Methods of information systems synthesis

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METHODOLOGICAL SUPPORT FOR MANAGING OF CRITICAL COMPETENCES IN AGILE TRANSFORMATION PROJECTS WITHIN A MULTI-PROJECT MEDICAL ENVIRONMENT

Abstract. Ensuring the continuity, efficiency and quality of medical care requires solving the problem of managing the critical competencies of personnel in a multi-project medical environment. **The object of research** is resource management processes in the medical environment. **The subject of the research** is models, methods and processes of managing critical competencies in Agile projects of transformation of a multi-project medical environment. **The purpose of the work** is to develop methodological support for managing critical competencies in Agile transformation projects within a multi-project medical environment. The article addresses the following **tasks**: analysis of factors affecting the formation of the register of critical competencies in the medical environment; development of a conceptual model for critical competence management; development of an aggregated model for the configuration management process of critical competencies; development of a method for managing critical competencies; development of recommendations for applying of methodological support for managing critical competencies in Agile transformation projects within a multi-project medical environment. **Research methods** are based on project-oriented, donor-acceptor approaches, combinatorial analysis and set theory, configurational management to solve the problem of managing critical competencies in a multi-project medical environment. The results of the work include the development of methodological support for managing of critical competencies in Agile transformation projects within a multi-project medical environment, specifically the conceptual model for managing critical competencies; an aggregated model for the configuration management process of critical competencies; a method for managing critical competencies. The application of the developed methodological support is considered through a test example. **Conclusions.** The proposed methodological support for managing critical competencies in Agile transformation projects within a multi-project medical environment contributes to improving the quality of medical services by proactively managing the resource provision of medical institutions. The comprehensive application of the proposed solutions showed an increase in the value of the team's characteristics by 1.1-1.42 times, depending on the type of input matrix of competences in the test examples.

Keywords: project management; critical competencies; human resources; Agile transformation, configuration management.

Introduction

Problem definition. The COVID-19 pandemic revealed general problems with providing medical personnel and the need to reengineer human resource management processes to ensure the quality of medical care. The increase in the number of patients, the unpreparedness of hospitals both in material and technical terms, and in resource (personnel) provision led to the inability to provide timely medical care in full.

The reform of the medical system in Ukraine, which began even before the pandemic and continues amid a full-scale invasion, is carried out in an unpredictable environment and needs to account for the impact of negative factors such as the acute shortage of medical personnel, migration processes and threats of shelling and blackouts.

Analysis of recent research and publications. The personnel crisis in medical institutions worsened during the COVID-19 pandemic, creating the need to change approaches to resource provision in medical institutions [1].

Dolati, S., Mojarad, A., Dimeh Noghani, M., Hedayat, M., et al. in their work [2] note that in order to ensure the quality provision of medical services, it is necessary not only to modernize the physical space of

the medical institution but also to reorganize the staffing processes. The issue of resource provision is especially important when providing specialists who have critical competencies and providing a staff of medical nurses who are in a high-risk group. Dividing personnel into groups, revising job instructions and work distribution within the team, and determining the procedure for managing critical competencies positively affect the efficiency of management in medical institutions.

One of the stages proposed by Wu et al. [3] to improve the resource provision of the staff of medical institutions is the development and preparation of a training plan for the medical staff in accordance with all the requirements of the environment.

Personnel development, changes in operating conditions, management of critical competencies as a response to changes in the environment and organizational context, readiness for adaptation determine the degree of success of crisis response [4]

The use of proactive regular planning of staffing in medical institutions and the creation of a hospital command crisis center [2] can be used in the organization of medical care during wartime and post-war periods in Ukraine.

The development of health information systems (HIS) [5, 6] is a promising direction that will allow

coordination of medical care and the processes of resource provision in medical institutions.

Improving approaches to personnel development for the implementation of post-war reconstruction projects requires changing approaches to resource allocation to reduce the corruption component [7]

Agile transformation projects within multi-project medical environment processes require not only managerial and professional competencies but also a high level of digital competencies [8, 9].

Analysis of the level of possession of digital competences among medical staff revealed the need for their development with further assessment during testing and solving case tasks.

