Perception of the Leadership Competency in the 4th Revolution Era in the Czech Republic

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Abstract
Leadership research is an essential part of all areas of organisational science worldwide, and there is still a lack of studies in this research area. The paper aims to determine leadership competency perceptions and their sub-competencies characteristics and determinants in the fourth industrial revolution era. The research survey, conducted in 2018-2021, covered a sample of 100 respondents from organisations from the Czech Republic. The most important competencies for leadership are effective communication, innovation, cooperation, creativity, solving problems, lifelong learning, Information and Communication Technology (ICT) and motivation and support of others. We selected statistical methods ANOVA and linear regression for the characteristics of the respondents and the cluster analysis for the leaders' 4.0 types determination. The linear regression results showed that age, the field of education, position in the organisation and tenure in the organisation of the respondents affect their assessment of the level of leadership competency. We identified three management types that are currently facing the challenges of Industry 4.0: ICT-oriented Junior Managers, Top 4.0 Prepared Leaders, and Non-Creative Unmotivated Senior Directors. The contribution of this paper is the in-depth study in the area of perceived levels of partial competencies for leadership for different criteria of respondents.

Keywords
Competencies, Leadership, Leaders types, Industry 4.0, Management.

Introduction

Leadership is a prevalent topic in all areas of organisational science because nothing can be done without it (Yammarino, 2013). Digitalisation and leadership are the oft-mentioned factors that influence the competitiveness of companies in an innovative future (Bencsik, 2020). Preparing for digital transformation is about operators, technical systems, and managers who have to get to grips with new requirements, ideas, knowledge, skills, and relationships. It is called Leadership 4.0. This new approach to leadership requires competencies for effective human resource development, which is the essence of the research in this study.

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Competency leadership remains an under-researched area, according to Saabye et al. (2020); Dorfman at al. (2012). The field still lacks a clear understanding of the universalistic compared with the specific approaches to competency leadership, especially in a "flat" technology challenged and rapidly changing world. In recent years, much research has begun to address the question of which competencies will be critical in the era of the fourth industrial revolution (Shet & Pereira, 2021; Hernandez-de-Menendez et al., 2020; Blumberg & Kauffeld, 2021). The research gap resides in a deeper focus on the relationship between Leadership 4.0 and its supporting competencies. The statistical analysis of leadership perception, which is based on respondents' self-evaluation, has not been often used (Grzelczak et al., 2017; Gudanovska et al., 2018; Hecklau et al., 2016; Vrchota et al., 2019).

We examine the relationships between perceptions of partial competencies for leadership, leadership and characteristics of leaders in the fourth industrial revolution era. The first research question focuses on identifying which partial competencies and skills belong to

leadership in literature. In the second research question, we seek to find out what are determinants of leadership competency perceptions. Finally, we analysed the partial leadership competencies and people's characteristics to answer the third research question: leaders' 4.0 types prevailed to manage others. The paper is intended to provide managers insight into the requirements for Leadership 4.0 partial competencies. The results may be helpful in the scientific community as they shed light on some crucial factors and determinants of leadership.

Literature review

Leadership competency

The conceptual idea of leadership has been extensively studied for the last century within different fields, mainly in social psychology, business, and economics (Yukl, 2010). However, studies often lacked the meaning and context for practical application in the past and did not address cognitive social and interpersonal viewpoints. Leadership is a multilevel process of interaction between leader and follower that occurs when the leader and followers share a goal and voluntarily achieve things together (Yammarino, 2013; Antonakis & Day, 2018). Similarly, Kruse (2013) describes leadership as a process of social influence that maximises the efforts of others towards the achievement of a goal. In this paper, we are mainly inspired by attitudes that leaders can control the pace and speed of organisational processes. However, we consider competency leadership generally as a nature of every organisation. It has its requirements in terms of leadership behaviour due to the different environments in which it operates Guzmán et al. (2020) state that leadership competency is essential in organisations to successfully promote a culture of innovation.

