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ARTIFICIAL INTELLIGENCE METHODS IN PREDICTING THE PRODUCTIVITY OF PROJECT TEAMS: TRANSHUMANISM AND EXPERIENCE IN PRACTICAL RESEARCH

Abstract

The article considers issues related to the use of artificial intelligence methods in the technoscience concept while moving from personnel management to human resource management using artificial intelligence elements. Authors consider the development of human resources at the expense of cognitive-communicative resources of personnel in specific (transformed) conditions of consciousness when a synergy of neurocognitively enhanced human capabilities and artificial intelligence occurs. Such situations are considered in predicting the productivity of project teamwork, characterized by various aspects: organizational, cognitive-communicative, socio-psychological, etc. It is analyzed a specific example of predictive analytics related to the assessment of future results of newly created teams (shift teams) and results that are corrected based on already existing teams (V. K. Finn's DSM-method of automatic hypotheses generation, as a way to organize knowledge using the non-Aristotelian structure of concepts, 2009). Some difficulties of using the shift form of labour organization are considered. The methodology for predicting the teams' assessment is based on the results of express diagnostics of their work on specific test cases and the general database of characteristics and results already existing successful and unsuccessful teams.

Keywords: human resource management, teams, shift teams, team characteristics, predictive analytics, artificial intelligence technologies, DSM-method of plausible reasoning, operationalization and quantification of parameters.

Introduction

Management and improvement of the use of human capabilities, based on the methodology of self-development and complexity, becomes a pivotal incentive to activate the transhumanism concept (N. Bostrom, R. Kurzweil, V. Winge, H. Arend, etc.), where the transformation of science is determined by re-direction from cognitive activity to the projective-constructive activity of technoscience. In technoscience, the truth is replaced by the 'technological efficiency' concept, and knowledge can be considered a project activity. Designing becomes a model of cognition. However, the goal remains the same - cognition of reality by thinking.

Currently, two sciences are most actively engaged in improving the thinking efficiency as a cognitive practice: cognitive science and neuroscience, divided into two components: neuroscience and neurotechnology. Neuroscience studies the brain and nervous system. Neurotechnology solves practical things. Such technologies are focused on understanding the human brain's neural structure and activity that read and control neurons.

In turn, the study of cognitive technologies (artificial intelligence, machine learning, Big Data and Big Live Data, etc.), as technologies focused on managing the cognition processes, lear-

ning and communication, makes it possible to optimize meanings formation using various phenomena of perception (peculiarities of feelings, configurations, constancy, reference systems/ subjective scales, objectivity and attitude) and logical-heuristic methods (brainstorming, synectics, lateral thinking, TRIZ, etc.) (Kholodnaya, 2004). The synthesis of cognitive and neurotechnologies will allow (creates conditions) to increase the efficiency of thinking and, therefore, the efficiency of the modern economy that entered the era of new forms of human resource management. The simplest way to reach this goal will be using parameters in cognitive technologies based on the results of applying neurotechnologies, for example, medical research, electroencephalograms, cardiograms, tomography, etc. Based on this, it is necessary to rethink the theory and practice of work with personnel, including the organization of project teamwork. Besides that, these goals should be solved in conditions of modern reality. Western and Russian studies say about the final transition to the VUCA world, conditions of which were considered by the authors as a characteristic of the environment (Kraev & Tikhonov, 2019; Runsten & Werr, 2020; Fedotova, 2018; International trends in personnel management, 2020).

The Issues of Teams' Formation

A number of HR specialists believe that one of the most priority areas will be the management of changes in teamwork (International trends in personnel management, 2020; Runsten, 2017) and, first, the change of human resources itself, both external (the use of exocortex, neural network HTTP 2.0 protocols and biological feedback, active cooperation/symbiosis with artificial intelligence, etc.) and internal (development of engagement and meta-competencies, first of all cognitive-communicative, the use of more complex multi-focus logical models of the reality description, visual thinking technologies and system analytics, that take into account dynamic complexity and network hierarchy of problem situations in the mode of initiality and self-building) (Belbin, 2003). Among the most actual goals of personnel management with the use of artificial intelligence for the issues of team management, these should be highlighted: considering new requirements related to dynamics of career and educational trajectories of teams; the need for mobile cognitive selection that considers psych emotional contacts and neurophysiological features; active learning, first of all, meta-competencies in real time and on a regular basis; creating a systematic "positive" employee experience for an employer brand; developing HR platforms that have analytics functions, including predictive one; new leadership – 'digital leader' and transform-teams in symbiosis with artificial intelligence resources (Fedotova, 2019); the development of cultural diversity and equal opportunities; open talent economy; robots, cognitive computing and artificial intelligence (International trends in personnel management, 2020).