The document "Framework of Digital Competence of Health Care Workers of Ukraine" states the requirements for the digital competence of employees of medical institutions and establishes the levels of digital competence (basic, sufficient, professional, high), which can be used when evaluating the characteristics of teams in the management of critical competencies [10]

Among the critical digital competencies (areas of competence) of employees in medical institutions, the following are distinguished:

– general digital literacy;

– working with data from the electronic health care system and other information systems;

– digital communication, interaction and cooperation in a digital environment;

– digital tools, devices and applications in the field of health care;

– digital transformation in healthcare [10].

McLean & Company's HR Trends Survey 2024 [11] analysis of HR trends showed that trends related to the management of critical competencies will remain relevant in 2024:

– personnel selection;

– support for changes;

– development of organizational leaders;

– provision of training and development;

– operational resource mobility in response to changes in the company's strategic priorities.

According to the operational guidelines for the organization of the system for providing primary medical care, a group of medical workers is involved in the team, which "is formed by the subject of providing medical care to ensure the provision of care to patients, and during the formation of which the directory of qualification characteristics of the professions of health care workers is taken into account (doctors of other specialties, paramedics, nurses, etc.)" [12]. It is noted that when forming a primary medical care team, it is necessary to rely on competence-based approach to provide quality care.

When forming the register of critical competencies, it is necessary to differentiate medical personnel [12]:

– key personnel;

– key personnel with the possibility of a long interruption of professional activity;

– personnel with the prospect of retirement;

– personnel with qualification restrictions.

The increase in the amount of digital information circulating in the medical environment, requires the development and implementation of a knowledge management system in health care institutions [13]. It should be noted that the knowledge management system should take into account the specifics of the health care institution and be able to integrate with the critical competence management system.

During the implementation of projects, especially in a multi-project environment, there are changes in the criticality of competencies, their levels, approaches to team formation. Therefore, taking into account the factors of development and erosion of competencies throughout the life cycle of the project in the management of human resources is an urgent task that requires proactivity [14, 15].

Identification of previously unsolved parts of the overall problem. Purpose of work, tasks

The use of classical approaches to the formation of the staffing schedule of a health care facility cannot ensure the flexibility and efficiency of the forming of medical care teams, as it requires a significant amount of coordination time. Rapid changes in the profile of competencies in medical institutions lead to:

– migration of medical personnel (internal and external);

– migration of patients;

– repurposing of a medical institution;

– decrease in the number of medical workers;

– mobilization;

– obsolescence of knowledge without training.

To ensure the continuity and efficiency medical care provision, it is necessary to develop and implement the management of critical competencies of the personnel in the multi-project medical environment.

The object of research is resource management processes in the medical environment. The subject of the research is the models, methods and processes of managing critical competencies in Agile projects for transformation of multi-project medical environments.

The purpose of the study is to develop methodological support for the management of critical competencies in Agile projects for the transformation of a multi-project medical environment.

The article addresses the following tasks:

– conduct an analysis of factors affecting the formation of the register of critical competencies in the medical environment;

– develop a conceptual model of critical competence management;

– develop an aggregated model of the configuration management process of critical competencies;

– develop a method for managing critical competencies;

– offer recommendations on the application of methodological support for the management of critical competencies in Agile projects of transformation of a multi-project medical environment.

Materials and methods. Research methods are based on the use of project-oriented, donor-acceptor

approaches, the application of combinatorial analysis and set theory, configurational management to solve the problem of managing critical competencies in a multi-project medical environment.

Research results and their discussion

The criticality of competencies is assessed at the medical facility, regional, and national levels. Aggregation of indicators of the management system of critical competencies facilitates the coordination of resource provision processes at different levels of management.

The implementation of the cluster approach and the use of hospital districts enhance the efficiency of applying the donor-acceptor approach to resource allocation for projects implemented in a multi-project medical environment.

The list of critical competencies is formulated on the basis of statistical information, reflecting development trends and project implementation risks.

When evaluating the existing profile of competencies in a medical institution, it is necessary to take into account both standard and specific industry aspects:

– approaches to forming a pool of resources in a medical institution;

– determination of qualitative and quantitative requirements for human resources;

– requirements for the qualifications of medical personnel;

– working conditions (full-time, part-time employment, combination of positions);

– the possibility of combining work in different departments (specific restrictions due to sanitary, hygienic, and epidemiological requirements);

– level of engagement;

– experience (when analyzing experience, the context of gaining experience should be considered: international activity, work in a private and/or state medical institution, region and working conditions, level of traumatization).

