

# IT Development of HR-Systems in the Field of Human Safety

Oleh Kovalchuk <sup>a</sup>, Oleh Zachko <sup>a</sup>, Dmytro Kobylkin <sup>a</sup> and Tanaka Hiroshi<sup>b</sup>

<sup>a</sup> Lviv State University of Life Safety, Kleparivska Street, Lviv, 79007, Ukraine

<sup>b</sup> Tokyo Institute of Technology, 2 Chome-12-1 Ookayama, Meguro City, Tokyo, 152-8550, Japan

## Abstract

The study of the process of human resources management of the safety-oriented system (BOS) of civil safety (CPS). Based on the system analysis, the strengths and weaknesses of the functioning of structural elements are analyzed. The classification of safety-oriented civil protection system is developed, the influence of classification on the choice of application of modern information systems for development of computerized and automated HR systems for human resources management in the field of human safety is analyzed. The model of human resources management in CPS is developed taking into account the multiparametric environment of project management and project environment. The HRM competency model has been developed. The correlation between the effectiveness of human resources management and the implementation of the goals of portfolios of projects, programs and projects of civil safety organizations is studied. The subject of the study is the HR system of human resources management of civil safety. Processes of selection of project team members, their evaluation, formation, implementation of personnel management and completion of projects and portfolios of projects and programs in the civil safety system. Object of research: expert HR information system for decision support in the human resources management system of civil safety of a safety-oriented socio-technical system using information technology. The purpose of the work is to modernize the methods of human resources management system, to develop a model of automated personnel management information system for implementation in projects of safety-oriented system using the index method of evaluation of team members.

## Keywords

information system, safety-oriented system, civil protection, index method, human resource management, database, project teams.

## 1. Introduction

Today in Ukraine and the world the number of cataclysms and emergencies of man-caused, natural and social nature is growing, which in turn leads to human, material losses, losses. Emergencies of various levels and forms of complexity pose a threat to life and safety. Adaptation of organizational and technical structures of the civil protection system to functioning in a turbulent and dynamic environment, which encourages effective management of projects, programs and project portfolios. The solution to this problem lies in the concept of protection of the population and territories from emergencies, prevention of their occurrence, rescue operations and firefighting. Their implementation requires constant allocation of limited resources, control over the implementation of tasks and selection of competent command staff. In the transition to the information society there is a need to form a new approach to personnel management of organizations. The basis of success of any company is people. Without the use of the technological component, it is difficult to achieve efficiency and productivity, given the crisis, staff turnover, uncertainty and risks that arise at all stages of the life cycle. They affect the social effect that should be provided by a socio-technical safety-oriented system.

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EMAIL: Justdoitolejka@gmail.com (A. 1); zachko@ukr.net (A. 2); dmytrokobylkin@gmail.com (A. 3); hirojpmf@gmail.com (A. 4)  
ORCID: 0000-0001-6584-0746 (A. 1); 00000-0002-3208-9826 (A. 2); 0000-0002-2848-3572 (A. 3); 0000-0003-2631-721X (A. 4)



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As part of the development of digitalization in the subject area of human resource management (HRM), process automation. There is a problem of adapting critical infrastructures of the state, such as the civil protection system, where there is a crisis of governance due to outdated management methods. Human resources are an asset of the organization. Therefore, the scientific task is to develop methods and models for the formation of project teams in the civil defense system using a project-oriented approach.

## **2. Analysis of recent research and publications**

The scientific works of the following domestic and foreign scientists are devoted to the study of methods and models of formation of project teams: Lysenko D. E., Chumachenko I. V., Bushuyev S. D., Morozov V. V., Medvid A. P., Danilenko A. I., Sherstyuk O. I., Medvedeva O. M., Rach V. A., Oluyko V. M., Danchenko O. B., Bedriy D. I., Semko I. M., Archibalda R. D., Mazura I. I., Shapiro V. D., Ilyushko V. M., Koshkina K. V. and others.

In work Lysenko D. E. [4] developed methods and models for selection of project team members, using the theory of precedents as a basis for experience to implement new tasks. The developed structure of the qualimetric model allows to mathematically calculate and display the relationships between the input tasks, the base of precedents and their evaluation, candidates for the role in the project and other actors for the formation of the project team. This model should be considered for recruitment and integration of decision support system (DSS) with the information system of human resources management.