Such work with personnel is considered in the conditions of transition from target management to attributive design, and cognitive-neuro-communicative resources of a team in specific (transformed) conditions of consciousness are considered a specific resource condition. There is a simultaneous parallel equivalent development of both the person itself, the person's capabilities (first, cognitive and communicative), and the development of the artificial intelligence use, including in collective teamwork, as an additional cognitive element. The critical element of this transition is the generation of the team's unified creative field and the management of parameters that characterize the deep models of team behaviour.

Considering the issues of transhumanism in the context of team formation, it is necessary to pay attention to some aspects. The authors are adherent to the moderate transhumanism, believing that a person has a desire to improve and develop his abilities and capabilities, but boundaries and goals of development should correspond to ethical principles (Sandberg, 2014; Diéguez, 2020; Hofkirchner & Kreowski, 2021; Tikhonov

& Novikov, 2020; Vorontsova, Arakelyan, & Baranov, 2020).

The development and improvement of human abilities in the formation of teams occur due to various factors: selecting employees according to professional competence and psychocompatibility, evaluating medical indicators, considering mode peculiarities of working a team and individuals, training, forming culture and values, the use of psychotechnics, etc.

In fact, in forming a team, network structures are created. They use each participant's strengths and neutralize weaknesses by training for the goals of a project and an organization; interchangeability and complementarity in professional goals and others are formed. It makes the team a more stable structure than an individual and increases reliability in working with people. However, on the other hand, there is a serious impact on a person. Group effects should be remembered, which have both positive and negative consequences. Among others, conformism (from necessary acceptance of group rules to extreme forms of personal viewpoint loss and following to the group opinion), social laziness (from saving energy to shifting their tasks to other team members), and others may occur. Some issues should be considered as well. Is it ethically to work with medical research of employees (encephalograms, tomography, etc.) and to use particular medicine and simulators, for example, to increase productivity (from VR simulators to the use of psychotechnics and medications)?

This article is based on research conducted in 2020 at one of the largest non-metallic mining companies in the Moscow region with more than 500 employees. This research aimed to develop and verify a methodology for predicting the productivity of newly created or modifying shift teams based on an existing database of facts, including assessing efficiency and socio-psychological, organizational, neurophysiological, technical and technological parameters that characterize the work of shift teams. Some problems of organizing shift teams are well known. These are: long isolation from home and family, not well-organized delivery to the workplace, overcoming long distances, changing time zones and climatic zones, etc. (Davydova, 2008). Besides that, studies show additional requirements for forming shift teams: psychological compatibility of workers, stress resistance, coherence and stability of relationships, etc. (Lobova, Loginov, & Koveshnikov, 2014).

As a rule, various mathematical methods are used to model teams' management processes, first, regression and cognitive modelling methods [website: IPU RAS - Sector 51 'Cognitive analysis and situations modelling']. Methods of mathematical statistics are not well suited for such tasks (Finn, 2015). To overcome these limitations, it is proposed to use artificial intelligence methods because these methods allow extracting knowledge from disordered and unformalized data in explicit form, using various formal procedures. However, before applying the methods, the mentioned knowledge was hidden among massive facts in the database.

For practical use in tasks of forecasting the efficiency of shift teams, it is proposed to use DSM-method of automatic hypotheses generation - a logical-combinatorial (non-statistical) method based on the use of mathematical logic and intended to analyze dependencies between the combination of features and desired effect, which is the productivity of shift teams in our case (Anshakov & Fabrikantova, 2009). Shift teams are presented as a structured set of organizational, socio-psychological, and other characteristics. At the same time, characteristics can be represented by both nominal and interval scales. This only requires adequately representing such data and determining the similarity operation for decisive predicates of the DSM method.

Predictive analytics is the most actual goal. It is the assessment of future efficiency of the newly created team based on express diagnostics of work with micro-projects (from 2 to 5 days) in the format of an organizational and activity game, in which successful and unsuccessful team's results are compared to the previously created database of factors. The result of such a

task is probable since the newly created team (collected shift team) is evaluated. The task is solved by the DSM method of automatic hypotheses generation of V. K. Finn, using induction, analogy and abduction. DSM-method is a means to organize knowledge based on the non-Aristotelian structure of concepts (extensions of G. Frege's triangle to the corresponding quadrangle that implements procedures for generating a specific extensional employing an intentional) (Finn, 2015). The mathematical formulation of the DSM method is given in (Anshakov & Fabrikantova, 2009).

