

Selected Aspects of the Managerial Function Organizing in the Context of Industry 4.0

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Presented at **International Conference on Trends & Innovations in Management, Engineering, Sciences and Humanities, Dubai, 19-22 December 2023 (ICTIMESH-23)**.

<https://doi.org/10.37082/IJRMPS.ICTIMESH-23.12>



Published in IJRMPS (E-ISSN: 2349-7300), ICTIMESH-23

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Abstract

The shift in industrial revolutions is irreversible. The changes have to be reflected in the management. Management as science develops under the influence of these changes, therefore it is necessary to monitor, verify and implement them into theory. The aim of the contribution is to identify the impact of the fourth industrial revolution on the managerial function of organizing. The study deals with the identification of the mentioned changes both on a theoretical level based on a search of relevant scientific literature, and on a practical level based on the analysis of data from a questionnaire survey in 115 industrial enterprises in Slovakia. Descriptive statistics were used, as well as structural equation modeling with SmartPLS 3.3 software. The results point to the introduction of agility, flexibility, and teamwork approaches in the context of Industry 4.0. However, new trends in organizing, arising from the influence of Industry 4.0, cannot be implemented without leadership 4.0, which is the complete mediator of this relationship. A significant challenge for management in the Industry 4.0 era is not only to find and implement the right technology but to translate it into relevant organizational arrangements through progressive leaders who have the potential to foresee future developments, thus preparing businesses to adapt to the modern phenomenon.

Keywords: Industry 4.0, Management, Leadership

1. Introduction

In the context of dynamic breakthroughs in the business environment at home-country and abroad, significant changes are taking place within individual managerial functions that make up the content of management. Management represents an open system of knowledge with the possible implementation of new trends and changes in its content.

One of the significant changes in the current environment is the fourth industrial revolution, i.e. a transformation based on technological advances. The term Industry 4.0 is not just a modern term, but an

effective tool that spreads globally and affects all aspects of human life today Information has become very important and leads to many changes in scientific fields related to Industry 4.0 [2]. The concept and definition of Industry 4.0 focus on the automation of the industrial world [3] and provides the implementation of information and communication technologies (ICT) or digitization, which form the "backbone" of current existence [2]. It is evident and clear that the modern phenomenon is changing corporate strategies, business models, value and supply chains, processes, products, skills, and relationships with stakeholders. Industry 4.0 creates new opportunities, but also vulnerabilities that need to be managed in order to have a positive impact on business and the enterprise as a whole [4].

With the growing awareness and implementation of Industry 4.0, significant changes and trends arise in management, which transforms individual managerial functions. The topic of Industry 4.0 in the context of management is still new and not well-researched. This is confirmed by recently carried out partial studies regarding various aspects of Industry 4.0 in the field of management, which do not provide a comprehensive systemic approach, which could clearly identify changes within individual managerial functions due to the influence of Industry 4.0. This claim is confirmed based on a comprehensive study by Piccarozzi et al. [5], dealing with the topic of Industry 4.0 in the field of management and business, which is based on 70 scientific works from indexed databases and confirms that several areas of management have not got enough attention. Based on the data provided by this study, the research focuses mainly on the topics of production models (24%), business models (15%), strategy (13%), impacts and consequences of Industry 4.0 (10%), human resources (9%), small and medium enterprises (9%), supply chains (9%), sustainability (9%), information systems (1%) and social innovation (1%). On the basis of the mentioned statements and findings, a significant research gap has been found, based on which we aim to identify a set of changes and techniques in individual managerial functions.

The purpose of the presented contribution is to describe the changes in the managerial function of organizing due to the influence of the fourth industrial revolution.

2. Theoretical Research

The increasing people networking, use of machines, and with them associated "real-time" communication does not only bring changes in the business model of the company. Digital transformation creates great pressure on businesses in the form of flexibility, agility, and innovative capabilities. Fixed forms of organization that can be found in many companies today are not able to change their usual processes. However, Industry 4.0 leads to a change in the organization of work, which puts pressure on organizational structures, hierarchies, and work methods to adapt to technological progress [6] [7]. The Internet of Things brings challenges in the form of creating an adaptable and flexible hierarchical structure [8]. It is obvious that with the introduction of Industry 4.0, companies will face numerous social, economic, and technological challenges, which require the dynamic skills and innovativeness of the workforce. It is therefore extremely important to discuss how businesses can improve the capabilities that come from innovation to meet the demands of Industry 4.0. [9] The consequences of these advances were manifested mainly in the areas of organizational agility, organizational structures, self-management of teams, and decentralization.