In works Bushuyev S. D. [1] studied the processes of project knowledge management and developed a conceptual model that allows you to structure data, information and turn them into knowledge. These developments should be taken into account when developing new models of human resource management information systems in the field of safety - oriented system for data presentation in the information environment. In the monograph of Chumachenko I. V. [2]. special attention is paid to multi-projects, which are relevant in a complex socio-technical system where projects are constantly growing and require effective tools for selecting and forming teams in a dynamic environment, as well as interaction between stakeholders, task allocation and project resource management. In the textbook of Morozov V. V. [3] considerable attention is paid to the improvement of automated personnel management systems through the methodical implementation of multifunctional expert systems for career guidance, selection and certification of employees.

## **3. The bulk of research**

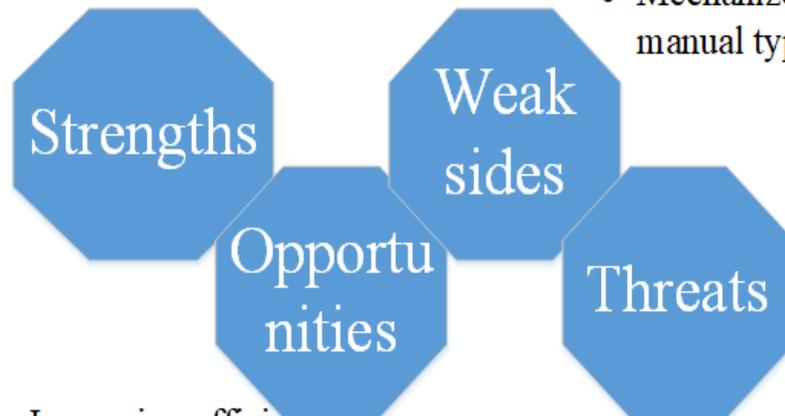
Solving the problem of human resources management in portfolios of projects, programs and projects and the effective implementation of goals under the influence of a dynamic turbulent environment is a complex task that requires modern methods of crisis management and project-oriented approach. Solving tasks at the basic level and coordination with strategic plans of senior management requires coordination of project participants. The safety-oriented system (BOS) includes a civil safety subsystem (CPS), which have a project-oriented nature[5-18] in response to fires, accidents and a program of preventive measures, the main processes of control and management of change (monitoring, forecasting

the environment). This is a set of projects that are initiated as an adaptation to a changing turbulent environment. They should embody the project management methodology (figure 1).

HRM BOS uses a non-flexible management system, which differs from the traditional one where tasks are set by the command-administrative method in a vertical passive hierarchical structure, which causes bureaucratic and corruption situations due to human intervention and incompetence, so the organization's goals are not achieved. European human resource management practices use a variety of modern project management tools, such as the PRINCE2 British Management Standard, which is used in complex government project portfolios.

- 24/7 functioning system
- Quantitative composition of HR
- Experience and research

- Poor management
- Uneven distribution of resources and workload
- Mechanized operations of manual type



- Improving efficiency
- Productivity
- Speed of realization of life cycles
- Automation of operational processes

- incompetence
- Project failure
- Human and material losses

**Figure 2:** SWOT analysis BOS CPS

The American PmBOK Project Management Standard considers the relationship between project integration management (a group of project implementation processes and team management) as a valuable asset of an organization. Japan's P2M standard focuses on HRM values, the rising sun state did not have strengths in natural resources, so it chose a strategic course to develop the value of human labor and became a world leader in implementing innovative projects and programs. The permanent matrix structure of civil protection is the SES, which acts as an executor of portfolios and projects (PMO), which provides organizational and technical activities and coordinates functional units. During large-scale disasters and emergencies, operational headquarters (temporary project teams, working groups and staff) are created, which by definition in the field of project management knowledge are temporary project teams. In the conditions of computerization it is possible to automate mechanized operational processes in relation to HRM, as the speed and accuracy increase significantly, which allows to reduce the cost of resources and better allocation of resources in projects. Global trends encourage organizations of different types to use project management tools, taking into account innovative digital technologies for information processing and management.

An important factor in the implementation of programs and projects is the productive staff and team that implement the goals of the organization.

The project approach in the safety-oriented system has great potential, because thanks to this method optimizes the efficiency of large programs and personnel management, which in this socio-technical system has thousands of employees. In 2019, the total staff was 60,050 employees. It is necessary to consider models of formation of project teams in the given organization. The first step is the analysis and formalization of the concept of "safety-oriented civil safety system" (BOS CPS) and its classification.

Safety-oriented system of civil life safety is a complex socio-organizational technical structure that provides a social effect on the protection of the population and territories. Operates in a matrix organizational structure under conditions of uncertainty with outdated and passive vertical linear relationships. The decision-making process is time-consuming, long-term strategic planning is ineffective, a significant amount of human and material resources are expended, and it is not always justified and appropriate. Project structuring is low. Classified by:

- scale (large-scale, global, local, regional),
- complexity (simple, complex, very complex),
- duration (short-term, medium-term, long-term) and
- project class (monoproject, megaproject, metaproject, multiproject).