Perception of the partial competencies for leadership

Perceptions of competence to leadership have been presented in the subsequent studies led by Vrchota et al. (2019), Goksoy (2016), Afzal, et al. (2018). We design the literary consideration of the partial competencies for leadership competency, which means leaders' required abilities and skills. The partial competencies of leaders should primarily revolve around a team approach for today's technologically flat organisations with teams at the middle and lower levels of the organisation with individuals with different

backgrounds and leadership roles making decisions in groups. Table 1 shows the partial competencies for leadership.

In defining the leadership competencies, we draw on the following leadership partial competencies. Kyllonen (2012) highlights the characteristics of a leader with the competencies to lead, delegate and act responsibly, influence people within ethical rules, help others with individual professional development, work effectively in a set team and handle social situations

Table 1
The partial competencies of the competency Leadership

Competencies for leadership	Interpretation
Effective communication (COM)	Effective communication is focused on transferring and using the leader's experience in the roles of internal coaches, mentors, lecturers, project managers, etc. (Veteška & Tureckiová, 2008). Effective coworker management, delegation and non-directive management (Li, 2009).
Innovation (INO)	New and alternative ways of thinking, the constant search for improvements or the use of new methods are typical examples of what has been defined as innovative work behaviour (Kinkel et al., 2017).
Cooperation and collaboration (COO)	Establishing and maintaining positive working relationships means building effective cooperation and developing and mentoring teamwork (Kyllonen, 2012). It is related to developing an atmosphere of long-term trustworthy relationships with others (Casner-Lotto & Barrington, 2006).
Creativity (CRE)	Creativity is acquiring professional skills and talented employees, supporting the creativity of others, working with different types of personalities, creating and developing an environment for talent (Veteška & Tureckiová, 2008). The creative environment is based on mutual trust, openness, and predictability of reactions (Vrchota, 2019).
Solving problems (SOL)	Ability to solve problems and strive to achieve strategic goals and continuous improvement (Robles & Zárraga-Rodríigueza, 2014). The competency to ensure the smooth running of the organisation (Li, 2009).

Table1 [cont.]

Competencies for leadership	Interpretation
Lifelong learning (LL)	Motivation to learn, respectively frequent work related to change makes it mandatory for employees to know (Hecklau et al, 2016). Retrieve information from different sources (Collet et al., 2015). Lifelong learning is a prerequisite for developing knowledge and better preparedness of employees for new technologies and processes Vrchota et al. (2019)
Information and Communication Technology Abilities (ICT)	Hecklau (2016) define ICT as technical and technology skills, media skills, understand emerging technology and its potential impact. Liboni et al. (2019) add coding skills, understanding IT security. Bogoviz et al. (2019) add to these skills computer programming and digital thinking.
Motivation and support of others (MOT)	The professional ability to motivate others individually and in groups Mitchelmore & Rowley (2010).

Source: own research

brilliantly. Teng et al. (2019) suggest that continuous industrial development requires technical know-how combined with soft skills and social adaptability, focusing on communication, personality development, leadership, teamwork, innovation, problem-solving and critical thinking skills. Li (2009) prefers development and research, innovation, and technical leadership, where leaders integrate observations, problems, and ideas into a more general context. Casner-Lotto & Barrington (2006) add the competencies of a leader to develop and coach others to assume the professional roles required of them to make decisions and consider the consequences of those decisions. Considering Nsoedo (2016), the success of organisations cannot be possible if individuals in organisations cannot combine their different talents and temperament to work as a team.