Fixed organizational structures are gradually losing importance. In the future, there will be a transformation of companies' traditional organizational structures and an acceleration of decision-making processes as a result of Industry 4.0 and the increasing speed of business processes [10] [11]

[12]. A flat organizational structure is characterized by fewer levels of hierarchy and extensive control. It increases the chances of workers taking part in discussions and participating in decision-making, which helps them to learn new things as well flat structure can provide quick feedback to top management due to horizontal communication [13]. Thus, it is rational to argue that a flatter organizational structure is compatible with Industry 4.0 because it facilitates corporate learning and promotes innovation, by increasing worker participation and faster feedback for top management [9].

The flattening of the hierarchical structure leads to greater personal responsibility and higher capabilities of the worker. Bersin et al. [14] conclude from the results of the mentioned survey that there is a shift from traditional organizational structures to models where work in teams prevails. The results indicate that leading companies have a flexible organizational structure with a predominance of teamwork. Due to the impact of Industry 4.0, high-performing enterprises are able to create a "digital customer experience" group, selecting individuals for a team with the requirement to design and create a new product or service within one to two years. Subsequently, the team disperses, and the members of the disbanded team move to new teams. According to Bersin et al. [14] the team network represents the organizational structure that businesses should adopt due to the pressure of digitization and technological progress. Holocratic structures consist of teams that can be quickly assembled and dissolved to meet corporate goals. The goal of holacracy is to divide decision-making activities while allowing everyone to work on what they do best [15]. Another inexorable driving force is globalization. Businesses must learn to work globally and virtually. They have to lead virtual teams in different geographies. Employees must be able to navigate within self-directed teams, teams oriented on a short-term project, and cross-functional teams, many of which are virtual. Management should introduce a design thinking approach to corporate learning initiatives for their executives so that they are prepared to operate and manage effectively in a rapidly changing world [16].

Decentralization remains a significant organizing trend in the Industry 4.0 era. It enables workers to make timely decisions, change direction by changing the business environment, and also facilitates quick decision-making and learning [9].

Decentralization opens up the possibilities of borderless contact and interaction with all members of the corporate network - they are not subject to centralized information. This type of customizable interaction will also enhance changes in businesses and manufacturing processes by enabling last-minute notifications and adjustments. We consider the emerging possibilities to be beneficial in order to offer a supporting role to the position of workers. With the increased demand for personalized manufacturing, the authors Carvalho et al. [17] believe that decentralization would mean increased flexibility, whereby the production line would be able to adapt to customers with the help of intelligent machines and the autonomous exchange of CPS information without the intervention of operators who would have to reprogram or set up the machines. The authors of the study further claim that the operators will only perform maintenance and intervene in case of errors or problems. Another example of decentralization given by Brettel et al. [18], is how manufacturing systems could autonomously cooperate with other manufacturing systems and supply chains. This would mean that manufacturing systems would exchange information about customer orders with material suppliers and their systems to order the right amount of materials and prepare deliveries without human intervention. According to the authors, this would enable a more flexible allocation of production capacities in value chains. However, it requires

each participating actor to provide potentially sensitive information about their supply and production capacities.

Agility is an element, which is inevitably associated with processes of technological change. The faster a business can adapt to events or factors that cause a change, the greater the benefits of adaptation will be. The company's ability to act agilely in the market depends significantly on the company's setup and on the human-centred corporate culture [19]. Established businesses should have an entrepreneurial spirit, aiming for a flexible and open mentality similar to start-ups [20]. The purpose of open communication is the free exchange of knowledge across all hierarchical positions and departments, which makes it possible to accelerate learning processes and focus on a common vision. Workers should be willing to constantly improve things and improve themselves, on the other hand, responsible managers should apply a democratic style of leadership, appreciate the skills of workers, see them as part of the community and have tolerance for failure [19]. Among the specific approaches for starting corporate cultural changes, we include e.g. workshops and the introduction of "think tanks" (a group of experts who provide advice and ideas on specific political or economic issues) [20]. It is also necessary and important to create interdisciplinary cooperation across hierarchical levels [21] [22].