Important issues that need to be addressed are the definition of the required profile of competencies, approaches to solving personnel issues (how employees are involved): whether it is possible to attract employees from other medical institutions, overtime work, combining positions, etc.

When managing the critical competencies of the staff of medical institutions, making changes to the established and signed staffing schedule makes it difficult to respond quickly to changes in the profile of competencies.

Using the principles of the donor-acceptor approach is effective at the level of divisions/departments of medical institutions, but there may be problems with attracting external employees to a stable staffing schedule.

When forming a personnel development strategy that takes into account the principles of critical competence management, it is suggested to use the apparatus of symbolic sequences, which will allow determining the most adequate development option.

When determining the management system of critical competencies, it is necessary to ensure proactive management, since excessive attention to a certain critical competency with subsequent training of personnel for transfer to another position/other task may lead to the deficit of other competencies as a result of redistribution of resources.

The conceptual model of the critical competence management system during the implementation of Agile transformation projects in a multi-project medical environment is shown in Fig. 1.

The proposed model is based on the principles of configuration management and takes into account the peculiarities of the deployment of critical competence management both within a medical institution and at the national, regional level, by implementing coordination mechanisms in the processes of managing critical competencies.

The determination of the configuration of resource provision involves the formation of requirements for the number of resources, their qualifications, reservation coefficients, and project-specific restrictions. Based on the audit of the available resources in the multi-project medical environment, taking into account the resource requirements of the configuration, resource provisioning options are generated (project team composition, distribution of work, provision of necessary competencies). These options are evaluated according to specified characteristics.

After selecting a resource provision option, recommendations are developed for the profile of critical competencies. The implementation of the critical
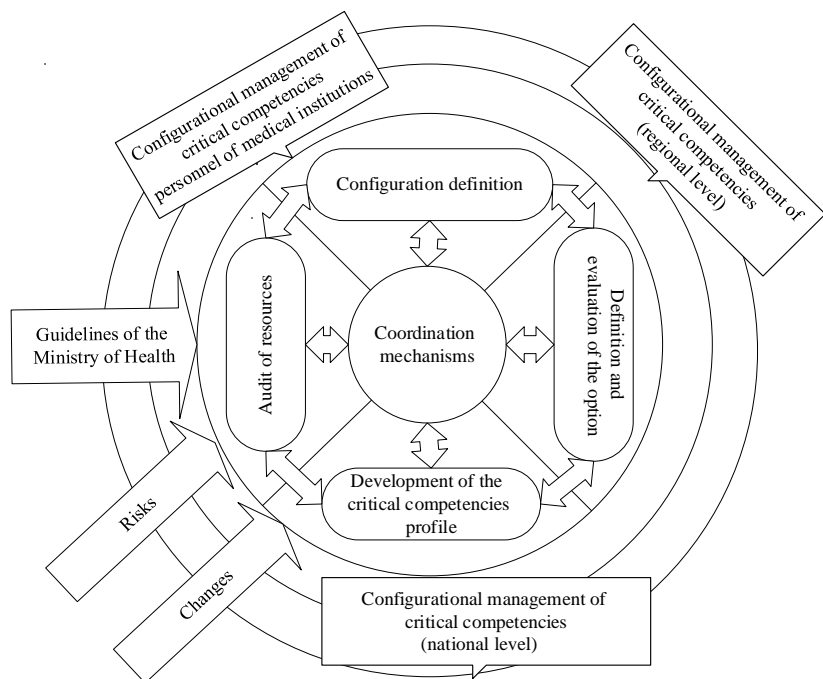

Fig. 1. Conceptual model of management of critical competencies of medical personnel in Agile transformation projects

competence profile development program leads to the initiation of a resource audit and the updating of information in the resource pool. The integration of coordination mechanisms with all elements of the process ensures the effective management of critical competencies, taking into account risks, guidelines and initiated changes.

To improve the quality of medical services, it is proposed to define specific metrics that reflect the specifics of medical care provision in a particular region. Since the approaches to resource provision vary, for example, the formation of teams of medical institutions in front-line territories or territories of active (possible) hostilities, differentiation of metrics is necessary.

