THE SHADOW ASPECTS OF CRITICAL THINKING FOR LEADERSHIP, SOCIETY AND INDUSTRY 4.0

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Abstract *- The text focuses on selected aspects of critical thinking in the context of leadership in a modern security environment, from the point of view of selecting and preparing professionals and leaders. It discusses, in particular, the changes in the professional quality requirements related to the development of industry and society 4.0 as well as selected situational and systemic contexts in which the critical thinking applies in the process of cognition, decision making, and action of professional leaders.*

Keywords - INDUSTRY AND ENVIRONMENT 4.0, COGNITIVE CONTINUUM, COGNITION, RATIONALITY, INTUITION, CRITICAL, SITUATIONAL AND SYSTEMIC THINKING.

1. Introduction

The article discusses the area of critical thinking and selected personality aspects in relation to the characteristics and expectations of the development of a modern environment in the form of society or industry 4.0. It presents partial aspects of the complex analysis carried out for the preparation of a pilot project focused on the selection and preparation of professionals and leaders for the pursuit of activities and functions of security character in conditions of a modern environment. The first part deals with the characteristics of modern environment, in the second part we discuss the requirements for professionals and leaders, in relation to critical thinking. In the third part, we highlight the specific aspects related to the selection and preparation of professionals.

The purpose of the analysis and the research was to create background documentation for a pilot project aimed at the complex identification of the level of natural potential of human competences and the natural methods of their cultivation for professional action and leadership in the environment 4.0. Environment 4.0, or Industry 4.0 or "Revolution 4.0," is an environment characteristic of which are trying to address various initiatives responding to what is called the Fourth Industrial Revolution. Environment 4.0, or else Industry 4.0 or "Revolution 4.0," is an environment whose characteristics are trying to address various initiatives responding to what is called the Fourth Industrial Revolution. An example of this may be the German initiative of 2013, called Industrie 4.0, or the Industrial Internet Consortium or the Smart Manufacturing Leadership Coalition in the USA or similar projects and programs of Japan and China. All of them emphasize an entirely new philosophy of system usage, integration and interconnection of various technologies with the dominant role of information and communication technologies, considering their sustainable and fast development. This "brand new" philosophy in a number of its supporting characteristics corresponds to the implementation of the NATO Network Enabled Capability (NNEC) concept, i.e. the warfare with the use of modern information and communication technologies, which we have been focusing on since 2006, in the context of optimizing quality and human factor potential. It identifies and develops the qualities and competencies of professionals, leaders, and teams to pursuit functions and activities in such organized conditions and circumstances of missions, situations, and tasks in the security environment. In connection with the "National Industry 4.0 Initiative" prepared by the Ministry of Industry and Trade of the Czech Republic[1] in 2015, and taking into account the features of the so-called Revolution "5.0", emphasizing artificial intelligence, we consider useful to contribute with our experience and knowledge to the evolving debate and express willingness and openness to cooperation.

2. Analysis of Characteristics of Environment and Requirements for Individuals

Human Systems and Their Management. The environment that we create as human beings with specific ways of life in different communities is changing and transforming more dynamically than the natural environment. In relation to these changes and transformations the requirements on the quality and capabilities potential of the professionals and leaders, i.e. people who pursuit specific functions and activities related to the organization and management of human systems, are changing either. The environment created by people in the process of human community development has approached the parameters of the unstable environment due to various specific changes and transformations (modern information technologies, globalization, etc.). We identify the characteristic aspects that are indicative of this approach in several areas:

I. technologies, their development, and application
II. relationships and their development
III. thinking, cognition, and information

A partial summary: In terms of the natural potential of human resources in the 4.0 environment, the most significant is the problematics of digitalization of information, artificial intelligence, virtual reality, and mediated communication. All these aspects have, besides undisputed direct and obvious advantages and positive effects, also secondary and asymmetric, hidden or shadowed, complex and nonlinear influences and effects on the psychical condition, mind, and thinking of individuals or communities. The shadow effect of digitization and mediated communication is recorded in two modalities. The first suggests that their excessive use gradually transforms the quality of self-consciousness in the full sense of the term. The second effect associated with the growth of digitization, algorithmization and artificial intelligence is the reduction of intuition and analogy in cognitive processes and the creation of knowledge for decision-making and action in a particular situation, and a reduction in spontaneous adaptability to changes in the conditions and circumstances of task situations.