3. Objectives and Methodology

The presented research is part of a wider research, carried out in 115 manufacturing enterprises in Slovakia. The research was focused on examining changes in individual managerial functions as a result of Industry 4.0. The aim of the contribution is to identify the impact of the fourth industrial revolution on the managerial function of organizing.

A questionnaire form of data collection was used. respondents were low, medium, and top managers from manufacturing companies operating in the territory of the Slovak Republic. The sample consisted of 115 respondents from diverse industries. All identification data were part of the first part of the questionnaire. For the organizing function, was chosen question about the degree of the introduction of modern forms and elements within organizational structures and the application of organizational agility of the company. Managers evaluated individual statements through agree/disagree on a set Likert scale from 1 to 6, where 1 = the minimum value and 6 the maximum value (i.e. I completely agree).

As part of the theoretical research, we focus on the following research questions:

Q1: What type of organizational structures is suitable in the conditions of Industry 4.0?

Q2: Why support decentralization in companies implementing the Industry 4.0 concept?

Q3: Why is agility suitable in the context of Industry 4.0?

As part of the practical application, we focus both on the identification of changes in the managerial function of organizing in manufacturing enterprises in Slovakia and at the same time on the confirmation of the hypothesis about the influence of Industry 4.0 on the managerial function of organizing, which is mediated by leadership in the 4.0 era.

Data analysis was carried out using the PLS-SEM method (partial least squares structural equation modelling) using SmartPLS 3.3 software for the assessment of both the measurement model and the structural model.

4. The Results

We coded the statements in the form of identifying changes in the field of organization which are detailed in the following Table 1.

Table 1: Codes of Identified Changes in the Managerial Function of Organizing

Identified Organizational Changes	Variable Codes
Flat organizational structure	ORG_1
Predominance of teamwork	ORG_2
Virtual teams	ORG_3
Virtual work from anywhere and everywhere	ORG_4
Self-management of teams	ORG_5
Making decisions at lower levels of management	ORG_6
Subordinate workers with more authority, responsibility and knowledge	ORG_7
Sharing information between workers about changes in the environment	ORG_8
Strengthened communication networks between management and workers	ORG_9
Agile teams	ORG_10

Source: Own processing

Next, we present an overview of descriptive statistics from the results of the survey, which point to the rate of introduction of individually identified changes within the managerial function of organizing in industrial enterprises in Slovakia (Table 2).

Table 2: Descriptive Statistics of the Managerial Function Organizing

Organizing										
	ORG_1	ORG_2	ORG_3	ORG_4	ORG_5	ORG_6	ORG_7	ORG_8	ORG_9	ORG_10
Examined Sample	115	115	115	115	115	115	115	115	115	115
Arithmetic Mean	4,20	4,68	2,95	3,38	3,84	4,03	3,77	3,84	4,06	3,54
Median	5,00	5,00	3,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00
Modus	5	5	1	4	5	4	4	5	5	4
Standard Deviation	1,46	1,07	1,63	1,57	1,33	1,29	1,35	1,44	1,38	1,41
Distraction	2,14	1,15	2,66	2,45	1,77	1,67	1,83	2,08	1,90	1,99
Skewness	-0,63	-0,98	0,36	-0,07	-0,71	-0,64	-0,43	-0,52	-0,83	-0,36
Pointiness	-0,51	1,17	-1,08	-1,01	-0,42	-0,10	-0,47	-0,60	-0,02	-0,80
Variation Range	5	5	5	5	5	5	5	5	5	5
Minimum	1	1	1	1	1	1	1	1	1	1
Maximum	6	6	6	6	6	6	6	6	6	6

Source: Own processing

As part of the identified changes in the managerial function of organizing, according to the results of the survey, industrial enterprises most implement teamwork (ORG_2) into their processes. When compared

to the managerial function of planning, several changes in organizing reach an arithmetic mean value higher than 4 - "slightly agree". It points to the introduction of flatter organizational structures (ORG_1), strengthening of communication networks between managers and workers (ORG_9), and decision-making at lower levels of management (ORG_6). On the contrary, the lowest arithmetic mean was achieved by the introduction of virtual teams (ORG_3) with a value of $\mu = 2.95$, with mode 3 - "slightly disagree". The maximum and minimum values are identical for all organizational changes in the context of Industry 4.0, i.e. the minimum value is 1 and the maximum value is 6, from which it follows that the range of variation is equally identical and takes the value 5. For virtual teams (ORG_3), the coefficient of skewness takes the value 0.356, which implies that it is a left-skewed distribution, which is a smaller value. The other changes involve a right-skewed distribution. The skewness coefficient takes on a positive value only for teamwork (ORG_2), which implies that it is a more pointed distribution and most of the examined values are closer to the mean. The other variables have a flatter distribution of values. Virtual teams (ORG_3) have the highest variance with a value of 2.66, with a standard deviation of 1.63. The lowest variance with a value of 1.15 is achieved by the prevalence of teamwork (ORG_2), with a standard deviation of 1.07.