Based on the received metrics, taking into account the functional requirements for the team and the available applicants, options for resource provisioning configurations are formed. After verifying the functional feasibility of the received options, the option that best meets the specified requirements regarding cost, availability, qualification, etc. is selected. To maintain the quality of process management, the consistency of the implementation conditions of the chosen resource provision option with the medical institution's personnel development strategy is checked.

The aggregated model of the process of configurational management of critical competencies in a multi-project medical environment is shown in Fig. 2.
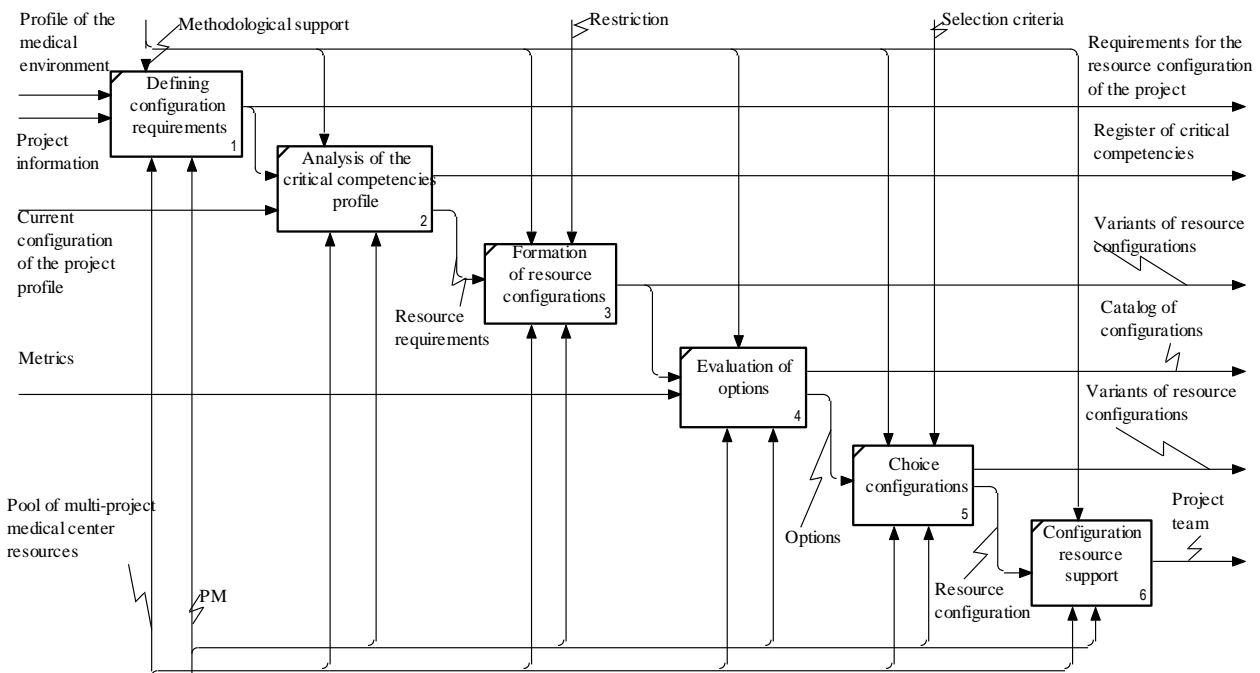

Fig. 2. Aggregated model of the process of configurational management of critical competencies of medical personnel in Agile transformation projects

Based on the analysis of the work to be performed in the project, the profile of resources in the medical environment, and the results of the audit of the resource pool in the multi-project medical environment, the limitations and criteria for choosing the configuration of the team, the configuration requirements are determined. This involves analyzing the profile of critical competencies, forming resource configurations, evaluating configurations, and selecting and provisioning the configuration.

The outputs of the process of configurational management of critical competencies are:

– documented requirements for the resource configuration of the project implemented in a multi-project medical environment;

– the register of critical competencies, taking into account the requirements for the resource configuration of the project being implemented;

– variants of resource configurations;

– a configuration catalog with estimates, which will allow, if necessary, reverse engineering of the resource provisioning process;

– an updated profile of critical competencies with recommendations for further balancing the profile;

– a project team that meets the requirements of the current resource configuration.