Partial competencies determinants and Leadership 4.0

Competency leadership is determined by characteristics of managers like gender, age, field and level of education, job position in the organisation, term of employment and company size (in which they are working). In the studies reviewed, these characteris-

tics were addressed superficially. Studies on characteristics and competencies usually focused on one or two of them under study. The positive trend is observed in the investigation led by Hecklau (2018), who specifies younger generations as future professionals and leaders. For instance, the comprehensive set of challenges that Leadership 4.0 brings to organisations in the human resource cluster focuses mainly on developing the workplace of the future qualifying employees and building their digital competencies. Other studies have highlighted digital competencies, labelled ICT in our review, as one of the partial competencies for leadership. In choosing the characteristics for leadership, we were inspired by authors who have focused more intensely on gender studies in leadership research (Sczesny & Kuhnen, 2004; Samuel & Mokoaleli, 2017). The age-related characteristic was the basis for the research conducted by Kourtesopoulou et al., (2012). Another relevant factor is, according to Marian & Boarescu (2010) and Yahya et al. (2010), the size of organisations, especially differences between small, medium and large enterprises.

Liboniet al. (2019) proposed 21st-century leader development of learning, reverence, service, authenticity, and flaneur. Moreover, as reported by Schaubroeck et al. (2012), researchers will likely return to focus on the leader, actually the "new leader"— the ethical, moral, professional, "green", socially responsible, and 3P (people, profits, and planet) leader. The leadership learning process is then "a cognitive schema" built on five constructs. A good leader applies the guiding principles and adapts to new information, new experiences, new levels of complexity and new contexts throughout their life and career spans. Leadership may be "formal, occurring at all levels of management and not just at the top, and it may be informal and emergent, not solely bestowed by title or position" (Yammarino, 2013).

Methodology and data

The paper aimed to determine leadership competency perceptions and their partial competencies characteristics and determinants in the fourth industrial revolution era. The research's partial goal is to formulate the literary consideration of the partial competencies for leadership competency, analyse the competency leadership perceptions determinants related to people characteristics, and identify prevailed leaders 4.0 types based on the partial competencies for leadership and peoples characteristics.

Data

The study was conducted between 2018 and 2021. In this quantitative research, we worked with structured data from 100 respondents (employees and managers) of specific professions in the Czech Republic. Respondents were selected according to the work orientation. Samples of respondents were collected based on nonprobability sampling method through an online questionnaire survey focused on individual leadership competencies. The measurement of respondents is based on the self-assessment of perception of the level of the competencies for leadership. In the questionnaire, the author came out the research of Vrchota et al. (2019). Respondents were asked to rank on the ordinal scale (1–10 points) in the online questionnaire their self-evaluation of the selected competencies. The questionnaire was based on the self-assessment of the leadership competency and the following partial competencies for leadership: creativity (CRE), cooperation (COO), effective communication (COM), innovation (INO), lifelong learning (LL), solving problems (SOL), information and communication technology abilities (ICT) and motivation and support of others (MOT).

Methods

The methodological apparatus for fulfilling the second research question is based on the assumptions set out in the Vrchota et al. (2019) research. It is about finding out the characteristics of respondents influencing the development of Leadership competence. According to the study of Vrchota et al. (2019), we set the following hypothesis regarding the perception of the evaluation of the influence of the respondents' characteristics on leadership competence:

H0: For competency leadership, the respondents' answers are the same regardless of the mentioned characteristics.

H1: non H0 (For the competency leadership, the respondents' answers are different for at least one characteristic of the mentioned characteristics.)

We perform the standard analysis of variance (ANOVA) for the competency leadership as the response variable (Rencher & Christensen, 2012).

Linear regression is used in the results chapter to clarify the effects of individual characteristics of competency leadership. For the linear regression model (Rencher & Christensen, 2012), we observe the factors (independent variables) of managers such as gender, age (levels 21–30 years, 31–40 years, above 41 years), type and level of education/school level (levels secondary, and tertiary such as a university), field of formal education (levels economic sciences, humanities and educational sciences, technical, natural, and health sciences), job position (levels administration, e.g. accountant, technical assistant, etc.; middle management, e.g. the marketing manager; specialists, e.g. personnel specialist, etc.; top management, e.g. directors, owners), length of tenure in the organisation (levels less than one year, 1–5 years, 5–10 years, ten and more years), level of management, and size of the organisation (micro up to 10 employees, small with 11–50 employees, medium with 51–250 employees, large with 251 and more employees).