A similar method was already used in practical studies of teamwork management conducted by authors (Prus, Fedotova, & Bin, 2018; Fedotova, 2019). Using the formulation of hypotheses, the task was to determine the initial matrix of objects (teams representing structural divisions of a regional administration and university students in 2011, etc.) and their characteristics. The presence of property-characteristic was evaluated by experts on a five-point scale (various types of scales are possible). Experts accepted the following conditions: 1. from 0 to 2, and the team does not have the property, 2. more than 3 - it has, 3. from 2 to 3 - the evaluation of the property is ambivalent. Various technologies were used: from exact scalar estimates, for instance, statistical concordance coefficient, to complex vector estimates (probability density, using, for example, "soft" calculations) (Saati, 2008).

Possible reasons for the presence/absence of a productive feature (for example, a team's success) may be various combinatorial subsets of properties. Subsets of properties are all possible permutations of properties of successfully working objects/teams. At the same time, two points are fundamental:

1. Accurate socio-psychological operationalization of used teamwork parameters (operands formation) based on the chosen language for describing the problem situation and the theoretical concept that links operands with the goals of research (in our case, it was the concept of socionavigation) (Fedotova, 2018).
2. The correct presentation of qualitative estimates in the form of quantitative values (quantification process) is necessary. In this case, the quantitative estimates/interval of estimate correspond to the presence, absence or inconsistency of properties of objects matrix and their characteristics.

The Experience of Practical Research in the Formation of Teams

In the research conducted by the authors, the methodology of rapid assessment of newly created teams (shift teams) was developed and tested based on their comparison with the fact base, which includes the results of actual successful and unsuccessful shift teams. In our case, the fact base included 18 object-shift teams. The list of the teams' properties included 12 parameters/ characteristics (X) reflecting various aspects of shift work.

The initial values of expert evaluations of teams' parameters are shown in Table 1. Teams No. 19, 20 and 21 were considered additionally (the calculation of their efficiency was skipped). It was necessary to make decisions on their correction and predict their future efficiency.

Table 1.

The Initial Values of Expert Evaluations of Teams' Parameters

Team number	Team efficiency	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12
1	1	4	4	4	4	4	4	4	4	3	4	4	4
2	-1	4	2	2	2	2	2	2	2	3	2	2	2
3	1	4	4	4	4	4	4	4	4	3	4	4	4
4	1	4	4	4	4	4	4	4	4	3	3	4	4

Team number	Team efficiency	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12
5	-1	4	3	4	4	4	2	2	3	3	4	4	2
6	1	4	4	4	4	4	4	4	4	3	4	4	4
7	1	4	3	4	3	4	3	3	3	3	4	4	3
8	-1	4	4	4	4	4	3	4	4	3	3	4	3
9	1	4	4	4	4	4	4	4	3	3	4	4	3
10	-1	4	4	4	3	4	3	4	4	3	3	4	4
11	1	4	3	4	4	4	4	3	3	3	4	4	3
12	-1	4	3	4	3	4	3	4	4	3	3	4	4
13	1	4	4	4	4	4	4	4	4	3	4	4	4
14	-1	4	3	4	3	4	3	4	4	3	3	4	4
15	-1	4	4	4	4	4	4	3	3	3	3	4	4
16	1	4	3	4	4	4	4	3	3	3	4	4	3
17	1	4	4	4	4	4	4	4	4	3	4	4	4
18	-1	4	4	4	4	4	4	2	2	3	3	4	2
19	?	4	4	4	4	4	4	4	4	3	4	4	4
20	?	2	2	2	2	2	2	2	2	3	2	2	2
21	?	4	4	4	3	4	3	3	3	3	4	4	2

The assessment of the shift team's work included test results: mandatory tests, such as MBTI, MSI (I. Adizes), temperament type, 'Self-perception' - a test to evaluate the variance of the initial intra-team vision of roles (Belbin, 2003). The following was used to evaluate the psycho-functional condition and efficiency of shift workers: to study depressive conditions – 'Zung Self-Ranking Depression Scale'; to identify the level of anxiety – personal and situational anxiety scale, also 'Reader Stress Scale' and medical parameters; to study well-being, activity, mood - the 'Test of differentiated self-assessment of functional condition', etc. (Lobova et al., 2014; Inyushkin, Filatov, Grigorieva, & Bulatov, 2018).