The management of the medical institution and representatives of the personnel department are involved in the implementation of the process of configurational management of critical competencies, if necessary.

When applying the scenario approach to the management of critical competencies, the specific team formation scenario is determined, and the impact of human resource provisioning scenarios on the management of critical competencies is evaluated [16].

Uniting medical institutions into clusters should contribute to improving the quality of service provision but is dependent on the availability and quality of primary care services. In 2022-2024, the issues of providing quality medical care by family doctors in the front-line territories have become even more urgent. At the beginning of the full-scale invasion, the rapid transition to Agile management led to the formation of resource provision for medical institutions with the

involvement of external specialists who could quickly meet needs through consultation, mutual assistance, and coordination actions between hospitals. Now, there is a return to centralized management of the medical industry, with resource needs being mainly met by the medical institution or department itself. This, combined with a shortage of personnel, negatively affects the quality of service provision.

The change in the model of functioning of medical institutions in 2022 highlighted certain problems, although it contributed to the development of staff competencies.

Risks associated with the transition to the deployment phase of the transformation project include:
– a desire to return to centralized management;
– a return to the previous configuration of management processes;
– a reduction of qualified employees of medical institutions compared to 2022;
– problems of interaction among specialists with different experiences during the war;
– incoherence of actions and manifestations of corruption during manual management.

For critical competencies, we define:
– the level of criticality of competence;
– the criticality term;
– the species;
– the impact on project indicators;
– the conditions of occurrence;
– the available level of provision;
– the maximum level of provision.

A method of managing critical competencies is proposed, based on the analysis of configurations of critical competencies of a multi-project medical environment. This method enables the identification, planning and provision of critical competencies in Agile transformation projects.

Stages of the method of managing critical competencies of medical staff in Agile transformation projects:

Stage 1. Formation of the responsibility matrix in the RACI format (role/position for the work to be performed in the project).

Stage 2. Formation of the matrix of critical competencies based on the responsibility assignment matrix.

Stage 3. Assessment of existing resource support with defined competencies in a multi-project medical environment and the possibility of redistributing resources between projects.

Stage 4. Selection of candidates for the project team.

Stage 5. Distribution of performers taking into account requirements and restrictions.

Stage 6. Formation of recommendations for the management of critical competencies.

At the stage of distribution of performers, the methods described in works [17, 18] are used.
The management of critical competencies of a multi-project medical environment requires the formalization of the process of reviewing the competency profile and making changes, the elements of which includes:

– preparatory stage. At the this stage, the concepts of personnel development, creation of a reserve and availability of the possibility of involvement are determined;
– audit of resource support of the project;
– determination of the process of managing critical competencies at the organisational level;
– transition to the aggregated level.

Based on the analysis of the profile of the organization's competencies, a development potential matrix (DPM) of critical competencies is formed, which indicates the level of competence compliance with the requirements.

Let's consider the application of the method using an example. For the presented responsibility matrix, a matrix of critical competencies was formed according to the competency passport (Table 1). The characteristics of the applicants are determined based on the evaluations during the personnel certification.

Table 1 – **Matrix of critical competencies**

Q/Kcr	Kcr$_1$	Kcr$_2$	Kcr$_3$	Kcr$_4$	Kcr$_5$	Kcr$_6$
q$_1$	250	500	80	500	80	900
q$_2$	600	50	90	500	70	100
q$_3$	800	40	600	180	30	160
q$_4$	150	700	140	850	150	260
q$_5$	60	60	800	200	950	800
q$_6$	400	260	900	230	200	900
q$_7$	500	790	230	240	50	120
q$_8$	800	180	600	150	750	130
q$_9$	40	800	210	300	140	890
q$_{10}$	89	230	500	140	800	130
q$_{11}$	90	200	500	700	700	125
q$_{12}$	900	150	200	200	1000	200
q$_{13}$	68	560	210	800	140	180
q$_{14}$	50	60	190	900	750	90

Table 2 shows the matrix of critical competencies and potential performers from the resource pool possessing a certain competency.

Restrictions on the minimum level of competence for the project R = {275, 270, 250, 250, 210, 265}.

As a result of the applying the developed specialized software for forming the project team, a simulation of the resource provision process was carried out, and 3,379 options for resource distribution were determined. Taking into account the restrictions on the level of competences and functional redundancy, the generated options for building the project team are shown in Table 2.