2.1. Systemic (ecological) and Situational Mobility

Systemic (ecological) mobility refers to the environment, and is characterized by the ability to stay in an environment with predominantly artificial characteristics and in environments with predominantly natural characteristics as well as in professional and collaborative environments. Situational mobility is shaped as

1 Available at http://www.businessinfo.cz/cs/clanky/narodni-iniciativa-prumysl-40-71386.html#!&chapter=3

proactivity in the adaptability of changing conditions and circumstances.

2.2. Mobility in Relationships

This mobility includes social and organizational mobility. It is manifested on the social continuum (individual vs. team member), on the organizational continuum (hierarchical vs. network organizational structures) and on the management continuum (management/ leadership).

2.3. Mental Mobility

It represents the thinking in terms of the ability to generate knowledge for decision-making and action in the process of fulfilling the task and its most effective management (energy / least demanding way of performance).

Mobility on a cognitive, ecological, situational, social, and organizational continuum requires, in the end, a change of the attitude of each team member (the individual), in favor of personal self-development and self-fulfillment, individual development and cultivation of natural potential in the profession and position (Ambrozová, et al., 2016, Koleňák, 2015). The above-mentioned trends and requirements for the level of quality potentials of individuals and human systems require an upgrade in understanding the terms of management and leadership. They also need new approaches to identifying and developing the resources, potentials, and qualities of professionals and leaders operating in the current environment.

3. Critical Thinking

The definition of the content and meaning of the term of critical thinking is accompanied by considerable variations. Critical thinking, as the specific quality of thinking for decision-making and action of people in various situational conditions, is sometimes ranked among key competencies for the 21st century. It is a necessary skill to pay attention to in educational and training systems, especially in higher education settings. The International Panel of Experts in 1990 formulated critical thinking as follows: [Critical thinking is an efficient, self-regulatory reasoning the result of which is the interpretation, analysis, evaluation, and derivation, as well as the explanation of the obvious conceptual, methodological, contextual justification on which the reasoning is based on.[2]]

The etymology of the word critical shows that the root of the word krinó means to judge and relates to judgment, reasoning. Critical thinking is a skeptical thinking, i.e. exploring, perceiving thinking. Skepticism, skeptical, critical, because conjectural thinking has characteristics of subtle skills including openness; distance (neutrality and impartiality); mobility (in and out of the situation as well as stay in the gap); skepticism (skeptical, exploratory thinking, allowing to formulate reasonable doubts - questions, and putting forth reasoned arguments that distinguish simple idea from an opinion). The critical, because skeptical, inferring thinking has the characteristics of subtle skills (Ambrozová, et al., 2016), i.e. it contains openness; requires distance (neutrality and impartiality); the mobility on the cognitive continuum[3] and under the circumstances and conditions (in and out of the situation, as well as a stay in the gap); it produces reasonable doubts and arguments, allowing to distinguish a view from an opinion. These are the qualities of thinking that each professional and leader should acquire for situational, tactical, operational (project) or strategic decisions.

It turns out that the essence of critical thinking in different task situations is always the distinction, the analysis and synthesis, and at the same time the assessment of similarities and observation, which allows insight into the situation of the task or overview of the whole situation and the environment. The insight and overview represent the aspects related to professional intuition, which is often considered as an opposite to the logic and analysis, or as its complementary, additional aspect in the whole process of thinking and cognition. Critical thinking is flexible, as shown by K. R. Hammond on the model of the cognitive continuum. The demand for mobility shows that it is necessary to free the critical thinking from the domain of formal logic and rationality and to place it in the area of reasoning, closer to the concepts of wisdom, knowledge, or quasi-rationality according to K.R. Hammond, as for instance P.M. Senge (2016) or Cognitive Management (Ambrozová, et al., 2016) do.

This allows thinking as a process to be better applied not only in linear tasks but also in all forms of heuristics (both by Hammond[4], and Kahneman[5] or other authors), or tasks requiring decision-making under uncertain conditions, permanent changes and transformations, or due to random processes, etc.

