Model of an intelligent system for managing the process of developing the competencies of industrial enterprise employee’s competencies

Gennady Abrahamyan¹², Anush Atayan²³, Lyubov Sharabaeva⁴ and Tatiana Gureva⁴

¹ Admiral Makarov State University of Maritime and Inland Shipping, Saint-Petersburg, Russia
² Herzen State Pedagogical University of Russia, Saint-Petersburg, Russia
³ The Bonch-Bruevich Saint-Petersburg State University of Telecommunications, Saint-Petersburg, Russia
⁴ North-West Institute of Management of Russian Academy of National Economy and Public Administration, Saint-Petersburg, Russia

E-mail: abrgv@rambler.ru

Abstract. The article considers issues and tasks of industrial enterprise employee’s competencies development in conditions of digitalization of economy. Analysis of automated systems, tools and intelligent technologies of formation, monitoring and development of industrial enterprise employee’s competencies development was carried out. The choice of software tools of the Microsoft Power Platform analytical platform for intelligent support of industrial enterprise employee’s competencies development is justified. A typical digital infrastructure for training of industrial enterprise employees is considered: goals, functions, elements and relationships for automating and intellectualizing the development of competencies of enterprise employee’s. Proposals are made to improve the digital infrastructure for training industrial enterprise employees. A model of an intelligent system of managing employees’ development is proposed. It provides monitoring of employee’s actions and recording the results of competencies development. This model is based on the integration of data collection and analysis processes of the digital profile of employee competencies and its relationship with the competencies profile of the position based on the iterative algorithms of the Microsoft Power Platform (Power BI, Power Automate, Power Apps, Power Virtual Agents).

1. Introduction
Modern industry is influenced by a dynamic change in industry fundamentals. Digitalization completely changes processes and business models. Technological progress, changes in management and business models, use in the production of AI require the constant competencies of industrial enterprise employees [1].

There are significant changes in the needs of specialists and requirements for employees: reduction of demand for a number of professions, reduction of profession life cycle, transformation of competency and job profiles, emergence of new roles and professions, increased requirements for flexibility and adaptability of staff.
The development and implementation of breakthrough technological projects in the digital economy creates a demand for specialists who own a complex of hard-, soft- and special- competencies.

Under these conditions, the process managing of the enterprise employees competencies development is required to be changed.

Competency development is a complex iterative process that combines special training with the participation of the employee in projects aimed at developing the required skill; learning from the experience of others through interaction with more experienced and trained employees; active self-training; development at the workplace in the process of carrying out production tasks aimed at the development of targeted competencies [2].

It is necessary to optimize the cost of updating employee competency models and their development based on the analysis of accumulated big data, both from external and internal information systems. The harmonization of the competency model with professional standards is important. The model of professional competencies is the criterion for selecting the necessary employees, serves as the basis for forming a request for internal corporate training and development, as well as for subsequent evaluation and certification of personnel. The use of intelligent systems for managing the development of competencies will make it possible to make informed managerial decisions on the individual trajectory of professional development of employees.

2. Review
The results of the IBM Institute for Business Value (IBV) global survey indicate that about 120 million employees of organizations will need retraining or training in the coming years. Only 41% of the 5670 managers surveyed said they had the personnel needed for the planned strategic plans.

An overview of information technologies used to automate the training of enterprise employees shows that the market for existing solutions offers software products with different functionality. Over the past year, distance learning software products have become especially popular. Effective interaction models are being sought and solutions for their implementation are being proposed [3].

Among them are applications that provide real-time interaction between employees. The most popular are Teams, Zoom, Slack [4].

The remote training system at modern enterprises involves taking advantage of mobile devices (personal or dedicated by the enterprise) that are becoming more and more in demand for the development of competencies. Technologies that integrate learning into the production process are particularly popular [5].

Learning Management System (LMS) creates a virtual platform for interaction between employees and teachers. Employees can use content of various types (lectures and practical instructions in text, video files, animated presentations, links to external sources, simulators), prepared by teachers for the course, tests to control knowledge, messages - to interact with other participants in the educational process [6]. The software market offers the following LMS specifically for training enterprise employees: Oracle Learning Management, WebEx, MeetingPlace, WebTutor, TalentMS, SAP Litmos, Docebo, iSpring Learn, Moodle [7].

Recent LMS developments take advantage of the ability to embed Web content by links, download video and audio files, test with different types of questions, organize webinars, and generate certificates. It is possible to organize various forms of personnel training in such systems - active and passive, individual and group. They even provide the ability to connect external users to sell courses. The competence management function is implemented. Moreover, it provides the creation of new curricula for selected competencies.

