Influence of Intellectual Infrastructure of Technological Development on the Personnel Management System at Industrial Enterprise

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Abstract. At industrial enterprises the problem of the human resources quality in the field of its compliance with the increased requirements due to innovative development of digital technologies is becoming more and more relevant. This circumstance necessitates a deep rethinking of the management priorities based on innovative development of digital technologies at domestic industrial enterprises. At the same time, managerial interest in the intellectualization of employees as a reproduction process built into the innovation activity increases. Using infrastructure-reproduction approach, the concept of intellectual infrastructure for technological development at industrial enterprises is formed. Its content and purposeful influence on transformation processes and improvement of the personnel management system are revealed. As the central target of such improvement, the management organization of employees' intellectual resources is defined. Its values are determined by the interrelated components of human resources that form the intellectual potential of the personnel. The result is aimed at practical improvement of personnel management at modern industrial enterprises. Methods of system analysis, scientific modeling, as well as economic and statistical ones are used.

1. Introduction
In the conditions of technological transformation due to intensive digitalization modern industrial companies have increasingly become resource-dependent on the intellectual personnel resources. Moreover, at the high-tech level, top management pays more and more attention not only to improve the productivity of live labor, but also use the creativity and knowledge of employees in the innovation project team [1-4]. Consequently, a relatively new management task is being formed to identify and purposefully use the potential capabilities of personnel.

That is, in the technological economy transformation the intellectual personnel resources determine the personnel skill level, forming a core foundation of employee working potential. It becomes paramount and relevant from the point of view of the need for innovative changes aimed at technological development of industrial enterprises [5-7].

Consequently, the growing relevance of human resources and increasing requirements for their quality level require the development and application of more modern approaches to HR management. Moreover, economic entities are faced with the problem of making more systematic changes in the field of HR management, focused on the innovative result of the digital technologies development.
The actual practical need to improve the system organization of HR management in industry causes a conceptual rethinking and formation of new approaches to the management of industrial and production personnel. They involve the comprehensive development of intellectual infrastructure that ensures the balanced reproduction of employees' intellectual resources.

2. Problem statement
The main task of this study is to reveal the conceptual essence and content of the intellectual infrastructure for technological development at industrial enterprises and identify the integration aspects of influence on the personnel management system. The solution of the posed problem allows developing and improving the personnel management at modern industrial enterprises.

3. Research methods
The methods of system analysis and scientific modeling, as well as economic and statistical ones were used. The main types are presented in table 1.
Table 1. Groups of methods for studying the intellectual infrastructure for technological development and its impact on the personnel management system at industrial enterprises.

| Group of methods                        | Research methods                                                                 |
|-----------------------------------------|----------------------------------------------------------------------------------|
| Formalizations of control object        | - decomposition modeling - dividing the studied object into components with their subsequent synthesis in the form of a logical construction; |
|                                          | - morphological analysis - structuring the object by elements and evaluating compositional options |
| Identifications of control subject, object, and content management | - functional and cost analysis that allows choosing the least expensive solution; |
|                                          | - options based on equivalent transformations; |
|                                          | - structuring goals - defining the goal to form an intellectual infrastructure for technological development at the intra-company level; |
|                                          | - decomposition modeling; |
|                                          | - morphological analysis |
| Algorithmization of an internal company organization management | - factor analysis; |
|                                          | - block typing - the linkage of the model block and the original organizational decisions; |
|                                          | - scenarios - justifying possible solutions and their comparative analysis; |
|                                          | - functional and cost analysis; |
|                                          | - decomposition modeling; |
|                                          | - morphological analysis |
| Modelings of management system          | - factor analysis; |
|                                          | - modelings; |
|                                          | - system analysis; |
|                                          | - main components - determining the complex resulting management indicator; |
|                                          | - block typing; |
|                                          | - functional and cost analysis; |
|                                          | - decomposition modeling; |
|                                          | - morphological analysis |
| Formings of tools for management        | - factor analysis; |
|                                          | - options; |
|                                          | - functional and cost analysis; |
|                                          | - scenarios |
| Developments of evaluative tools        | - parametric - establishing a parametric ratio of indicators for the formation and development of the intellectual infrastructure for technological development and its impact on the personnel management system; |
|                                          | - standard and reference, providing for the application of the appropriate system of standards and references; |
|                                          | - quantifications - establishing quantitative certainty in relation to the qualitative characteristics of objects based on the ranking scale |

