A Model for Allocating Labor Resources to Project Work Based on Task Prioritization

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Abstract
In the context of the growing complexity of IT projects and increased demands on the speed of their implementation, effective labor management is becoming one of the key success factors. The development of information technology and a dynamic project management environment is an important component of effective management based on the optimal allocation of labor resources.
IT project management is a complex process that requires efficient resource allocation. One of the key aspects of this process is the assignment of labor resources to various tasks based on their importance and priority. Incorrect allocation can lead to delays in project implementation, budget overruns, and lower quality of the final product.
The process of assigning specialists to IT project tasks should take into account not only the qualifications and competencies of the team, but also the importance and priority of individual tasks. Different stages of a project require different levels of involvement of specialists with the appropriate qualifications, and the optimal selection and allocation of resources can significantly affect the timing and quality of work [1]. The peculiarity of implementing projects according to iterative models is the constant change of the population in a separate iteration or sprint, which requires a prompt response and the appointment of those responsible for project work.
The article discusses a model for assigning labor resources based on an analysis of the importance and priorities of tasks, which allows for better project management, reduced risks, and increased efficiency of working time.
The purpose of the publication is to present a new model for assigning labor resources to IT project work, which allows taking into account both the importance of tasks and available resource constraints.

Keywords
project, task, project management, IT, resource allocation, optimization, model, algorithm, task importance, priority

1. Introduction

Managing labor resources in IT projects is a complex task that requires taking into account many factors, such as the qualifications of specialists, the availability of resources, the timing of tasks and their priority [2,3].

In today's fast-paced world of IT development, effective project management is critical to success. One of the key tasks of a project manager is to optimize allocation of labor resources [4]. Traditional methods are often based on intuition and experience, which can lead to uneven workloads, delays in project implementation, and lower quality results. The tasks that arise in the development process

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can vary in scope, complexity, importance, and deadlines, which requires a competent approach to their prioritization and distribution. Each specialist has his or her own set of competencies and level of qualification, which should also be taken into account when assigning tasks [5]. Incorrect allocation of resources can lead to delays, deterioration of product quality, increased costs, and disruption of project implementation [6].

Increased competition in the IT services market is forcing companies to look for ways to improve project management efficiency, among which labor allocation is an important one, as employees are a key resource for successful project implementation [7].

Existing research in project management offers a wide range of methods for assigning tasks [3,7,8]. Modern approaches to resource management involve the use of different models based on factors such as the experience of specialists, time constraints, the importance of tasks, and priorities that may change at different stages of the project. However, most of them focus on static models that do not take into account the dynamic nature of IT projects [4,8]. In addition, existing approaches often do not pay enough attention to the individual characteristics of the performers and their interactions. In this paper, we propose a new model that addresses these issues by using methods that take into account all conceptual requirements for all project tasks. The presented model is more flexible and adaptive than existing approaches and allows for a more accurate prediction of project outcomes.

The main problem is that at each stage of the project there are tasks of different levels of importance: some are critical for the further development of the project, while others are less important. In addition, a task can be prioritized not only because of its importance, but also because of its timing or dependence on other tasks. This leads to the need for a flexible approach to resource allocation, where each specialist is assigned to a task not only according to their level of qualification but also taking into account the strategic priorities of the project.

The main goal of the study is to optimize the allocation of labor resources, which allows critical tasks to be completed on time and with high quality, while effectively using available resources.

2. Problem statement

The manual distribution of project tasks among project team members has certain problems that have negative consequences for the project as a whole and can have a negative impact on each individual project employee. Let's highlight the most significant problems that arise on projects when distributing project tasks [9,10].

- Subjectivity in task distribution. Tasks are often assigned based on the project manager's intuition or the experience of employees, which can lead to uneven workloads, delays in completing tasks, and a decrease in overall project efficiency.
- Insufficient consideration of competencies. When assigning tasks, the specific skills and knowledge of employees are not always taken into account, which can lead to less qualified specialists performing tasks and increasing the time required to complete them, or to simple tasks being performed by highly qualified employees, which increases the cost of the project.
- The need to respond quickly to changes. IT projects often face unforeseen situations that require prompt reallocation of resources. The manual reallocation process can be lengthy and cause additional delays.
- Lack of objective criteria for assessing efficiency. Assessment of the effectiveness of resource allocation is usually subjective, which makes it difficult to identify problems and implement improvements.
- Priority of tasks. Companies do not always have a system of task allocation based on the priority and importance of the task, which makes it impossible to launch a software product with minimal viability or one that can be put into commercial operation.