BOS CPS interacts with project stakeholders: society, state, civil defense teams. Unique services are the social effect (protection): the welfare of man, society, the state, which acts as a customer, the SES as a performer.

To date, there is the following classification of civil defense personnel:

- 1) certified personnel of bodies and subdivisions of internal affairs;
- 2) civilian personnel or employees who are partially endowed with personnel innovations;
- 3) support and service (technical) staff.

**Table 1**

Task and content HRM CPS

№	Task HRM CPS	The content of the system
1	A.	Structuring and organizing work on achievement organizational goals and priorities.
2	B.	Identification of staffing needs taking into account the necessary competencies and skills.
3	C.	Selection, training, development and management of project teams, definition of tasks and priorities for them.
4	D.	Leadership and human resource management.
5	E.	Creating working conditions.
6	F.	Renovation of the management system.
7	G.	Information and communication infrastructure HR monitoring and control
8	H.	Evaluation of efficiency and productivity.

The employee of the civil defense system is required to have high culture, honesty, integrity, diligence, perfect knowledge of the law, ability to think and act quickly in times of acute shortage of time, courage, endurance, ability to endure possible burdens and complications associated with the service figure 2.

Risks in HRM CPS:

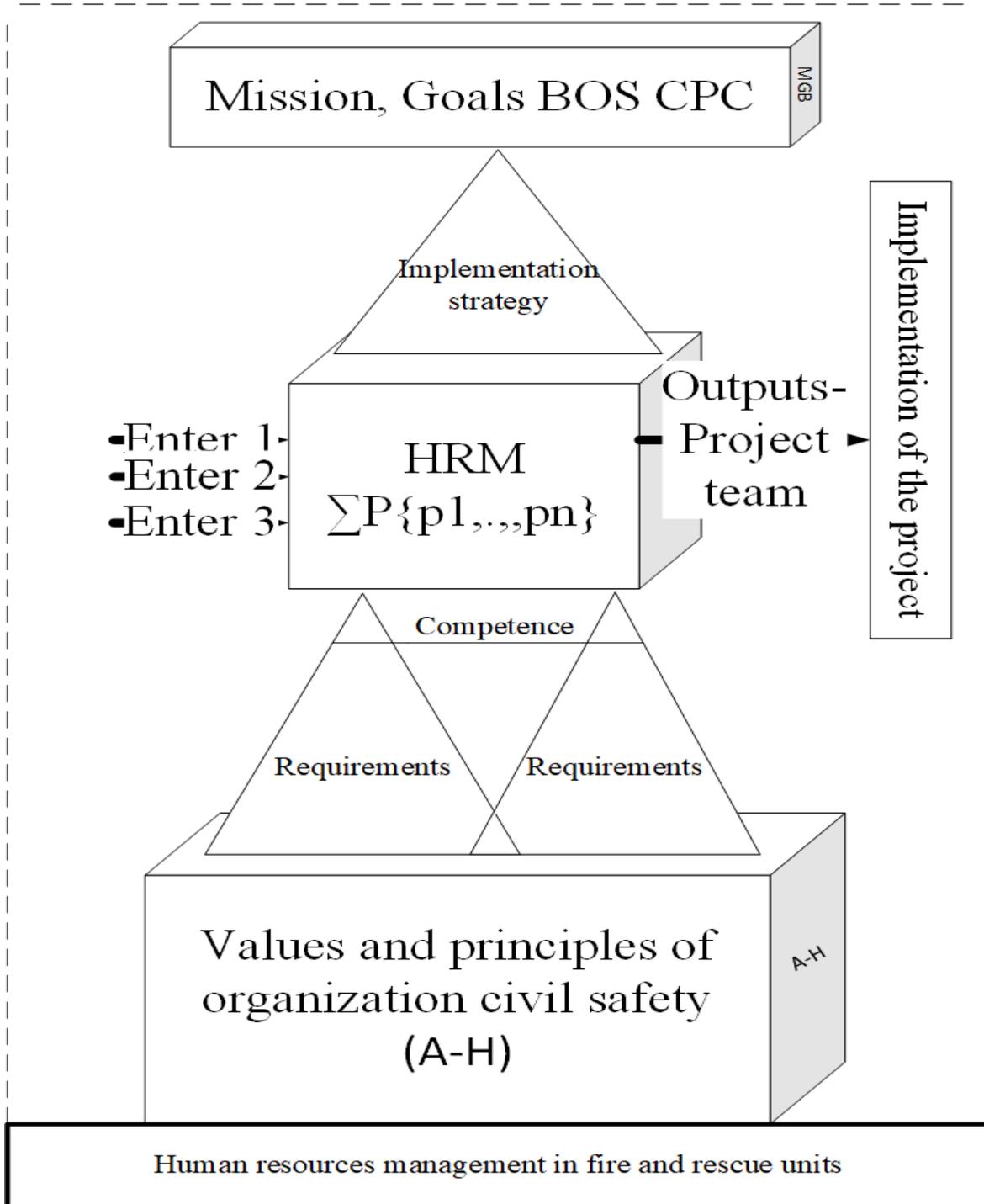
- 1) low qualification of employees
- 2) low level of loyalty to the strategic goals of the organization
- 3) fatalities among employees at the emergency
- 4) instability of the staff of organizations, staff turnover coefficient ( $K_{phr} = n \text{ released} / n \text{ Staff} \times 100\%$ )
- 5) non-compliance with official discipline
- 6) lack of a systematic approach to the group of human management processes

