telepathy is predominant in the communication process

Source: adapted from Arup –The Future of Project Management (2017), p. 11

As can be seen in the previous table, in the Arup concept, focused on the field of construction projects, the pace and magnitude of the changes are also distinctive with a major effect on the execution of construction projects. Also in the construction sector, the issue of project portfolios dedicated to sustainability and energy efficiency is growing. For example "a methodology has been developed and applied which allows the creation of an optimal portfolio of projects for increasing the energy efficiency of the housing fund at regional level through the use of LCC" (Simion, Nicolescu and Cioc, 2018).

Cerezo-Narvaez, Otero-Mateo, and Pastor-Fernandez (2017) considered that the Industry 4.0 concept is a new challenge for project managers through relationship in behavioral, technical and contextual skills. The conclusion of the study by Cerezo-Narvaez, Otero-Mateo and Pastor-Fernandez is that in Industry 4.0 human resources and skills remain an essential element in any organization.

IPMA, in a report published in 2016, considers that the main theme of the future project management in the digital era is projectification of society. Bierwolf et al. (2017) considered that project management will be affected by the following changes in 2030: projects based on project life cycle will be replaced by project complexity and project management theories; projects will be seen as social rather than operational - instrumental processes, practitioners will become reflective practitioners. From the perspective of these authors, the core skills of project managers in the future will be 14 from technical to business knowledge.

Gemuenden and Schoper (2015) considered that there are 12 possible future trends in project management, of which 5 are essential: projectification of societies, coping with complexity, transnationalization of project management, project management virtualization, professionalization of project management. As can be seen, most of these changes are closely related to the idea of digitization.

3. RESEARCH METHODOLOGY

Based on the main approaches in the literature for the research carried out under this article, the following research objectives were set:

- establishing future trends in project management evolution taking into account the main features of the Fourth Industrial Revolution;
- defining the concept of Project Management 4.0;
- establishing the main influences of digitization and Industry 4.0 on project management.

In order to achieve the research objectives, a research methodology was developed which includes the following steps:

- selecting from the literature the main features of project management in the digital era;
- analysis of other studies and / or opinions expressed by specialists on the directions in which project management will evolve;
- defining Project Management 4.0 by integrating in the existing definitions the elements specific to the fourth industrial revolution;
- analysis of the impact of digitization on project management and its main components;
- formulate conclusions on the concept of Project Management 4.0 and its main features.

From a methodological point of view in the research, through a qualitative approach, the main changes that project management will have as a result of the entry of the economy and society into a new stage of evolution have been observed.

4. RESEARCH RESULTS

The main influences that the 4th Industrial Revolution has on project management as a practical activity and decision center are: projectification of society, digitalization, virtualization, coping with

complexity, transnationalization, professionalization (figure 1).

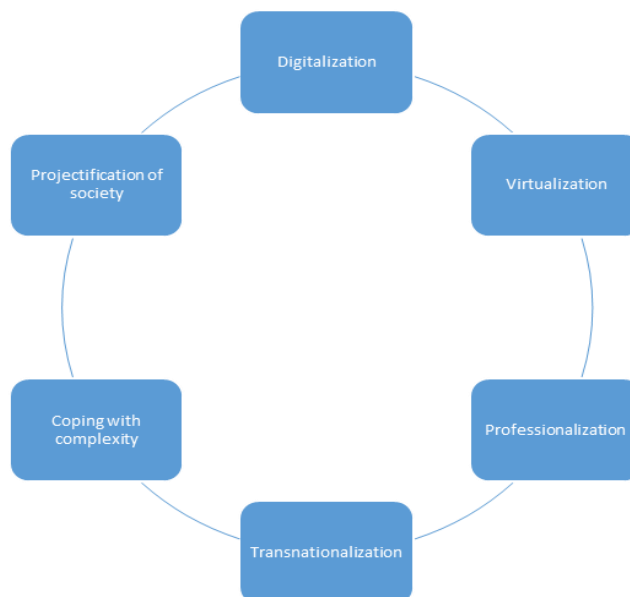


Figure 1. The main influences of the fourth industrial revolution on project management
Source: authors

Digitization involves the use of storage, processing and retrieval technologies among online users. Support for digitization is the Internet, including the Internet of Things. Digital transformation will put project managers ahead of new problems (deploying virtual applications, virtual coins, 3D printing, and autonomous vehicles), but will also greatly amplify the arsenal of automated methods and techniques available to project managers. These will be used to facilitate project planning, monitoring and control. Machine-to-machine communication can be used for real-time monitoring of project progress.