One of the possible versions of the positive operationalization of critical thinking, as the quality or ability that every individual, who has the right to lead other people and human systems should possess, is as follows: [Critical thinking is an individual's ability to create optimal conditions for correct judgment in a situation and a task that manifests itself in the mental mobility. The mental mobility saturates the following measurable parameters:

A) Cognitive variability and mobility between analysis and intuition[6]
B) Skeptical curiosity[7] and courage[8], openness and spontaneity of learning.
C) Psychophysical condition in terms of stability of quality and quantity of performance of psychical functions in time (attention and memory).] (Ambrozová, et al., 2016)

Critical thinking plays a dominant role in terms of situational and systemic leadership and is manifested as the mobility on a cognitive continuum. The central concept of the cognitive continuum is a quasi-rationalist (Kostroň, 1997, Hammond, 2000), which represents an adequate presentation of analysis and intuition, as modalities of cognition, for a specific situation and task. The pre-concept[9], often an individual's unconscious opinion, experience, cognitive model, methodical procedure or stereotype, from which

2 See www.insightassessment.com/dex.html.

3 Involves both the systemic and concrete thinking reflected and manifested in the entire conditions of cognition, decision-making, and action (tactics and strategy) as well as the mental mobility on the continuum of analytical-intuitive.

4 K. R. Hammond (2000) suggest the heuristics as tasks with multiple variations of solutions, i.e. offering more than one correct solution.

5 Kahneman suggests the heuristics as cognitive and decisive „shortcuts". „…simple procedure, which facilitates the search for adequate, even if, frequently incorrect answers to complex questions. The term originates from the same basis as the famous heuréka". (Kahneman, 2010, p. 28-41; 2012)

6 Includes the ability to simultaneously visualize the whole and the insight in terms of fine and precise detail resolution; both concrete (positive) and abstract thinking; work with similarities, differences and relativity. Cognitive variability refers to the quality of a professional, not an expert insight, and refers, for example, to the ability to pragmatically, situationally create
a "meta-method" for cognition in a current task (whether from familiar elements and principles of methods (innovation) or to create, "discover" a new one. There is a continuous relationship (continuum, transition) between the intuition and analysis resulting in the usage of the term of cognitive continuum theory. In the sense of an adequate way of cognition in relation to the situation of a task, the transition can also be referred to as the "common sense" or by K.R. Hammond as quasi-rationality.

7 Skeptic in the sense of exploratory, conjectural thinking, including distance, neutrality, and impartiality allowing to formulate reasonable doubts and to put forward reasoned arguments that distinguish the simple view from the opinion.

8 In the sense of exceeding the task, context within time, space, and conditions; think the „un/thinkable". (Taleb, 2011).

9 The basal pre-concepts can be divided into natural (reflective) and acquired (in a social and professional setting).

the individual examines, recognizes and acts, is also reflected in the preference of ways of cognition and the effectiveness of decision-making and action. This "inner attitude" supports also a different self-concept under the conditions of the situation, the relation to the environment, the situation and the task as well as the different ways of perception and cognition, decision-making and action. The importance of truly critical thinking in leadership for decision-making in challenging conditions, complex and dynamically changing conditions is increasing for a number of reasons. As mentioned above, these reasons include both quantity and availability of information and knowledge, as well as their timeliness and reliability, validity. For example, the rate of obsolescence of information and knowledge is so high that the ability to create own and "fresh" information and knowledge significantly influences the potential success of decisions in different situational contexts. Similarly, the amount of information (related to cognitive optimum) is important in decision-making, and the ability of rapid, fine, and precise differentiation, falling more into the domain of insight and professional intuition, is a highly valued skill (Cejpek, 2005).

4. Results and discussion

The results of the environmental analysis suggest that the importance of mental condition and cognitive potential for critical thinking is growing, and it turns out that the quality of mind, thought, and knowledge of a particular individual is a common element or a central quality, potential and competence involved in all other competencies. This mental "vitality", as a central quality, has at least two modalities.

The first modality involves critical thinking; mobility on the cognitive continuum and optimal condition of mental functions involved in perception and cognition. The other modality can be considered as a mental mobility for decision-making and action in situations and tasks. Dominant characteristics of this modality are spontaneity (openness, curiosity, and courage) and flexibility (flexibility of thinking). The aspects of the first modality can be traced to a certain extent by various tests that measure the quantity and quality of performance of psychical and executive functions. The other modality level can be analyzed with the help of selected personality aspects that are identified by the different methods of personality questionnaires. Critical thinking as the mobility on a cognitive continuum, concerns both the functions and capacities involved in cognition for correct decision-making and effective action in the situations and the personality, in terms of the inner environment of individuals who evolve in this environment or are temporarily present within. In the concepts of analytical psychology of C.G. Jung and with reference to the concept of K.R. Hammond it is the finding of the state of balance of tension between the maxima of the cognitive continuum in relation to the requirements (conditions and circumstances). In situations, where the environment, by its characteristics, prefers forms of perception and models of cognition, linked to the digitization of information, mediated knowledge and communication, to algorithmization of "smart" technologies as well as artificial intelligence, there is a risk of loss of mobility, which is reflected in rigidity, standardization, and stereotyping, as well as non-cultivation, non-development, and thus the emptying of the natural qualities of abilities, or the shadowing of those natural ways of cognition, which relate, for example, to intuitive and analogical thinking functions that relate more to the logic of discovery than to the logic of reasoning (Alleau, 2008, p. 39).