Staff turnover ratio. About 60% of workers between the ages of 20 and 30 are laid off voluntarily.

Staffing is a specific activity. The content of this type of activity is:

- selection and placement of personnel;
- legal regulation of service;
- training and education of staff;

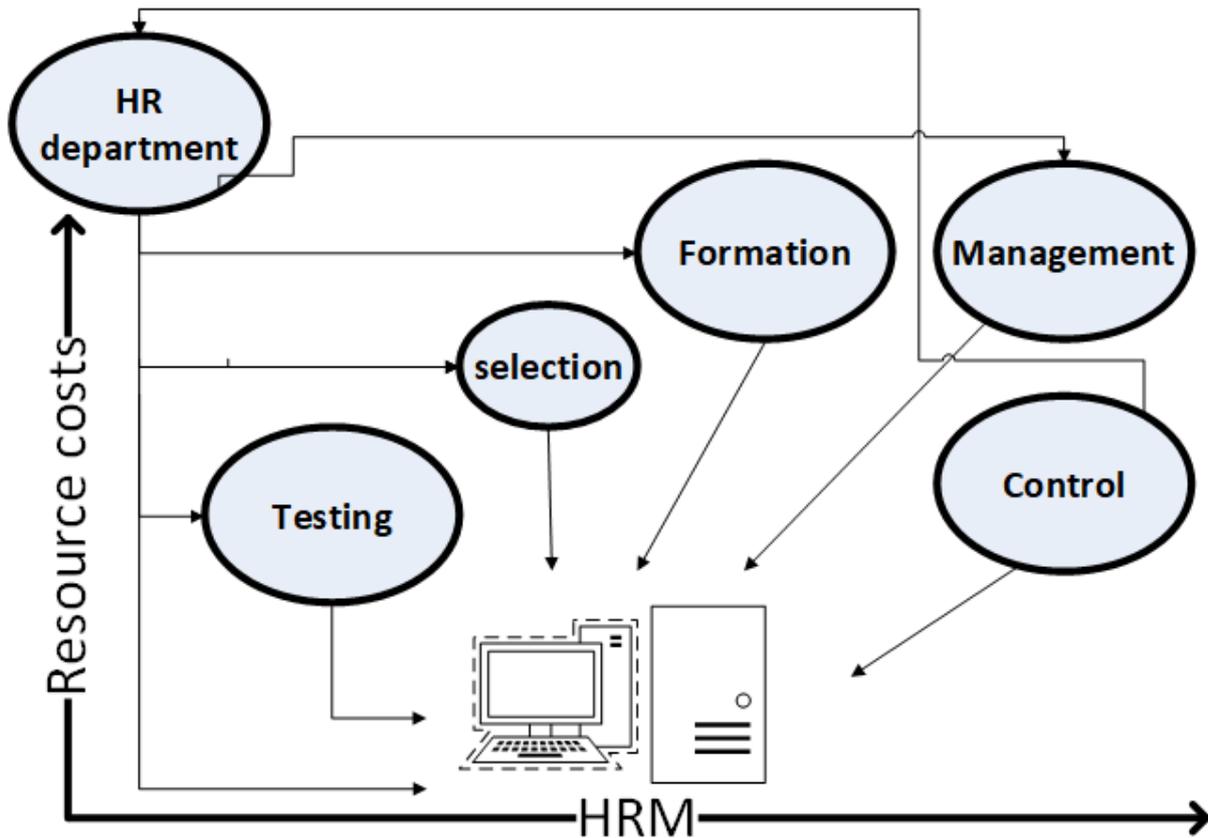
- staff incentives;
- providing legal and social protection.