Virtualization of project management involves increasing the possibilities to run projects virtually through the use of ICT tools. Virtualization of project management will have several advantages:

- increasing the scalability of project management processes;
- increasing the efficiency of project implementation and exploitation;
- modeling and simulation of project management processes;
- faster communication that allows an expansion of working in virtual teams spread across any geographic area;
- increasing the flexibility of the project team (work schedule, response to customer requirements, ability to react to changes in the project environment).

As a result of digitization and virtualization, organizations will want to simulate project implementation before they begin implementing them to be aware of the potential problems they may encounter during execution and other phases of their life cycle.

The professionalisation of project management is specific to the increasing maturity level of organizations in project management. Professionalization of project management arises as a consequence of:

- the continuous increase in the number of members of national and international professional associations;
- the emergence of the need for professional mobility;
- turning the occupation into a project manager as a profession.

Professionalizing project managers can be considered a stage in the human resources career. It may be a final stage or only an intermediate step towards positions on higher hierarchical levels. On the

other hand, organizations are more willing to spend more with experienced project managers instead of incurring expenses from the lack of professionalism of projects. Organizational management is largely the result of professionalisation and project management will follow the same trajectory in the future.

Transnationalization of project management is a consequence of the acceleration of globalization processes in the digital age. Digitization will allow a company to be involved in project implementation in various geographic areas, to have virtual teams with members from different countries or continents. This will generate a cultural challenge for project managers in these companies. They will have to deal with local stakeholders so they can act globally and stay in the global competition. This is not easy because it is difficult at a project level to create a culture that is strong enough to level the cultural differences between the members of a project team.

Another effect of the fourth industrial revolution is the increasing complexity of the projects. The complexity of the projects will increase as the number of elements to be tracked during a project is increased. Enhancing the complexity of projects will lead to:

- tools used for standardization and integration will proliferate;
- increase the demand for project execution simulations so that project managers are informed of potential problems;
- collaborative methods and models will proliferate;
- research will be amplified to study the complexity of projects and eventual possibilities to reduce it.

The fourth industrial revolution leads to the elimination of repetitive tasks that can be taken over by robots or guards and the concentration of staff on the creative, non-repetitive side of the activities to be done within companies. They mostly have a unique character and can be solved through project work. The effect of this trend across society is projectification of society. Essentially projectification of society is the degree of diffusion of project management in all sectors of the societies (Packendorff & Lindgren, 2014). From this point of view, project management continued its expansion as a scientific discipline and as a practical activity in the digital age as well. This is also confirmed by "the amplification of project-oriented organizations in contemporary society" (Simion & Popa, 2017).

Initially present in only a few areas (R & D, Innovation, Construction, IT) project management tends to expand to the whole of its economic and social life due to its multiple advantages as a way of working. The digital era will further accelerate this process through the disappearance of jobs requiring repetitive work tasks and the processual extension of functions that are in the creative sphere (such as the R & D function within the organization, for example).

Transforming project management as a result of the changes brought about by the fourth industrial revolution is profound and lasting because it overlaps with other changes brought about by the evolution of the economy and society. In this context, we propose to define the concept of Project Management 4.0. For the Project Management 4.0 concept there may be two definitions:

1. Project Management 4.0 is project management specific to the fourth industrial revolution.
2. Project Management 4.0 as a practical activity represents the whole process of planning, organizing, coordinating and controlling projects using mainly the technological tool specific to the fourth industrial revolution.

Project Management 4.0 is the fourth phase of project management evolution as a scientific discipline.

In the following figure are the stages of the project management development from the perspective of the fourth stage: PM 4.0.