Subsequently, cluster analysis is used to analyse partial competencies and peoples' characteristics relationships to identify leader 4.0 types related to the third research question. We used the k-means method for clustering respondents according to the eight partial competencies of the leadership. According to Rezankova (2007), the non-hierarchical cluster analysis k-means algorithm assumes that the clustered objects can be viewed as points in Euclidean space and the number of clusters k is pre-determined. The optimal number of groups was sought using the Elbow, Silhouette, Hubert and D index methods. The optimal number of clusters was determined to be three clusters, which are easier to interpret. The breakdown of partial competencies in the cluster analysis is deeply elaborated according to the characteristics of age, management level (position in organisations) and perception level of the leadership. We chose age and management levels determinants as significant results of the analysis of variance results.

Results

First, we investigated the perceived level of leadership of the managers surveyed. The results show that the average level of perceived leadership is 6.79. Of this, men (mean = 7.02) are more than women (mean = 6.62). Leadership in terms of age is best rated for the 31-40 age group (mean = 7.40) and the 41+ age group (mean = 6.97). This competency was perceived the least among young managers (mean = 6.22). We found, by job position in the organisation, that leadership was perceived most highly in top management positions (mean = 8.29), followed by middle management positions (mean = 7.44) and positions of specialists (mean = 6.78). This competency was least attributed to managers in administrative positions (mean = 4.88).

The ANOVA and linear regression

Further, we chose the statistical methods of ANOVA and linear regression to determine the statistical significance of the impact of the following respondents' characteristics on leadership: gender, age, level and type of education, position in the organisation, length of time in the organisation, size of the organisation. Table 2 shows the ANOVA result for the competency leadership. Respondents' perceptions of competency leadership vary by gender, age, level of education, position in the organisation. The overall F-statistic of the linear regression model confirms the rejection of H_0: the p-value is 0.00011.

For a closer look at the details of how the characteristics of the respondents affect their answers, we made the complete estimation of the linear regression model, where the following levels of factors can be seen as independent variables. To mediate linear regression (Rencher & Christensen, 2012), the standard linear regression model was applied with the response variable leadership and the dummy variables for the following independent factors (the first level of each variable is always the base group of the level): age, field of formal education, type and level of education, job position, tenure in the organisation, and size of the organisation.

The linear regression results (Table 3) show that the estimated difference –1.056 points between the expected response of the age group over 41 years compared with the primary group is statistically significant with the p-value of 0.0073. From the above, it is clear that the estimated expected score for the competency leadership for the age group 41 and older differs significantly from the primary group, other factors being fixed on their fundamental values. In addition, for

the age group 41 and over and 31–40 years, the estimated response differs by 1.056 + 0.115 = 1.171 points favouring the younger age group 31–40 years and is also implicitly statistically significant.

Differences are caused only by age – possible differences between age groups caused by other factors (included in the regression model) are not considered by these values. The higher mean value for the age group 41 and older (6.96 on a 10-point scale) compared to the mean value for the 21–30 age group (6.15 points), in contrast to the negative estimated difference in the former group score, is due to other factors than age. The following statistically significant coefficients relate to the type of education, where for technical, scientific and health types of education, the p-value is 0.0327. The most statistically significant is the job position in the organisation, where at the place of middle management, the p-value is <0.0001. At the top management position, the p-value is 0.0007, and at the position of specialists, the p-value is 0.0002. The estimated score differences are 2.1675, 2.8246 and 3.5552 points in comparison with the base group. The remaining significant coefficient (for respondents working ten or more years in the organisation) has a p-value of 0.0380 and the estimated difference in the score 0.737 points from the base group.