The managing technology of the modern enterprise personnel development is designed to ensure continuous improvement of the skills of employees in order to maintain their competences, as well as building their business careers.

Such capabilities are implemented in the fast-growing form of Learning Experience Platform (LXP) educational project platforms. They are designed to search for corporate educational content, experts, digital resources based on resource indexing methods and artificial intelligence [4, 7]. For example,
Pathgather is an enterprise platform that improves employee skills, Adobe Captivate Prime is a platform that, in addition to providing its courses, implements recommendations and selection of content from third-party suppliers, development of social skills, personalization, gamification, training for compliance with regulatory requirements, generates detailed reports and analytical data [8].

The most relevant trend in the development of automated training systems is their intellectualization, that is, the ability of the system to generate educational tasks; solve the tasks required for the trainee using methods of representing knowledge about the studied discipline; define the strategy and tactics for dialogue; simulate the state of the trainee's knowledge; self-study based on analysis of results of interaction with trainees [9-13].

It is expediently to solve personnel tasks at the enterprise on the basis of information models of professional knowledge of specialists and positions [14].

Next-generation intelligent training systems enable trainees to determine not only their level of knowledge when completing tests, but also to receive specific recommendations for studying the required additional material [15-16].

Watson Career Coach with virtual assistant, created using artificial intelligence by IBM, provides career advice, identifying gaps in employee skills. This allows an employee to be offered a better job in another position or follow the training recommendations of the system. Thanks to this system, more than one and a half thousand IBM workers found themselves within the company a more suitable job [17].

The development of models and algorithms for adaptive testing and software control of the process of advanced training of industrial personnel is devoted to the works of the authors [18-20]. Generation and evaluation of complex training results in automatic mode is implemented by means of learning trajectory control on the basis of feedback based on trainee's responses and biometric signal parameter values.

The method of personalized corporate training based on personal qualities of employees in order to increase motivation and quality of training of specialists in various enterprises is reflected in the study [21]. Development of this method is implemented with the help of cognitive model of e-learning trajectory control system taking into account digital trail of trainees [22]. At the same time, it can be concluded that the digital trace of the trainee is a digital imprint of his current cognitive model, fixed at a certain point in time and showing the place of a particular person in the social and professional environment.

The models and algorithms of adaptive testing and software management of the enterprise employee’s personnel competencies process development is considered in the review are very promising, but difficult to implement at this stage of development of industrial enterprises of Russia due to their highly specialized software tools. Therefore, we offer a model of an intelligent competency management system, which can be implemented in a short time or step by step on the basis of a standard system of employee training in enterprise using universal software tools. These software tools enable the creation and management of electronic content through cloud-based solutions, communications applications, and intelligent tools. The advantage of this approach is the possibility of seamless integration with the corporate information system of an industrial enterprise.

3. Main part
To implement the process of developing the competencies of industrial enterprise employees, an intelligent system model based on several modules is proposed (figure 1: a competence development module, managerial, analytical and advisory).

Microsoft Power Platform applications such as Power BI, Power Apps, Power Automate, Power Virtual Agent included in the analytical and advisory modules of the proposed system are the core of the employee's intellectual competency development system [23]. This platform allows you to easily get all the necessary information from related Office 365 services and combine it in applications, data streams, reports, as well as support services-assistants. Microsoft Power Platform implements various models of artificial intelligence for working with data, such as machine learning, prediction, form processing, object detection, classification and object extraction, using a simple intuitive interface.
Let's take a look at the intelligent system model modules.

**Competency development module.** The main unit is the LMS, within which the content of the electronic course is delivered to the employee, testing and collecting a digital trace. The trainee interacts with tutors using enterprise cloud solutions. For example, Microsoft 365: Teams for Communications, Outlook e-mail, Forms for feedback, one drive for storage and collaboration, Planner for distributing team tasks. The development of competencies also takes place on the basis of training and production complexes.

**Analytical module.** The analysis module includes a database and Power BI tools that collect and convert data for evaluations. The application programming interface (API) provides to get all needed information from different sources. Power BI transforms gotten data to necessary formats to be used for analysis. Power BI analysis is implemented based on data slices, filters of different depths and formulas. The cloud service allows data to be processed together by different process participants. Analytical reports are dynamically updated by selecting query parameters and changing data. The results of these processes are used to perform automatic queries and provide employees, trainers, experts with of production processes, statistical reports, research, etc.