During the analysis, we also determined the interrelationships of individual variables using the Kendall tau_b correlation coefficient. They are shown in Table 3.

Table 3: Correlation Matrix of Summary Variables

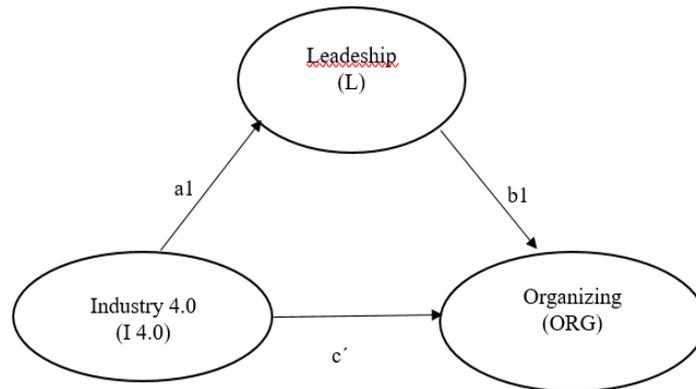
			I4.0	PL	ORG	L	HRM	C
Kendall's tau_b	I4.0	Correlation Coefficient	--					
		Sig. (2-tailed)	.					
PL		Correlation Coefficient	0,596**	--				
		Sig. (2-tailed)	< 0,001	.				
OR		Correlation Coefficient	0,552**	0,514**	--			
		Sig. (2-tailed)	< 0,001	< 0,001	.			
L		Correlation Coefficient	0,528**	0,529**	0,670**	--		
		Sig. (2-tailed)	< 0,001	< 0,001	< 0,001	.		
HRM		Correlation Coefficient	0,612**	0,542**	0,527**	0,580**	--	
		Sig. (2-tailed)	< 0,001	< 0,001	< 0,001	< 0,001	.	
C		Correlation Coefficient	0,612**	0,573**	0,557**	0,600**	0,507**	--
		Sig. (2-tailed)	< 0,001	< 0,001	< 0,001	< 0,001	< 0,001	.

** The correlation is significant at the level 0,01,

I4.0 = Industry 4.0, PL = Planning, OR = Organizing, L = Leadership, HRM = Human Resources Management, C = Control

Source: Own processing

All relations between summary variables are statistically significant and there are positive correlations between them. In the context of managerial function organizing there is relatively strong relation with leadership (0,670). As far as the interrelations between variables I4.0, ORG and L are significant, we can adapt mediation as well and examine hypothesis I4.0 and its relation with ORG through the variable Leadership. Theoretical model is illustrated in the Figure 1.

Figure 1: Theoretical Model of the Study

Source: Own processing

Theoretical model fulfils are requirements of validity a reliability. Cronbach's alpha of all summary variables is satisfactory (from 0,847 to 0,937). Composite reliability (CR) is in the range 0,770–0,950 and together with rho_A criterion (in the range 0,771 to 0,949) they fulfil the established requirements. We assessed the convergent validity which exceeds the level of 0,5 for all constructs by measuring the average variance extracted (AVE). Concurrently the requirement of discriminant validity measured by Fornier-Lacker and HTMT criteria is fulfilled. Square-root of AVE for the construct was greater the inter-construct correlation and the mean value of the indicator correlations across constructs measured by HTMT indicator is suitable because its value is lower than 0,9.

Structural model identifies individual identified paths outlined in the theoretical model. They are illustrated in the Table 4.