As natural for any regression analysis, the above-estimated differences are netted out of the remaining factors included in the regression model. On average, the respondents rated characteristics age and administrative positions for competency leadership worse (4.875 on a 10-point scale) than specialists (average 6.77 on a 10-point scale), top management (intermediate 8.17 on a 10-point scale) and middle management (average 7.42 on a 10-point scale). For work require-

Table 2
Analysis of Variance of the competency Leadership

	Df	Sum Sq	Mean Sq	F value	Pr(>F)	Sign.
Gender	1	5.0150	5.0147	1.7225	0.1934	
Age	2	33.5790	16.7895	5.7672	0.0047	**
Field of formal education	2	9.8450	4.9225	1.6909	0.1913	
School level	1	17.9550	17.9549	6.1676	0.0152	*
Job position	3	67.8780	22.6260	7.7721	0.0001	***
Lenth of org. tenure	3	14.2940	4.7647	1.6367	0.1880	
Organisation size	3	8.7000	2.8999	0.9961	0.3994	
Residuals	75	218.3390	2.9112			

Note: Overall F-statistic: 3.6010 on 15 and 75 Df, p-value: 0.0001. Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1. Source: own research

Table 3
Analysis of Variance of the competency Leadership

	Estimate	Std. Error	t value	Pr(>|t|)	Sign.
(Intercept)	4.8732	0.6100	7.9890	0.0000	***
Gender: female	0.0928	0.4516	0.2050	0.8378	
Age: 31-40 years	0.1150	0.4022	0.2860	0.7757	
Age: above 41 years	−1.0560	0.3827	−2.7590	0.0073	**
Field: humanities and education	−1.0582	0.5841	−1.8120	0.0740	
Field: technical, natural, health	−1.0488	0.4820	−2.1760	0.0327	*
School level: tertiary	0.5498	0.3175	1.7320	0.0874	
Job position: specialists	2.1675	0.5522	3.9250	0.0002	***
Job position: middle management	2.8246	0.6432	4.3910	0.0000	***
Job position: top management	3.5552	1.0088	3.5240	0.0007	
Tenure in org.: 1-5 years	0.8732	0.6108	1.4300	0.1570	
Tenure in org.: 5-10 years	0.4099	0.5293	0.7750	0.4410	
Tenure in org.: 10 and more years	0.7372	0.3490	2.1130	0.0380	
Size of the organization: small	0.0439	0.4323	0.1010	0.9195	
Size of the organization: medium	−0.1825	0.4426	−0.4120	0.6814	
Size of the organization: large	0.6874	0.4815	1.4280	0.1575	

Notes: Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1. Residual standard error: 1.706 on 75 degrees of freedom; Multiple R-squared: 0.4187, Adjusted R-squared: 0.3024 ; F-statistic: 3.6010 on 15 and 75 Df., p-value: 0.0001. Source: own research

ments in the organisation, top management, middle management and specialists are more closely related to the competency leadership than the administrative staff.

In summary, position in the organisation, age above 41 years and technical, natural and health fields of education are statistically significant according to the linear regression and ANOVA results.

The cluster analysis results

To meet the third research question of the study, we chose the statistical method of cluster analysis, and the three clusters were used for the clustering parameters. These three clusters were found to be the best solution option. According to Rezankova (2007), the algorithm of non-hierarchical cluster analysis *k*-means assumes that clustered objects can be understood as points in Euclidean space, and the number three of clusters is pre-determined. The following results in Figure 1 show the clustering for the partial competencies of problem-solving, creativity, innovation, information and communication technology abilities, effective communication, collaboration, lifelong learning, motivation and peer support.
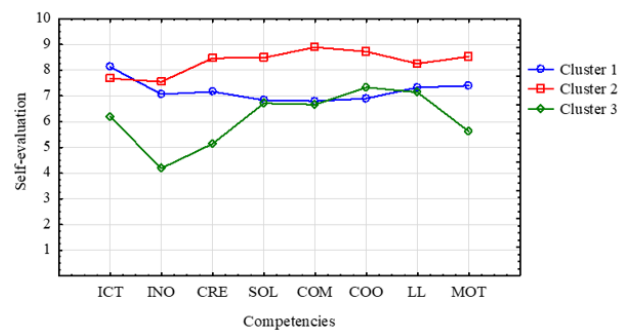