A shift in this area may indicate not only the differences in the ability of professionals and leaders to move in solving various specific situations in the selection and preparation process as we have seen in recent years but also in partial changes in selected indicators that are related to this mobility. The selection and preparation practice shows some trends of change that need to be adapted to the selection and preparation methods. The selection and preparation practice shows some trends in changes that need to be adapted to the selection and preparation methods. Therefore, it must reflect not only the changes in the requirements of the environment but also the changes in the qualities of abilities of those who want to apply with the professional environment as well as those who already work in it. A possible hint of these changes may be partial shifts in preferences as indicated by the following results.

These are groups of professionals and leaders operating in the security environment. The first group consists of 115 people monitored for their quality of skills in the course of 2014 and 2015. The other group consists of 127 people from the same environment where these qualities were surveyed in the course of 2017 and 2018. For the purpose of the article, indicators of selected global scales were applied using the GPOP method (Bents, Blank, 2009). In the table, we present aggregate values in the form of averages and standard deviations.

Table 1: *GPOP aggregate values indicators of selected global scales in the form of averages (AVG) and standard deviations (SD).*

2014-2015	**S**	**N**	**T**	**F**	**J**	**P**
AVG	6,1	6	6,6	6,1	6,6	5,4
SD	1,7	2	1,9	1,8	2,4	1,8
2017-2018	S	N	T	F	J	P
AVG	7,1	4,3	6,5	5,1	7,9	3,8
SD	2,9	2,4	2,4	2,1	2,9	1,7

The function of sensory perception (S) and intuition (N) are functions called irrational functions as they do not evaluate but are dependent on the act of perception. The preference of functions in terms of perception as information sources affects cognition and decision-making in various task situations.

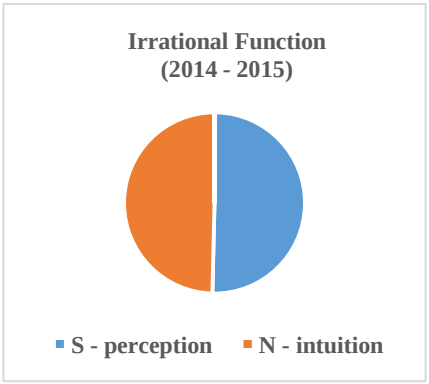

Fig. 1: *The preference of irrational perception functions as information sources; years 2014-2015.*

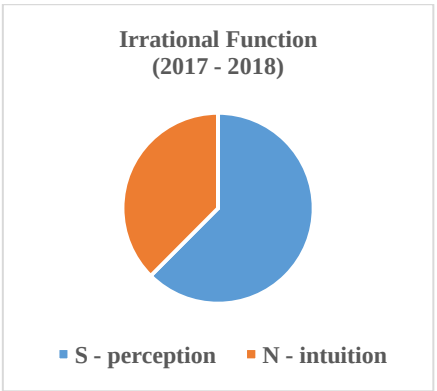

Fig. 2: *The preference of irrational perception functions as information sources; years 2017-2018.*

The functions of Thinking (T) and Feeling (F) are called rational as they allow rational evaluation of experience, information processing which reflects into a decision. Thinking "says" what a thing, an object, is, and usually works with facts, formal logic and the logic of reasoning, analysis, and synthesis. Feeling "says" what value a phenomenon, a thing has, it works by analogy, relationships and meaning.