**Figure 2:** Conceptual model of BOS CPS control system

One of the most important areas of personnel work is the selection of personnel dependence (1).

$$F(Lc\ cps)=\{F,p1\}, \{F,p2\}, \{F,pn+1\} \quad (1)$$



**Figure 3:** Resource costs life cycle

Application of role interaction (2):

$$(R = \{R1, R2, R3, R4, R5... Rn\}) \text{ in projects } (P = \{P1, P2, P3, P4, P5... Pn\}) \quad (2)$$

instead of positions based on the Scrum method **Figure 4:**

$$K=\{K1, K2, K3, K4, K5...Kn\} \quad (3)$$

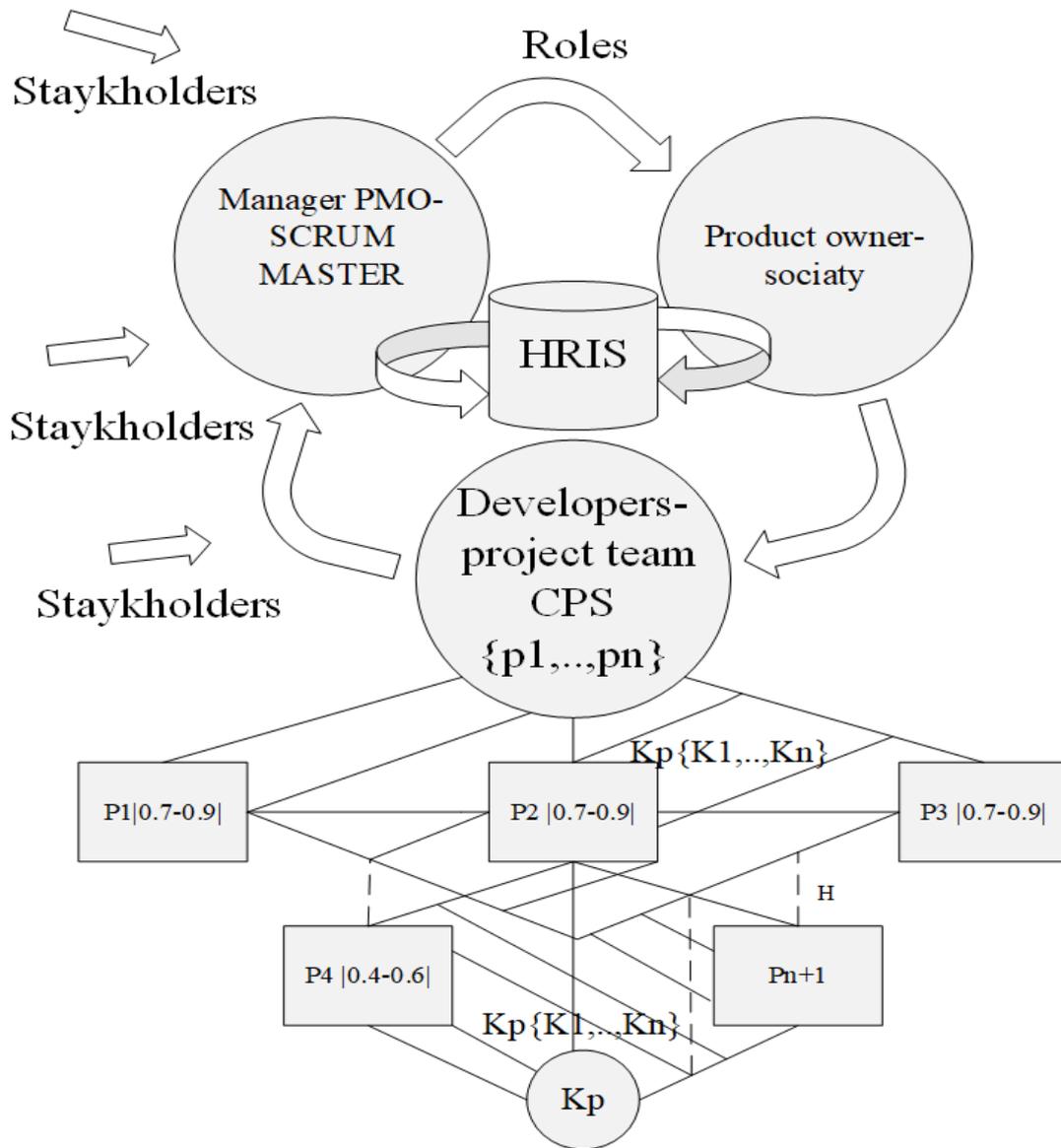
this is a set of competencies that include the tuple:

- knowledge A (tuple a1, ..., a2),
- skills B (tuple b1, ..., b2),
- experience C (tuple c1, ..., c2),
- practical abilities D (tuple d1, ..., d2).
- H-levels of organizational structure.