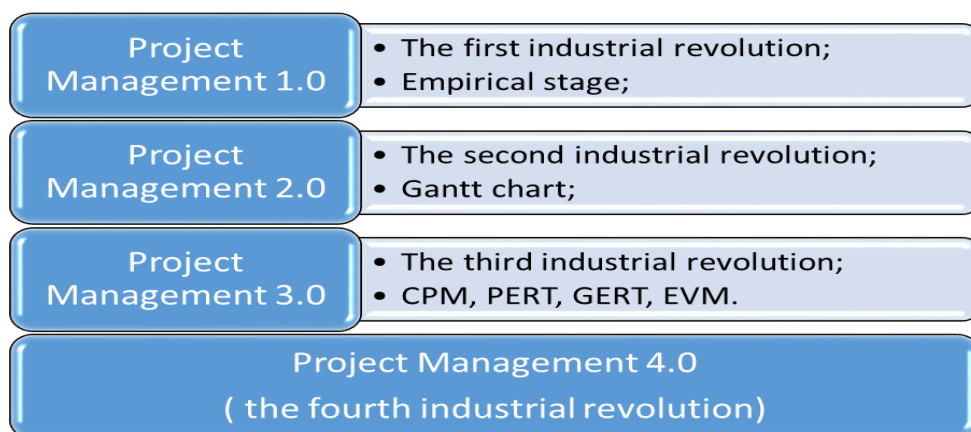


Figure 2. Evolution of Project Management from the First to the Fourth Industrial Revolution

Source: authors

From the above figure we can see the evolution of project management from the first to the fourth industrial revolution. In the first phase of project management evolution that intersects with the emergence of the first industrial revolution project management was at an empirical stage. Project management, at this stage of its evolution, was rather the result of the experience and intuition of project managers than the application of scientific methods and techniques.

In the second phase of project management evolution corresponds to the second industrial revolution. At this stage, the first attempts were made to program the execution of projects over time using the Gantt chart.

In the third phase of the project management evolution, the necessities imposed by the realization of the projects in the modern economy led to the emergence of:

- modern methods and techniques for the timely execution of projects such as CPM, PERT, GERT;
- Earned Value Management;
- the first text collections on the project management (called Body of Knowledge);
- specific project management methodologies.

The fourth project management phase, Project Management 4.0, which corresponds to the fourth industrial revolution, is characterized by digitization, virtualization, transnationalization, professionalization, switching from Waterfall to Agile, focusing on the project-organization relationship and the maturity of organizations in project management. This phase of project management development is still in its infancy and some of its characteristic features can only be inherited for the time being.

The main elements of influence of the 4th industrial revolution on project management are presented in the following table.

The elements listed above are just a few of the projects that will affect the future. Their manifestation in the realization of the projects is still at an early stage and some future developments are still unknown today. As can be seen from the previous table, the digital and the fourth industrial revolution, through the manifestation of their characteristic elements, will have an important influence on the planning and execution of projects in different fields of activity.

Table 2. Project Management 4.0 features

No.	Project management component	Project Management 4.0 features
1.	Time management	Real-time monitoring of project execution Eliminating gaps in progress reports
2.	Cost management	Update real-time cost progress indicators Foresight on the cost of projects
3.	Quality management	Automatic quality control of deliverables Digitalization of project quality control
4.	Project team management	Generalize the use of virtual teams Using gamification as a method of preparing and developing human resources Collective intelligence
5.	Communication management	Accelerating communication processes within projects Removing physical communication support and increasing connectivity Use of human - machine and machine - machine communication in the execution of projects Less time spent on progress reports; Autogeneration of progress reports
6.	Project risk management	Project execution simulation; Using techniques to identify and analyze risks as involving the use of large volumes of data.
7.	Procurement and resource management	Sharing knowledge about purchases Using virtual platforms in procurement processes Strengthening the share of acquisition and use of knowledge resources in project implementation.

Source: authors

5. CONCLUSIONS

Project management in the digital age is affected by a series of influences specific to the Fourth Industrial Revolution. Among these, the most important ones identified in the research carried out within this article are represented by: projectification of society, digitalisation, virtualization, coping with complexity, transnationalization, professionalization.

The influences of the fourth industrial revolution on project management require at least an attempt to redefine this concept as Project Management 4.0. In this paper we have developed three definitions of the Project Management 4.0 concept: as a project management specific to the fourth industrial revolution; as a fourth stage of project management evolution and as a set of processes through which the projects are planned, organized, coordinated and controlled using mainly the technological tools specific to the fourth industrial revolution.

The influence of elements specific to the fourth industrial revolution is felt primarily on seven key components of project management: time management; cost management, quality management, project team management, communication management, project risk management, procurement and resource management.

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