Fig. 1. Cluster analysis of the leadership partial competencies (based on cluster centres)

Notes: creativity (CRE), cooperation (COO), effective communication (COM), innovation (INO), lifelong learning (LL), solving problems (SOL), information and communication technology abilities (ICT) and motivation and support of others (MOT)
Source: own research

Figure 2 shows an overall representation of respondents' characteristics of the clusters. A high rating of partial competencies for leadership is evident for the top managers from the age category 31–40 years. The average evaluation of partial competencies (especially

the ICT competency) is noted for the middle management with the dominance of 21–30 years old respondents. A lower rating of partial competencies for leadership is evident for administrative workers from the age category 51–60 years.
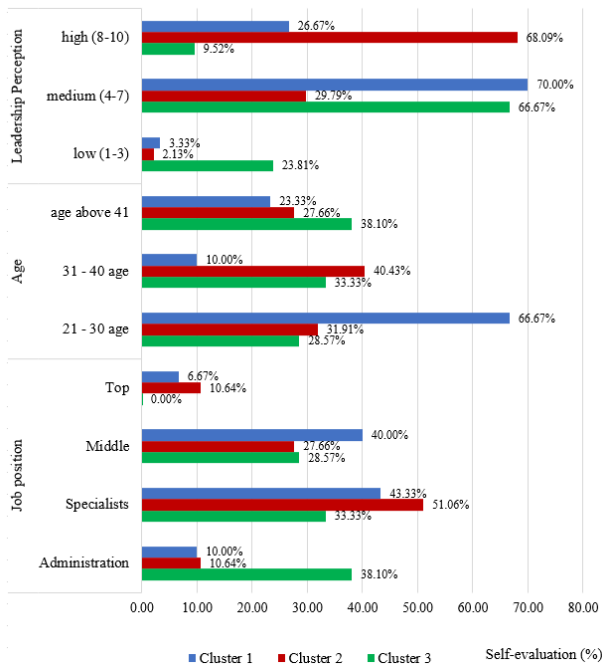

Fig. 2. Cluster analysis of the leadership partial competencies (based on cluster centres)

Source: own research

An exciting result shows that administrative staff are not closely linked to the leadership competency as top management, middle management and professionals, who are closer to leadership competency during their professional life. The older generation over 41 years of age with a length of work in the organisation over ten years tends to leadership competency more than the younger generation aged 21–30 years.

Overall we identified three different groups of managers based on the partial competencies self-evaluation. The three groups of leader types had other respondents due to their age, job position, and leadership competency evaluation. Their characteristics are described below.

The first cluster: ICT-oriented junior managers.

The partial competencies were perceived to be at an average level in cluster 1. This first cluster contains 30 cases and shows the high evaluation (mean = 8.13) of respondents in the ICT competency (Figure 2). Other values are averaged (mean values be-

tween 6.80 and 7.40). The 1st cluster includes 40% of middle management (Figure 2). It appears that there is not much preference for any of the partial competencies in the requirements at the middle management level. The higher ICT level may be related to the fact that there is now more pressure to use digital technologies also for management processes. The dominance of the 21–30 years' age group of 66.67% in this cluster is also evident (Figure 2). Young managers are more likely to use technology to support teamwork (e.g. MS teams and other applications for effective communication, collaboration. etc.). These employees are ICT-oriented junior managers.

The second cluster: top 4.0 prepared leaders. The second cluster contains 47 cases and is an above-average rating (mean values between 7.55 and 8.89) in most Leadership competencies (Figure 2). In cluster number two, the ratings of the partial competencies were rated above average. The representation of top managers is 10.64% (Figure 2). It is the most significant number compared to the other clusters. The 31–40 age group has a more excellent 40.43% representation (Figure 2). This group is assumed to be more cooperative and master effective communication. These managers are perfect top 4.0 experienced leaders for the future.