4. Research results

In various historical periods domestic and foreign researchers have considered many socio-economic aspects of human productive forces, their reserve capabilities [8-10]. The scientific foundation of these issues was laid in the works of the classics on Economics W. Petty, F. Quesnay, A. Smith, D. Riccardo (mid-XVII-early XIX centuries). Subsequently, a significant contribution to the formation of the theoretical foundations of human intellectual resource management abroad was made by R. Barro, D. Bell, G. S. Becker, R. Boyatzis, A. Brooking, T. Buzan, K. Wiig, J. Mincer, J. Naisbitt, I. Nonaka and H. Takeuchi, L. Prusak, P. M. Romer, K. E. Svebyi, R. Solow, T. A. Stewart, A. Toffler, H. Uzawa, J. Fitz-enz, T. W. Schultz, J. Schumpeter, L. Edvinsson, K. J. Arrow, and others.

In Russia, many traditional aspects of personnel management (human resources, person) have been thoroughly studied [11-14]. The study of these problems is associated with the names: T. Y. Bazarov and B. L. Eremin, M. I. Bukhalkov, V. R. Vesnin, N. A. Gorelov, I. B. Durakova, A. P. Egorshin, N. K. Ivankin, A. Ya. Kibanov, Yu. G. Odegov, O. S. Orlov, V. S. Polovinko, T. D. Sinyavets, etc.
Although domestic and foreign theory and methodology on human resource management are represented by quite diverse concepts and approaches, they are relatively little focused on modern problems of human resource management caused by innovative changes in the transforming Russian economy under the influence of digital technologies. Moreover, they do not give a clear idea of the specifics of management problems in the field of personnel intellectualization and ways to solve them in order to increase the efficiency of innovative digitalization processes.

In general, various aspects of the personnel intellectualization (enterprises) attract the attention of many researchers in Economics and management when understanding the economic phenomena generated by modern socio-economic transformation and the increasing role of intellectual resources, and, in particular, of personnel intelligence (table 2).

Table 2. Various aspects of intellectual infrastructure research for technological development.

| Field of research                              | Aspect of research                                                                 |
|-----------------------------------------------|-----------------------------------------------------------------------------------|
| Post-industrial society and innovative economy | Intellectualization of society.                                                  |
|                                               | Intellectualization of the economy                                               |
| Innovative management                        | Intellectualization of innovation management.                                   |
|                                               | Intellectualization of innovation activity.                                      |
|                                               | Intelligent management technologies that allow gaining new knowledge and transform it into innovations |
| Management of intellectual economy objects    | Management of intellectual resources, assets, their identification, management specifics. |
|                                               | Intellectual capital management.                                                 |
| Intellectual management                      | Management intellectualization as a new management culture                        |
| Innovative management by personnel           | Ensuring compliance of the intellectual personnel level with the innovative tasks of the enterprise |
| Motivation and development of human resources | Motivation for intellectual development of individuals and labor collectives       |
| Human capital                                 | Investments in the development of natural human skills that determine the size of the intellectual rent of the capital owner |
| Intellectual capital                          | Intellectual capital                                                             |
| Economy and organization of labour           | Intellectualization of labour, professional activity, and professional training   |
| Organization theory                          | Organizational dynamics in an innovative economy                                 |
| Learning organization                         | Intra-organizational knowledge increment                                         |
| Intellectualization of organization          | Intellectualization of enterprise activity in the modern electronic era          |

An integral part of the ongoing scientific discussions is the problem of resolving the contradiction between the existing intellectual level of Russian industrial employees and the quality requirements imposed on the modern workforce in the new industrialization [15-19].