Various qualitative, quantitative and combined methods are introduced in the practice of personnel performance evaluation.

Qualitative is called descriptive: comparing an employee with the ideal for a given position - a matrix method. Comparison of maximum achievements with significant misses is a method of a system of arbitrary characteristics. General assessment of task performance.

Discussion of the employee with his colleagues, management, subordinates, clients - 360 ° method. Discussion with the employee about the results and prospects. Quantitative methods of estimating the effectiveness of staff work are based exclusively on numbers: point evaluation is the summation of points according to pre-established criteria, for certain terms.



**Figure 4:** SCRUM CPS management method

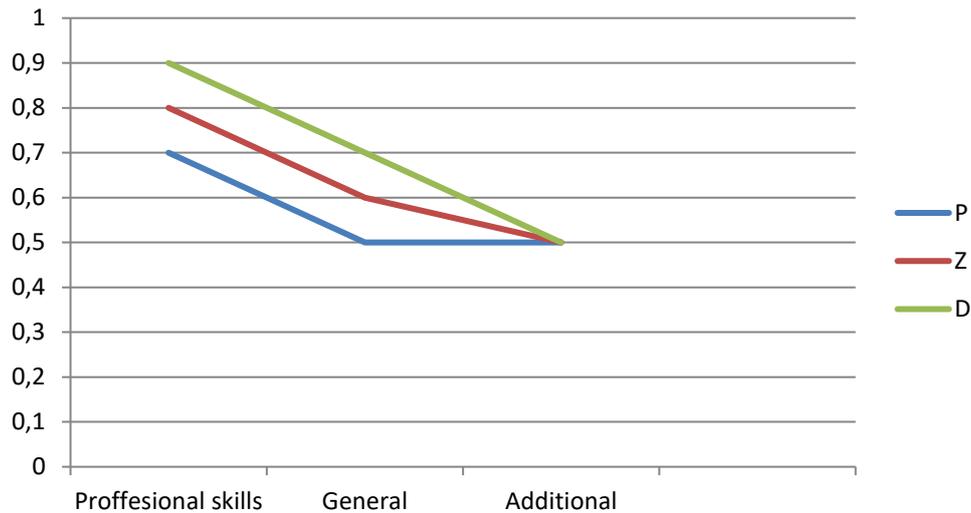
Determination of ranks - a rating of all employees by a group of managers. Free evaluation by points  
 - analysis of the qualities of the employee by experts and summarization of his points. The index method of evaluation helps to compare the actual results with the desired ones, in our case it is the ratio of the candidate's rating to the portrait of the "ideal" member of the fire and rescue team (4):

$$W_n = Q_n / Q_o \quad (4)$$

Where  $W_n$  is the relative rating of the candidate of the competition-selection for the project team of the safety-oriented system. The value of  $W_n$  testing allows you to expertly analyze and compare the evaluation results with the selection criteria;

$Q_n$  is the result of the points scored at the stages of the competition-selection by the  $n$ th participant;

$Q_o$  is the relative quantitative value of the "ideal candidate portrait" table 2 for the successful outcome of a project of selection into a safety-oriented system of a serviceman figure 5.



**Figure 5:** CPS competency schedule

It is also advisable to take into account the qualimetric approach to assessing professional and business qualities (5):

$$O\delta = \{K_{pez}, K_{in}, K_{ek}\}, \quad (5)$$

Where  $O\delta$ -assessment of business qualities, Croesus-average relative performance,  $K_{in}$ -labor intensity,  $K_{ek}$ -saving resources.