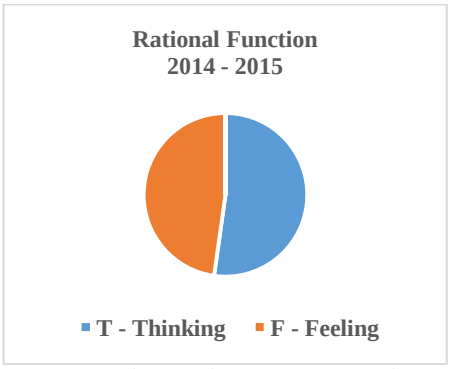

Fig. 3: *The preference of rational perception functions as information sources; years 2014-2015.*

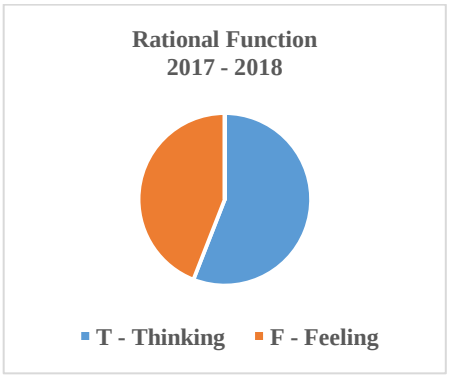

Fig. 4: *The preference of rational perception functions as information sources; years 2017-2018.*

For the correct situational and systemic decision-making, it is important to what extent the various cognitive models are involved in its constitution, creation, whether it is predominantly logical, factual or of a value. In general, the preference of a mode of cognition, decision-making, and action is growing and influenced by the coherence, positivist, direct, and rational thinking that prefers analysis and linear causality, developing and working with formal logic in language and mathematics. This is a modus from which the potential of digitization, algorithmization, artificial intelligence, mechanization, technology, and "dataisation" (Harari, 2017) originates. The ways of cognition and decision-making, based on correspondence and analogy, which are the natural "half" of the cognitive continuum of every living, recognizing person, are "receding into the shadows," as well as the potentials of the ability of analogous thinking, cognition, decision-making and action, based on the concept of correspondence, offer and enable.

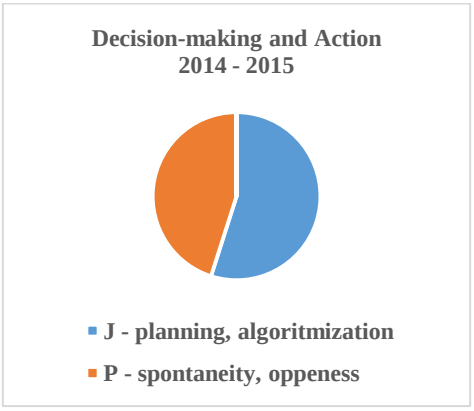

Fig. 5: *The preference of decision-making and action; years 2014-2015.*

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Fig. 5: *The preference of decision-making and action; years 2017-2018.*

Further features affect what the individual, in terms of decision-making and implementation, prefers, whether the plan, a goal, a structure, and procedure of algorithm or process and spontaneity. It turns out that the preferences of decision-making orientation related to algorithmization and planning have increased significantly, and the preferences of spontaneity, creativity, and openness to opportunities that are the basis for successful solutions to complex and complexly evolving situations and processes as well as heuristics has decreased.

5. Conclusion

The above results serve only as illustrations and suggestions for reflection. They correspond to our "intuitions"

and "feelings and insights" of the professionals involved in the selection and preparation, as well as to the need to innovate and adapt the methods of preparation and verification of results to changes in population and environment. Experience shows both the need for a comprehensive, multidisciplinary approach to identifying the qualities of their potentials and the need to incorporate elements that enable support, training and development of various aspects of critical thinking in favor of mobility on the cognitive continuum. This issue is being focused by the complex project, the program, for the preparation of which we used the analysis and the pilot study, from which we have chosen and presented only partial aspects.

The requirements of an environment and a situation for the pursuit of activities and functions are constantly evolving and changing. From the nature of the changes and the characteristics on their background, the basic features of the quality requirements and competencies of individuals in professional systems and environments are formed. These requirements, in various aspects,

emphasize the mobility, consistency and "adaptability" of the thinking process of every person who is involved in some way in the organization, management and leadership within human systems, from the "lowest" levels, with the direct practical consequence (task situation) to the highest" levels representing systemic, strategic decision-making and action.

The professional security environment is currently more structured, in terms of preferred cognitive models, due to the digitization and use of modern and sophisticated communication and information technologies. However, the situation of specific tasks or missions is far more complex and requires professionals and leaders to have mental fitness and mobility on a cognitive continuum.

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