It was stated that the transformation of the intellectual personnel potential into its intellectual capital occurs as a result of the personnel intellectualization process. Intellectual infrastructure, in turn, is necessary for organizing the process of personnel intellectualization (Fig. 1, 2).
Figure 1. Dynamic relation "intellectual potential of personnel - intellectualization of personnel - intellectual capital of personnel" as the basis for expanded reproduction of the intellectual personnel potential and, the intellectual capital derived from it: $IP_p$ is intellectual potential of the personnel; $IC_p$ is intellectual capital of personnel; $I, \ldots, k, \ldots, k+1$ are levels of personnel intellectualization.

Figure 2. Process of personnel intellectualization at the $k$-th level.

The main target of management focused on the development of digital technologies by personnel intellectualization is the achievement and stabilization of the required reproductive level of the intellectual personnel potential. This target defines the sequence of problem solving, tools, and resource allocation in the process of forming and developing the intellectual infrastructure for technological development.

The interrelated components that form the intellectual potential of the personnel (health, education, expertise, qualifications, as well as organizational, regulatory, moral, and creative) allow specifying the direction and content of the intellectual infrastructure formation. In this sense, these components are proposed to be considered as valuable ones for managing innovation-oriented intellectualization of personnel. The content of the author's concept, based on the specifics of improving the company's personnel management through the formation and development of the intra-company infrastructure for technological development, is shown in table 3.

5. Results and discussion

The personnel management system of a modern large industrial entity is known to be determined and shaped by such main factors as the size of the enterprise (number of employees), its type of economic activity and the corresponding type and nature of personnel activities.
Table 3. The author’s concept based on the formation and development of an intra-company infrastructure for technological development to improve the personnel management at an industrial enterprise.

| Element                                      | Characteristics                                                                                                                                                                                                                                                                 |
|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Approach to the study                        | Infrastructure-reproduction, which involves the formation of an intra-company intellectual infrastructure for technological development, ensuring a reproductive balance of intellectual personnel resources to meet the processes of technological development at the enterprise |
| Purpose of forming the infrastructure for technological development | Ensuring the achievement of indicators of the intellectual personnel potential due to the resource needs in the technological development at the enterprise                                                                                                                                 |
| Tasks of forming the infrastructure for technological development | - development of an active participation of the personnel’ intellectual potential in the processes of technological development;  
- improving (stabilizing) the required quality of the intellectual potential of the company’s personnel involved in the processes of technological development;  
- reducing the cost of personnel intellectualization |
| Principles of forming the infrastructure for technological development | a) the intellectual potential of the personnel as an object of intellectualization; b) focus on the result of technological development |
| Tools for forming                             | a) organizational and economic; b) moral and psychological |

Let’s concretize the improvement of the personnel management system under the influence of the formation and development of the intra-company infrastructure for technological development, presenting its impact on the traditional elements of personnel management at an industrial company (policies, functions, principles, technologies).

1. Inclusion of the personnel management system in the intellectual infrastructure for technological development. At the same time, the personnel management service can play the role of a coordinating center for managing employees’ intellectual resources in order to effectively involve them in the processes of technological development at the enterprise. One of the main ideas of improving personnel management through the formation of an intellectual infrastructure for technological development is the functional and technological development of personnel management in a modern intellectual and innovative enterprise. Such development suggests withdrawing personnel management beyond localized divisions and services and approaching directly to the technological processes. In fact this means creating a new form of structural organization at industrial enterprises, their organizational reconstruction (organizational reengineering), based on the priorities of technological development.

2. Influence of the intellectual infrastructure for technological development on individual elements of the personnel management system. The proposed infrastructure-reproduction approach assumes subordination of traditional functions of personnel management to the vector of technological enterprise development. Consequently, the traditional functions of enterprise personnel management at all levels (strategic, tactical, operational) will acquire a pronounced focus on technological development. In implementing the traditional HR functions the following aspects should appear: integration and synergy of the personal capacities of project teams members; the involvement of highly intelligent workers in enterprise management at various levels (participationist); comprehensive motivation of personnel to improve intellectual capacity and increase its use in processes of technological development; minimizing monotony and tedium, lowering the creative activity and destroying the creative personality; a relatively high degree of freedom in the actions of competent staff, etc.