**Table 2**

Index evaluation of candidates for BOS projects

Code	Competences (Kp) and personal qualities (Oy)	Professional(P), general (Z), additional (D)	Index [0.1-0.9]	Result
K1	Technical skills at work	P	0,5-0,9	0,5+<0,9
K2	Organization of firefighting and elimination of its consequences	P	0,7-0,9	0,5+<0,9
K3	Psycho-emotional stability in crisis situations	P	0,6-0,9	0,5+<0,9
K4	Experience of similar projects	Z	0,4-0,9	0,5+<0,9
K5	Responsibility	Z	0,6-0,9	0,5+<0,9
K6	Physical endurance	Z	0,7-0,9	0,5+<0,9
K7	Profile education	Z	0,5-0,9	0,5+<0,9
K8	Skills in working with telecommunications and information systems	D	0,5-0,9	0,5+<0,9
K9	proactivity	Z	0,5-0,9	0,5+<0,9
K10	communication	Z	0,5-0,9	0,5+<0,9
K11	initiative	Z	0,5-0,9	0,5+<0,9
...	...	...	...	...
Kn+1	Kpn	P, Z, D	0,5-0,9	0,5+<0,9

0-0.4 index values are not allowed for teamwork.

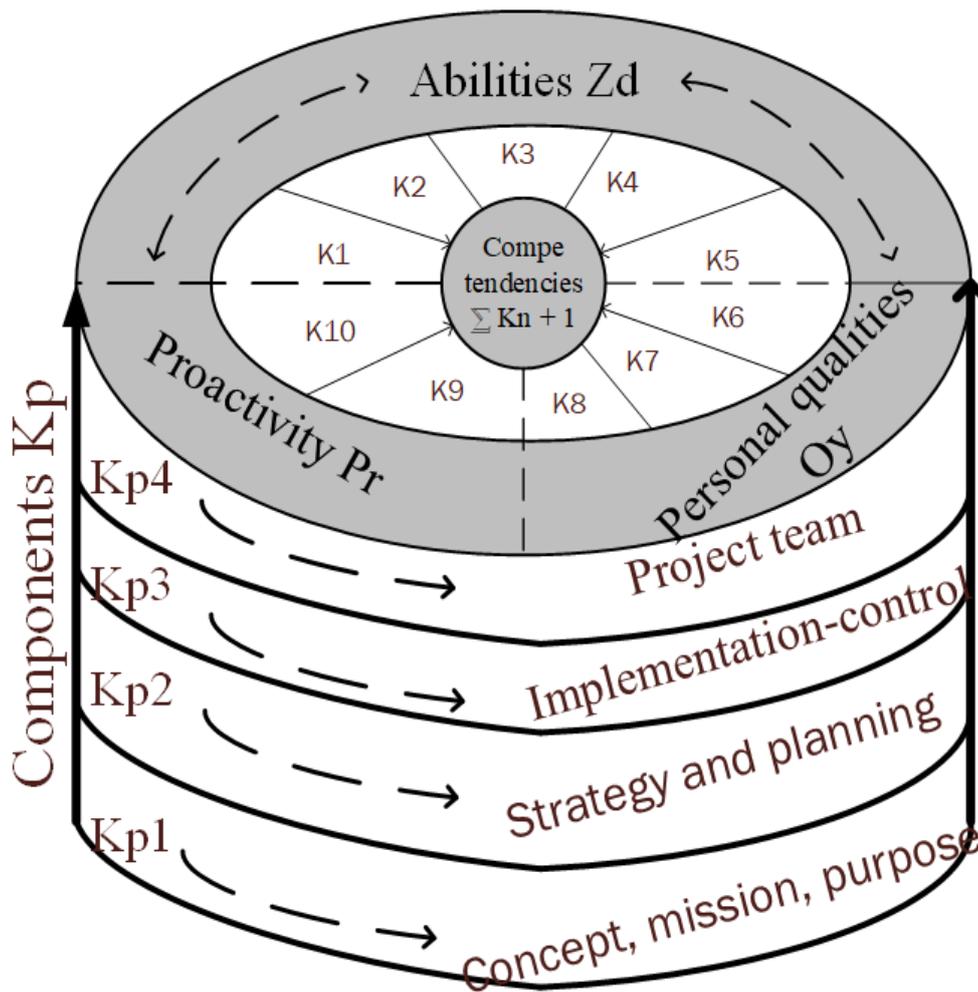


Figure 6: CPS competency model

#### 4. Conclusions

Continuous analysis of the personnel of divisions and services makes it possible to make timely adjustments, competently carry out personnel movements vertically and horizontally, to note and timely correct both positive changes and negative deviations in staffing. The generalized model-scheme of the expert information system for selection of shots in safety-oriented systems is developed. In this paper, we have analyzed information systems for human resource management and selection criteria for complex socio-technical systems. A model of information system formation for its implementation in safety - oriented systems for automation and optimization of personnel processes for human resources management has been developed. A module for selection of candidates for project teams of safety - oriented systems based on the index method for further formation of the project team has been introduced into the information system. The model of HR information systems is proposed, as well as the integration of the system with databases that improve the efficiency of process management at all levels of the life cycle of employees and the organization as a whole.