**Recommendation module (RM).** Recommendations are generated with such software products as Power Apps, Power Automate, and Power Virtual Agent. The Power Automate cloud service is used to automate processes using AI Builder. The various connectors implemented in this service allow you to create process flows to obtain the necessary data from other applications for analysis, reports, and data transfer. Power Apps is an application creation tool. Implementation in the mobile device application of the interface to access surveys, e-mail, content, surveys will make training possible at any available moment from any place (JIT), when convenient to the employee. The Power Virtual Agent is designed to create chat bots that help employees get guidance on choosing the right training course. Data is exchanged between applications using Power Automate connectors. It will be possible to deliver e-mail messages, publish data to Teams, and forward it from the database to Power BI.

**The management module** includes a staff certification unit, monitoring of employee performance and recommendations for personnel decisions.
The system inputs are professional standards, company job requirements and employee information. In the analytical module, the professional standard data is compared with the job requirements of the enterprise to obtain a job competency profile, which is periodically updated. The employee is tested to determine the level of competencies and receives the employee's current competencies profile. Further, the analysis module analyses the conformity of the with the and, based on the results, the recommendation module transmits data to the management module for making management decisions. In accordance with management decisions, the individual employee's competencies develop trajectory is built. Employee may be offered another position corresponding to his level of competence; studying in recommended courses; trainings. If the requirements of the enterprise change from the management module, the data goes to the analysis module to update JCP. On the basis of individual employee's competencies develop trajectory, individual electronic courses are created in LMS. After training and testing, the new employee's current competencies profile is formed. Thus, the intelligent system will be able to provide an iterative interactive process of developing the competencies of workers of an industrial enterprise, repeated with various frequencies.

4. Conclusion
The article analyzes the main issues and tasks of enterprise employee's competencies developing in the transition to the digital economy. In the context of digitalization, introduction of electronic production operation in business models and related changes of industrial enterprises mechanisms and management technologies, it is necessary to develop and implement new mobile, automated and intelligent systems in training process of enterprise employees.

The analysis of modern automated systems, tools and intelligent technologies for the formation, monitoring and enterprise employee's competencies developing made possibility to highlight such main trends as:

- Concentration (focus) on distance learning software;
- Development of models and algorithms for adaptive testing and software management of the advanced training process;
- Active search and development of employee interaction models in real time;
- Use of mobile devices of competency development;
- Development of complex tools supporting competency management, personnel business career management functions;
- Cognitive models of e-learning trajectory management taking into account the digital trail of trainees;
- Intellectualization based on methods of presentation of subject knowledge, determination of strategy and tactics of dialogue with employees, modeling of state of knowledge of trainee, self-training of system based on analysis of results of interaction with employees.

The article proposes a modular structure of a model of an intelligent system for managing the process of developing the competencies of workers of an industrial enterprise based on a typical digital infrastructure for training workers of an industrial enterprise taking into account the goals, functions, elements and relationships for automation and intellectualization of developing the competencies of employees of the enterprise based on LMS Moodle, Teams, OneDrive. The model infrastructure is based on the integration of data collection and analysis processes of the employee's digital competency profile and their relationship with the position competency profile based on the iterative algorithms of the Microsoft Power Platform (Power BI, Power Automate, Power Apps, Power Virtual Agent), providing monitoring of employee actions and recording the results of competency development.

The improvement and promising development of the model of the intellectual system for managing the process of enterprise employee’s competencies developing assumes development and implementing of:
- Natural Language Processing (NLP) technologies/algorithms/solutions for the applying of text and voice analytics of corporate communication data and industrial enterprise processes; speech recognition systems, chat bots, intelligent forms of language processing of production information.
- API integration of the model with existing and promising domestic and foreign autoregressive generative language models, for example, supporting the Generative Pre-trained Transformer (GPT)-3 transformer architecture.
- Machine deep learning modules at the enterprise level using graphics processors (GPUs) and computer vision technologies, taking into account the profile of the industrial enterprise, corporate infrastructure for the purpose of using an intelligent development system.
- Ensuring the acceleration of competencies of employees of the enterprise as a digital ecosystem based on HIGH-HUME technologies promoting self-development, self-actualization, personal and professional growth. The use of HIGH-HUME technologies will compensate for the negative impact on employees of the digital HIGH-TECH environment, to build a more flexible production environment and a comfortable organizational space, to promote the disclosure of internal motivation of employees, their interests in self-development and profession, the desire to work in a creative atmosphere, develop the ability to work enthusiastically and productively, encourage employees to professional success and creativity, and, in general, increase loyalty to the industrial enterprise and production processes in the digital environment [24].