Considering the interest in the team with the maximum characteristic (general level of competence), we select the configuration {2, 0, 1, 4, 5, 6, 0, 0, 0, 3, 0, 0, 0, 0}, which corresponds to option 16, C=4500.

The application of the proposed method demonstrated an increase in the value of the team characteristic by 1.29 times. The distribution of performers is shown in Table 3.

As a result of analyzing the level of critical competencies of the resource pool, a development potential matrix (DPM) of competencies was formed (Table 4).

Table 2 – **Options for building a project team taking into account critical competencies**

Option number	q_1	q_2	q_3	q_4	q_5	q_6	q_7	q_8	q_9	q_{10}	q_{11}	q_{12}	q_{13}	q_{14}	C
1	2	1	3	4	5	6	0	0	0	0	0	0	0	0	4400
2	2	1	3	4	0	6	0	0	0	0	5	0	0	0	4150
3	2	1	3	0	0	6	0	0	4	0	5	0	0	0	3600
4	2	1	0	4	5	6	0	0	0	3	0	0	0	0	4300
5	2	1	0	4	0	6	0	0	0	3	5	0	0	0	4050
6	2	1	0	0	0	6	0	0	4	3	5	0	0	0	3500
7	2	1	0	4	5	6	0	0	0	0	3	0	0	0	4300
8	2	1	0	0	5	6	0	0	4	0	3	0	0	0	3750
9	0	1	3	2	5	6	0	0	4	0	0	0	0	0	4050
10	0	1	3	2	0	6	0	0	4	0	5	0	0	0	3800
11	0	1	0	2	5	6	0	0	4	3	0	0	0	0	3950
12	0	1	0	2	0	6	0	0	4	3	5	0	0	0	3700
13	0	1	0	2	5	6	0	0	4	0	3	0	0	0	3950
14	2	0	1	4	0	6	0	3	0	0	5	0	0	0	4350
15	2	0	1	0	0	6	0	3	4	0	5	0	0	0	3800
16	2	0	1	4	5	6	0	0	0	3	0	0	0	0	4500
17	2	0	1	4	0	6	0	0	0	3	5	0	0	0	4250
18	2	0	1	0	0	6	0	0	4	3	5	0	0	0	3700
19	2	0	1	4	5	6	0	0	0	0	3	0	0	0	4500
20	2	0	1	0	5	6	0	0	4	0	3	0	0	0	3950
21	4	0	1	2	0	6	0	0	0	3	5	0	0	0	4100
22	0	0	1	2	5	6	0	0	4	3	0	0	0	0	4150
23	0	0	1	2	0	6	0	0	4	3	5	0	0	0	3900
24	0	0	1	2	5	6	0	0	4	0	3	0	0	0	4150

Table 3 – **Resource provision of the project**

Q/Kcr	Kcr$_1$	Kcr$_2$	Kcr$_3$	Kcr$_4$	Kcr$_5$	Kcr$_6$
q_1	0	1	0	0	0	0
q_3	1	0	0	0	0	0
q_4	0	0	0	1	0	0
q_5	0	0	0	0	1	0
q_6	0	0	0	0	0	1
q_{10}	0	0	1	0	0	0

Table 4 – **Development potential matrix**

Q/Kcr	Kcr$_1$	Kcr$_2$	Kcr$_3$	Kcr$_4$	Kcr$_5$	Kcr$_6$
q_1	-25	230	-170	250	-130	635
q_2	325	-220	-160	250	-140	-165
q_3	525	-230	350	-70	-180	-105
q_4	-125	430	-110	600	-60	-5
q_5	-215	-210	550	-50	740	535
q_6	125	-10	650	-20	-10	635
q_7	225	520	-20	-10	-160	-145
q_8	525	-90	350	-100	540	-135
q_9	-235	530	-40	50	-70	625
q_{10}	-186	-40	250	-110	590	-135
q_{11}	-185	-70	250	450	490	-140
q_{12}	625	-120	-50	-50	790	-65
q_{13}	-207	290	-40	550	-70	-85
q_{14}	-225	-210	-60	650	540	-175

Taking into account the obtained results, the configuration of performers {q1, q6, q7, q7, q6, q4} is promising for development. This configuration involves increasing the level of Ksr1 of the competence of performer q1 by 25 points, Ksr2 of the competence of performer q6 by 10 points, Ksr3 of the competence of performer q7 by 20 points, Ksr4 of the competence of performer q7 by 10 points, Ksr5 of the competence of performer q6 by 10 points, and Ksr1 of the competence of performer q4 by 5 points. This approach will facilitate their involvement in the resource configurations for these competencies, considering the restrictions on the minimum value.