#### References

- [1] S. Bushuyev. Project management: basics of professional knowledge and system of assessment of competence of project managers, IRIDUM, 2010, pp. 208.

- [2] I. Chumachenko. Methods of human resources management in the formation of teams of multiprojects and programs, monograph, 2015.
- [3] V. Morozov, A. Cherednichenko, T. Shpylyova. Formation, management and development of the project team (behavioral competence), textbook, 2009, pp. 464.
- [4] D. Lysenko, Models and methods of forming a project team using precedent theory, research, 2009.
- [5] M. Gogot, M. Chuprina. The use of information systems in personnel management. Current issues of economics and science: Collection of scientific works of the Faculty of Management KPI. I. Sikorsky. 2017, № 11, pp. 3–7.
- [6] D. Kobylykin, O. Zachko. Structural models of safety-oriented management of infrastructure projects decomposition. Materials of 2020 IEEE 15th International Scientific and Technical Conference on Computer Sciences and Information Technologies (CSIT 2020). V. 2. Lviv-Zbarazh, 2020, pp. 131–134.
- [7] D. Kobylykin, O. Zachko, V. Popovych, N. Burak, R. Golovaty, Wolff Carsten (2020). Models for Changes Management in Infrastructure Projects. ITPM 2020, pp. 106–115. <https://www.semanticscholar.org/paper/Models-for-Changes-Management-in-Infrastructure-Kobylykin-Zachko/9e91a135c4533e7cc58fd18ded3e81a49d9295d9#related-papers>
- [8] O. Zachko, Chalyy D.O, D. Kobylykin. Models of technical systems management for the forest fire prevention. Naukovyi Visnyk Natsionalnoho Hirnychoho Universytetu. 2020, No. 5. pp. 129–135. <https://doi.org/10.33271/nvngu/2020--5/129> <http://nvngu.in.ua/index.php/en/archive/on-the-issues/1850-2020/contens-5-2020/5519-models-of-technical-systems-management-for-the-forest-fire-prevention>
- [9] B. Kuybida, O. Petroe, L. Fedulova, G. Androschuk. Digital competences as a condition for the formation of the quality of human capital: an analyst, Kyiv: NAPA, 2019. pp 28.
- [10] M. Christine, M. Banaria, E. Joi, W. Ang. Developing a Human Resource Information System through Hybrid Software Engineering Model, University of Asia and the Pacific, Conference: Make SEnS Research Colloquium, April 2018, pp. 2-7, URL : <https://www.researchgate.net/publication/327061977>
- [11] M. Golam, R. Alam, A. Kadar, M. Masum, L. Beh, C. Hong. Critical Factors Influencing Decision to Adopt Human Resource Information System (HRIS) in Hospitals 2016, URL: <https://doi.org/10.1371/journal.pone.0160366>
- [12] Guide to the Project Management Body of Knowledge (PMBOK® Guide). Sixth Edition. Project Management Institute. Publications, 2017.
- [13] V. Pasichnyk, N. Kunanets, N. Veretennikova, A. Rzhеuskyi, M. Nazaruk, Simulation of the Social Communication System in Projects of Smart Cities, in: Proceedings of the 14th International Scientific and Technical Conference on Computer Sciences and Information Technologies, CSIT 2019, 2019, pp. 94–98.
- [14] R. Sand. HR and Cloud Computing: How the Cloud is Transforming HR [Electronic resource]. - Access mode: <https://www.hrtechnologist.com/articles/digitaltransformation/hr-and-cloud-computing-how-the-cloud-is-transforming-hr/>
- [15] E. Kennedy. How VR is transforming HR / CNN Business. URL: <https://edition.cnn.com/2019/02/26/tech/vr-transforming-hr-intl-bizevolved/index.html>
- [16] E. Vasilevskis, I. Dubyak, T. Basyuk, V. Pasichnyk, A. Rzhеuskyi, Mobile application for preliminary diagnosis of diseases. CEUR Workshop Proceedings, 2255 (2018) 275–286.
- [17] M. Odrekhivskyy, V. Pasichnyk, A. Rzhеuskyi, V. Andrunyk, M. Nazaruk, O. Kunanets, D. Tabachyshyn, Problems of the intelligent virtual learning environment development. CEUR Workshop Proceedings 2386 (2019) 359–369.
- [18] V. Pasichnyk, D. Tabachyshyn, N. Kunanets, A. Rzhеuskyi, Visualization of Expert Evaluations of the Smartness of Sociopolises with the Help of Radar Charts. Advances in Intelligent Systems and Computing 938 (2020) 126–141.