The resulted formation of the intellectual infrastructure for the technological development causes improvement of personnel management showing itself in two types of impacts:

a) in general - on the personnel management system as a whole;
b) in private - on separate elements of the personnel management system.
The impact of a general nature:
- on the strategic vector of personnel management;
- on the organizational structure of personnel management services and their interaction with other structural divisions of the enterprise;
- on the procedural (determination of personnel needs, recruitment, development, use, retention and reduction of personnel) and their supporting profile functions of personnel management (controlling, marketing, information services and management organization);
- on the fundamental basis of personnel management, its conditionality with the priorities of production innovation orientation and reproductive balance of intellectual resources of personnel;
- on priorities in the formation of personnel policy at the enterprise;
- on the technology of personnel management in general and their corresponding methods, techniques, tools;
- on evaluation of the personnel management service effectiveness.
The impact of a private nature:
- on the process and methods of personnel planning;
- on the formation of the company's personnel;
- on organizing professional development of personnel;
- on the system of payment and incentives for personnel;
- on preparation of job descriptions and determination of qualification requirements;
- on the subject, purpose, tasks and methods of personnel assessment.

6. Conclusion
Managerial competence in the economic nature of the intellectual personnel potential is the initial condition for the formation of the intellectual infrastructure for technological development. This implies an understanding of its essence, composition and structure, dynamics in the process of technological development; place in the system of socio-economic potentials of the enterprise; measurement features; reproduction and management specifics. On the other hand, the formation of an intelligent infrastructure for technological development is resource-dependent. The main types of regulatory resources are: innovative potential of personnel (human resources), investment portfolio, intangible resource component (information, knowledge).

These conditions determine the strategic goal, objectives, and principles of forming an intelligent infrastructure for technological development, interrelated with the general strategic attitude of personnel management and the enterprise as a whole.

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8. References
[1] Schwab K 2016 *The Fourth Industrial Revolution* (Eksmo, Moscow)
[2] Loebbecke C 2019 *Bul Moscow University* vol 6 no 6 pp 9–11
[3] Loebbecke C and Picot A 2015 *JSIS* vol 24 no 3 pp 149–157
[4] Markus M and Loebbecke C 2013 *MIS Quarterly* vol 37 no 2 pp 649–653
[5] Morrar R, Arma H and Mousa S 2017 *TIM Review* vol 7 no 11 pp 12–20
[6] Lapidus L V 2018 *Digital Economy: E-Business and E-Commerce Management*: monograph (INFRA-M, Moscow)
[7] Dynkin A A 2018 *RFBR* vol 2 no 98 pp 41–43
[8] Prigzhin A I 2015 Probl Theory Pract Manag no 4 pp 17–34
[9] Yakovets Yu V 2018 *Strateg: prior* vol 3 no 19 pp 89–101
[10] Osipov Yu M, Yudina T N and Geliskhanov I Z 2019 *B Mosc Univ* vol 6 no 3 pp 42–61
[11] Tarasov I V 2018 *Bus Strateg* vol 6 no 50 pp 57–63
[12] Manakhova I V 2015 *Inf Secur Reg* vol 2 no 19 pp 62–70
[13] Plutova M I and Lagutina E E 2019 *Her Omask Univ* vol 17 no 3 pp 102–110
[14] Tezikova N V 2016 *Sci Pros* vol 1 no 76 pp 12–18
[15] Rodina L A 2019 *Her Omask Univ* vol 17 no 4 pp 55–62 doi: https://doi.org/1024147/1812-3988201917(4)55-62 (in Russian)
[16] Davidenko L M, Bespaly S V and Bekniyazova D S 2020 J Her Belg Univ Cooper E L vol 1 no 80 pp 58–68 doi: https://doi.org/1021295/2223-5639-2020-1-58-68 (in Russian)
[17] Corallo A, Lazoi M and Lezzi M 2020 J Manuf Syst no 114 UNSP 103165 doi: https://doi.org/101016/jcompind2019103165
[18] Zavalko N A, Kozhina V O, Yudina E V, Beketova O N and Lavrenova A V 2020 J Rev Inclus no 7 pp 84–92
[19] Pyrozhenko V 2020 J Admin Soc vol 52 no 1 pp 4–30 doi: https://doi.org/10.1177/0095399718760591