The assessment was done according to twelve parameters characterizing the shift team:

1. The team motivation (X1).
2. The team competence level (X2).
3. The technical equipment level (X3).
4. Staff turnover (X4).
5. The conditions of physical working in the team (X5).
6. Socio-psychological climate in the team (X6).
7. Psychocompatibility (X7) - the result of MBTI testing was compared with parameters that show the presence of conflicts in the team, compliance with the rules of teamwork, communication barriers, etc. Compatibility is a socio-psychological characteristic of a group, expressed in the ability of its members to coordinate their actions and optimize relationships in joint work conditions.
8. The level of team self-organization/self-management (X8).
9. Emotionality/affectivity in the discussion of emerging problems: included the following indicators - simple/complex emotions, positive/negative, inward/outward, and the structure of emotion types (X9).
10. Initiative (X10) - the number of new proposals from team members in the design process.
11. The functional condition of the team (X11) was evaluated as the sum of indicators: well-being, activity, mood, sleep.
12. Psychoemotional condition (X12) - was evaluated as the sum of indicators: depression, situational anxiety, personal anxiety, and psycho-emotional tension (including based

on the results of a medical report).

The parameters X8, X9 and X10 were determined considering the methodology for evaluating the team's organization of thinking and behaviour (Zaretsky, 2011). Calculations were done using the 'DSM method' module of the "TTRP-EUREKA" software complex (Certificate of Official Registration of the Federal Service of the Russian Federation for Intellectual Property, Patents and Trademarks No. 20066-10693).

Based on the assessment results, efficiency was predicted for three teams (the calculation of efficiency was skipped earlier), and recommendations for its correction were given. Recommendations for the development of employees in teams and the replacement of participants should be developed by specialists that, as an option, can include personnel management specialists, psychologists, medical specialists and direct managers of employees (foremen, project managers, etc.).

Discussion

The study contains attempts to combine cognitive science and neuroscience elements, using a set of various parameters-characteristics of teams' assessment. On the other hand, this study is the experience of artificial intelligence using in personnel management. In turn, it can be considered a practical opportunity to compare and evaluate the work success of teams with a certain set of parameters on a stage of these teams' formation with the efficiency of teams that have similar parameters and somewhat experience.

As a result of the work, some questions require further discussion and search for solutions:

1. The complexity of operationalization of proposed initial parameters, first of all, functional (X11) and psycho-emotional (X12) condition of shift teams.
2. The complexity of processing the results of DSM-method of automatic hypotheses generation:
   2.1. a large amount of information (it was proposed to use and analyze video of the teams' work);
   2.2. the complexity of representation and quantification of expert assessments.
3. The complexity of socio-psychological interpretation and secondary operationalization of possible 'causes' for obtained results.

Conclusion

Summarizing the work results, we can draw several conclusions concerning both philosophical and technological components of the formation and the evaluation of team productivity using artificial intelligence elements. Of course, analytical tools, including Big Data and Big Live Data, provide new opportunities for assessing future productivity. Identifying the reasoning for the use and method of calculating the characteristics of teamwork is an important base for using these tools. In fact, we can talk about the need for operationalization and quantification of the new characteristics of teamwork.

Among actual goals of system management of teamwork, it is necessary to specify the following: development of a team management strategy; development of training programs, considering teams characteristics; project work management; team creativity and communication management in the project; competitive certification work for the whole team and building career-educational trajectories of whole teams, teams outsourcing, 'teams exchange'.

The indicators used to characterize teamwork should reflect the most important in the studied processes and, among other things, consider, for example, the reaction to the autokinetic effect, field dependence/field independence, the type of cognitive control, tolerance to unrealistic experience, etc. (Kholodnaya, 2004) and other processes related to the cognitive and communicative activity.

The authors are adherent to moderate transhumanism and propose combining various employee evaluation parameters (combining cognitive and neuro practices) to increase teams'

productivity at the stage of their formation. In this case, it is necessary to consider issues of transhumanism in the network structure of the relationship of people in a group/team and risks and effects that emerged in group forms of work. When making decisions on human resource management and transforming teams, decision-makers in the organization are responsible for human development and ethical issues. All this should be considered in the development of group forms of labour organization since artificial intelligence often offers solutions that finally are taken by people.

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