Table 4: Direct Effects Results

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics ((O/STDEV))	P Values
I 4.0 -> ORG (Total Effect)	0.769	0.773	0.049	15.619	0.000
I 4.0 -> ORG (Direct Effect)	0.149	0.170	0.128	1.161	0.246
I 4.0 -> L -> ORG (Indirect Effect)	0.620	0.603	0.096	6.484	0.000
L -> ORG	0.735	0.716	0.123	5.980	0.000
I 4.0 -> L	0.844	0.846	0.036	23.609	0.000

I4.0 = Industry 4.0, ORG = Organizing, L = Leadership

Source: Own processing

Hypothesis examining the relation between I 4.0 and ORG which is mediated by the variable L has support. The overall effect is significant and high ($\beta = 0.769$, $p = 0.000$). However, leadership is significantly contributing to this effect in terms of Industry 4.0 ($\beta = 0.620$, $p = 0.000$). Indirect effect is therefore 81% of the overall effect. It is a complete mediation.

5. Discussion

The answers for research questions are as follows. The first research question was concerning the appropriate type of organizational structures in conditions of Industry 4.0. The results of theoretical research are summarized in an overview Table 5.

Table 5: Organizational Structures in the Industry 4.0 Conditions

Type of Organizational Structure	Characteristic Features
Flat Organizational Structure	Flexibility
	Personal responsibility of employees
	Higher actionability of employees' competencies
	Effective communication – decreasing the distance between employees and management of an enterprise
	Employees' participation on discussions and decision-making
	Fast feedback from management to an employee
Project Organizational Structure	Self-organization
	Flexibility
	Solution orientation
	Breaking down functional and departmental barriers
	Accelerating decision-making processes
	Promoting learning and innovation in enterprises
	Project team members - independent professional personalities, able to develop their creativity with higher autonomy
Team manager - transparent and responsible communication with team members	
Matrix Organizational Structure	Flexibility
	Prompt response to the need for change
	Facilitating of connection mechanisms by combining the problem solving of product and functional managers

Source: Own processing

The development of new forms of organizational structures is essential because old bureaucratic models are rigid with inner and outer limits without the potential to react to changes in rapid hyperconnected environment.

Research question 2 was concerning the support of decentralization in enterprises introducing Industry 4.0. It is obvious that Industry 4.0 supports decentralization which facilitate various systems in enterprise to do decision-making autonomously without deviations from the path to the final organizational objective. Arising options are beneficial with the objective of offering a supporting role of worker empowerment. Therefore, opportunities for increasing motivation, responsibility,

coordination, creativity and life-long learning of employees arise [23] (Flores et al., 2019). To the third research question we state reasons for the need of agility in conditions of Industry 4.0. Changes brought by this industrial revolution can be adopted only by agile management approach. To reach the enterprise agility solely technological changes are not enough. New approaches to the organizational structure and enterprise culture are as well determining for the successful transformation. The aim of the transformation is therefore to create a learning enterprise with the ability to constantly adapt to the changing conditions thanks to the use of Industry 4.0 technologies, organizational learning and decision-making process which dispose with high quality of data which are quickly available.

In the context of identified changes in managerial function organizing the use of teamwork is dominant. Studies pointed out on the fact that there are positive effects in application of teamwork to the business processes in the context of Industry 4.0.

Hypothesis verifying the relation between Industry 4.0 tools and trends in the managerial function organizing which is mediated by the variable leadership in the era 4.0 has support and it is a complete mediation. Without changes in management in the context of fourth industrial revolution trends it is not possible to make necessary changes in organizational structures and organizing.

6. Conclusion

There are many changes occurring in organizing as managerial function along with the fourth industrial revolution. Organizational transformation is necessary. Digital transformation is pushing enterprises to adapt approaches of agility, flexibility, ability to react on changes in needs and expectations of consumers. It is not possible without changes in leadership itself because leadership is a mediator of this relation. The aim of leadership 4.0 is to support the development of new ideas and concepts and to increase innovative strength as well as the competitiveness of enterprises. Significant challenge for Industry 4.0 is not only to find and implement the right technology but to transfer it to the relevant organizational settings through progressive leaders which have the potential to predict the future advances through which they can prepare enterprises for the adaptation of new phenomenon. Undoubtedly, Industry 4.0 has the power to change many things from the physical to the digital world. Complete preparation is required from leaders because old ways are not enough to be compatible with Industry 4.0.

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Funding

This paper is funded by project Vega VEGA no. 1/0010/23. Adaptability of corporate culture - a factor supporting resilience and sustainability of enterprises in Slovakia in the post-COVID period; and project Kega No 001EU-4/2021 - Project of a study program in the field of economics and management, which reflects conditions of digital age, appeal of sustainability of economic activity and global citizenship.