References
[1] Mian S H, Salah B, Ameen W and Moiduddin K 2020 Adapting Universities for Sustainability Education in Industry 40: Channel of Challenges and Opportunities. MDPI Sustainability 6100
[2] Tan H-S, Ivander Octarina R, Reynaldo V and Sharina C 2020 Conceptual development of learning factory for industrial engineering education in Indonesia context as an enabler of students’ competencies in industry 40 era. IOP Conference Series: Earth and Environmental Science 426 012123
[3] Khmiliar O, Krasnytska O, Vainola R, Xi Z and Kravchenko I 2020 Intensification of the educational process of higher educational institutions by tools of interactive technologies. J Tempos Espaços Educ 13(32) 14955
[4] Pavlou C 2020 The-top-26-most-used-online-employee-training-tools Talent LMS Retrieved from: https://www.talentlms.com/blog/top-online-employee-training-tools
[5] Mauri J 2019 The Importance Of AII in Learning and Development Elearning Industry Retrieved from: https://elearningindustry.com/the-importance-of-ai-in-learning-and-development
[6] Abrahamyan G, Atayan A, Sharaeva L and Guryeva T 2021 The model of an online digital competencies development system for the management personnel of the Arctic region. IOP Conference Series: Earth and Environmental Science 678 012065
[7] Implementing learning Oracle Retrieved from: https://docs.oracle.com/en/cloud/saas/talent-management/20b/faiml/external-provide
[8] Adobe Captivate Prime vs Parthgather Capterra Retrieved from: https://www.capterra.com/learning-management-system-software/compare/145872-132340/Adobe-Captivate-Prime-vs-Pathgather
[9] Petrushin V A 1993 Intelligent learning systems: architecture and implementation methods (review). Bulletin of the Academy of Sciences Technical Cybernetics 2 164-189
[10] Golenkov V V 2001 Intellectual training systems and virtual educational organizations (Monograph Minsk BSUIR) 488
[11] Brusilovsky P 2003 International Journal of Adaptive and Intelligent Networked Educational Systems on Artificial Intelligence in Education 13(2-4) 159-172
[12] Rybina G V 2017 Intelligent technology for building learning integrated expert systems: new opportunities. Open education 4 43-57
[13] Sudarshan S 2018 The Role of Artificial Intelligence in Learning Retrieved from:
https://elearningindustry.com/artificial-intelligence-in-learning-role

[14] Myshkina I Y, Askhat Z, Asanov I Y and Grudtsyna L Y 2015 Evaluation and selection of personnel based on clear and fuzzy cognitive models. *International Journal of Soft Computing* **10** 448-453

[15] Popova Y B 2019 Intellectual component of the training system CATS. *J Educational technologies and society* **4** 422

[16] Barla M, Bieliková A B, Ezzeddine T, Kramár M and Šimko O 2010 On the impact of adaptive test question selection for learning efficiency. *J Computers & Education* **55(2)** 846–857

[17] Lewis N 2019 *IBM Transforms its Approach to Human Resource with AI SHRM* Retrieved from: https://www.shrm.org/ResourcesAndTools/hr-topics/technology/Pages/IBM-Transforms-Human-Resources-Ataspx

[18] Asadullaev R G and Lomakin V V 2013 Building a formal model of knowledge representation for an individual e-learning system. *Scientific Bulletin of Belgorod State University: scientific journal* **8(151)** 151-160

[19] Klenin J, Botov D and Dmitrin Y 2018 Comparison of vector space representations of documents for the task of information retrieval of massive open online courses. *Communications in Computer and Information Science: Proceedings of the 6th Conference on Artificial Intelligence and Natural Language* **789** 156–164

[20] Lyamin A V and Cherepovskaya E N 2018 An Automata Model for an Adaptive Course Development. *Smart Education and e-Learning 2017 SEEL 2017 Smart Innovation Systems and Technologies* 75

[21] Chunaev A and Shikov A 2018 The method of personalized corporate e-learning based on personal traits of employees. *J Procedia Computer Science* **136** 511-521

[22] Shamsutdinova T M 2020 Cognitive model of e-learning trajectory based on digital footprint. *Open education* **24(2)** 47-54

[23] Create a data-driven culture with business intelligence for all Microsoft Retrieved from: https://powerbimicrosoft.com/en-us/

[24] Abrahamyan G V 2021 HIGH-HUME methodology and algorithms for the implementation of HIGH-TECH control of the contours of natural physiological electronic and a hybrid of interfaces for the formation of professional competence of university graduates. *Materials of the III International Scientific and Practical Conference* **255-260**