The third cluster: non-creative unmotivated senior directors.

In cluster 3, there are people with a lower rating of leadership competencies (values between 4.19 –and 7.33). Especially innovation (mean = 4.19), creativity (mean = 5.14) and motivation (mean = 5.62) have very low level of perception. The third cluster contains 21 cases and shows a weak assessment of the competencies of innovation. Creativity and motivation of others (Figure 2). The 3rd cluster includes 31.1% administrative workers and 9.52% aged 51–60 years (Figure 2). The third group has an interesting result. The older generation predominates, and the rating of leadership competencies is lower than in other groups. We call these managers non-creative unmotivated senior directors.

Conclusions

Nowadays, it is crucial to reflect managers' competencies that should they develop to succeed in meeting future challenges. This paper examined the perception of managerial competence leadership and its partial competencies characteristics and determinants in the fourth industrial revolution era.

In answer to the first research question of the paper, we formulate the literary consideration of partial competencies for leadership competency. We characterise the partial competencies for leadership, which according to research (Hecklau et al. (2016); Vrchota (2019); Liboni et al. (2019); Bogoviz et al. (2019); Kinkel et al. (2017) include effective communication, collaboration, creativity, innovation, information and communication technology abilities (ICT), problem-solving, lifelong learning, and motivating and supporting others.

To answer the second research question, the hypothesis was established to meet the statistical objective of the paper for specific characteristics of competency leadership. We found that managers differ according to age, length of work in the organisation, and type of education. For these characteristics, coefficients were further investigated by linear regression. The linear regression indicates statistically significant job positions in the organisation, technical, science and medical field of education and age over 41 years.

The statistical research in partial competencies is concluded in the results by the cluster analysis to answer the third research question. We identified three leaders' types that are currently facing the challenges of Industry 4.0: ICT-oriented Junior Managers, Top 4.0 Prepared Leaders, and Non-Creative Unmotivated Senior Directors. Especially the last group of leaders can be a hindrance and barrier to the future competitiveness of companies. The cluster analysis of respondents' perceptions suggests that the highest self-evaluation for leadership prevailing among the older generation from top managers. There are two groups of respondents in the older generation. First, leaders who are inclined towards leadership and whose career growth is conducive to top management positions. Second, senior un-motivated managers who do not plan develop further and are not inclined towards leadership.

The new leader will have the opportunity to advance the new vision. Kotter (1996) argued: "that shared sense of desirable future can help motivate and coordinate people of actions that create transformations". Due to Dionne et al. (2012), the business and social landscape suggest new substitutes for leadership, such as advanced artificial intelligence and robotics systems, will emerge in leadership research. As in other research areas, older leadership methodologies should be modified and enhanced by newer methods and statistical tools for testing new approaches to leadership. We agree with some statements of the study Yammarino (2013) that there remains more to be done and beyond for leadership research in the next decade as more empirical studies

of Leadership 4.0. Especially a better understanding of the cognitive-emotional interface in leaders and for leadership and complete development of multilevel issues in leadership theory, concepts, construct usage, relationships, measures, data analysis and inference drawing.

Recommendations for theory and practice are visible in the development of the leadership and the resulting continuous management education. The research provides new insights in the theoretical area of the definition of Leadership 4.0, or which competencies leadership develops and are essential for leadership. The question remains how to motivate managers for effective performance effectively. This research is suitable as the proposal for comparing leadership competencies in the Czech Republic and abroad. In the case of foreign study, it is appropriate to specify the individual characteristics. An objective data for less developed countries and for more developed countries can be taken into account for future research. We agree with Yammarino (2013), who finally adds that leadership is now more typically a leader-follower interaction process rather than solely focusing on the leader as the primary locus or source of leadership. But this interactive process view still requires additional work to understand the processual and dynamic nuances involved. As in all research areas, older leadership theories will be replaced by newer approaches for further testing.

Acknowledgments

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