Modeling of project team building, taking into account critical competencies for input matrices of various sizes with different sets of levels of critical competencies, was conducted. The obtained results showed an increase in the value of the team's characteristics by 1.1 - 1.42 times.

Conclusions and prospects for further development

The results of the work include the development of methodological support for the managing critical competencies in Agile transformation projects within a multi-project medical environment:

– a conceptual model of critical competence management;

– an aggregated model of the configuration management process of critical competencies;

– the method of managing critical competencies.

Based on the analysis of project resource configurations, recommendations for managing critical competencies have been developed. The application of the developed methodological support for managing critical competencies is considered at various levels of

management, including medical institutions, regional, and national levels. The use of a project-oriented approach, stakeholder management and crisis management, combined with coordination mechanisms, will facilitate the identification, planning, management and monitoring of critical competencies in a multi-project environment and reduce the risk of losing critical knowledge.

The application of the developed methodological support is illustrated with test examples.

The proposed methodological support for managing critical competencies in Agile transformation projects within a multi-project medical environment contributes to improving the quality of medical service provision through proactive management of resource allocation in medical institutions. The comprehensive application of these solutions resulted in an increase in the value of team characteristics by 1.1 to 1.42 times, depending on the type of input matrix of competencies used in the test examples. An increase in the general level of team competencies is observed as the size of the matrix of critical competencies grows.

A promising direction for further development is the creation of an information system for resource management in health care institutions.

Acknowledgements

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Методологічне забезпечення управління критичними компетенціями в проєктах Agile трансформації мультипроєктного медичного середовища

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Анотація. Забезпечення безперервності, оперативності та якості надання медичної допомоги потребує вирішення задачі управління критичними компетенціями персоналу мультипроєктного медичного середовища. **Об'єктом дослідження** є процеси управління ресурсами в медичному середовищі. **Предметом дослідження** є моделі, методи та процеси управління критичними компетенціями в проєктах Agile трансформації мультипроєктного медичного середовища. **Метою роботи** є розробка методологічного забезпечення управління критичними компетенціями в проєктах Agile трансформації мультипроєктного медичного середовища. У статті вирішуються **завдання**: аналіз чинників, що впливають на формування реєстру критичних компетенцій в медичному середовищі; розробка концептуальної моделі управління критичними компетенціями; розробка агрегованої моделі процесу конфігураційного управління критичними компетенціями; розробка метод управління критичними компетенціями; розробка рекомендацій з застосування методологічного забезпечення управління критичними компетенціями в проєктах Agile трансформації мультипроєктного медичного середовища. **Методи** дослідження ґрунтуються на використанні проєктно-орієнтованого, донорно-акцепторного підходів, застосуванні комбінаторного аналізу та теорії множин, конфігураційного управління для вирішення задачі управління критичними компетенціями в мультипроєктному медичному середовищі. **Результатами** роботи є розробка методологічного забезпечення управління критичними компетенціями в проєктах Agile трансформації мультипроєктного медичного середовища, а саме концептуальної моделі управління критичними компетенціями; агрегованої моделі процесу конфігураційного управління критичними компетенціями; методу управління критичними компетенціями. Розглянуто застосування розробленого методологічного забезпечення на тестовому прикладі. **Висновки.** Запропоновано методологічне забезпечення управління критичними компетенціями в проєктах Agile трансформації мультипроєктного медичного середовища, яке сприяє підвищенню якості надання медичних послуг за рахунок проактивного управління ресурсним забезпеченням медичних установ. Комплексне застосування запропонованих рішень показало підвищення значення характеристики команди в 1,1 – 1,42 рази залежно від виду вхідної матриці компетенцій тестових прикладів.

Ключові слова: управління проєктами; критичні компетенції; людські ресурси; Agile трансформація, конфігураційне управління.