The objective of the study is to develop a model for assigning human resources to IT project tasks, taking into account the importance and priorities of these tasks [11]. The model should take into account factors such as limited human resources, different levels of task complexity, and the need to perform several tasks simultaneously within a single project.

In accordance with the requirements imposed on project implementation, the following criteria should be taken into account, which are the main ones for making a decision on the appointment of contractors for project work [3,12].

- Limited resources. Every IT project has a limited number of specialists who can work on different tasks. This means that resources need to be allocated in such a way as to achieve maximum results with minimum time and effort.
- Uneven task complexity. Tasks in a project can be of varying complexity and require different levels of specialist involvement. Some tasks require more time and qualifications, while others can be performed by less experienced professionals.
- Prioritization of tasks. In IT projects, the importance of tasks can change over time. There are tasks that are critical for the further implementation of the project, so their implementation should be a priority.
- Dependencies between tasks. In many cases, one task cannot start until another is completed, which adds complexity to resource allocation planning.
- Changing conditions during the project. Often, unforeseen changes (new requirements, changes in priorities) occur during the project, which requires flexible reallocation of resources.

Based on these provisions, we will present the main parameters that influence the appointment of executives in accordance with the priority of the task.

3. Methods for Solving the Problem

3.1. Specific features of implementing the tasks of projects implemented using agile methodologies

Taking into account the priority of tasks when implementing projects using agile methodologies such as Scrum, Kanban, or Agile has its own peculiarities that require immediate response for high-quality project implementation. The main goal of such approaches is to quickly adapt to changes, which requires effective management of tasks and resources, in particular based on their prioritization [13].

Flexible methodologies involve regular review of priorities based on current business goals, changes in client requirements, or other external factors within a particular sprint or project iteration. In Scrum, for example, the backlog is constantly updated, and the highest priority is given to tasks that bring the most value to the user or business [14]. This makes it necessary for the team to focus on the most important aspects of the project (the most critical tasks) in each sprint.

In Agile, tasks are evaluated not only by complexity or cost, but also by their value to the end user or business. Priority is given to those tasks that bring the product as close as possible to achieving business goals. The Product Owner determines which tasks are the most critical for the further development of the product, and they are brought to the fore. Agile methodologies often focus on delivering a minimum viable product (MVP) that already contains the basic features first [13,14]. This means that tasks that are critical to creating a basic version of the product will have the highest priority. All other functions that are not vital can be completed in later stages.

Agile methodologies involve frequent interactions with users or customers, which allows for feedback after each iteration or sprint [15,16]. Based on this feedback, priorities can change. For example, if a client sees a need to change functionality that was not previously critical, the team can quickly adjust the list of priority tasks. Prioritization of tasks in agile methodologies involves not only determining the order of their execution, but also specifying clear criteria for completing each task. When a task is prioritized, the team knows exactly when it is considered complete. This ensures maximum transparency in the execution process and allows for a more accurate assessment of progress.

Here's a table of the main parameters of severity and priority assigned to a task (Table 1)

Table 1
Main parameters of severity and priority assigned to IT project problems.

Severity is an attribute that characterizes the impact of a task on the performance of the application	
Blocker	the development or use of the product is impossible. An immediate solution is required.
Critical	serious problems (a critical block of functionality is not working, serious errors related to data loss, etc.)
Major	a task related to the important functionality of the product.
Minor	the problem is related to the secondary functionality of the product or there is an easy workaround for this problem.
Trivial	a cosmetic problem (‘unfinished’ interface: typos, color mismatch)
Priority is an attribute that indicates the priority of a task or defect. The higher the priority, the faster the task needs to be resolved.	
High	the problem should be fixed as soon as possible, because its presence is critical for the project
Medium	the problem must be corrected, its presence is not critical, but requires a mandatory solution
Low	the problem must be corrected. It is not critical and does not require an urgent solution.

Each priority indicator can be assigned a different level of severity in relation to the project as a whole. After all, each task can acquire a specific priority with a corresponding severity: a high priority of significant severity, a medium priority of significant severity, a low priority of trivial severity, and so on. For ease of interpretation, the combination of priority and seriousness will be identified as the priority of the task.

The implementation of the mechanism for taking into account competence indicators and indicators of seriousness criteria and prioritizing tasks is a complex indirect model. To link these parameters, it is necessary to determine the importance of resolving conflicts that arise during the implementation of IT projects and contribute to the efficiency of the entire project by promptly assigning and reassigning employees to tasks in IT projects when such changes occur [1,17].

3.2. Modelling the logic of project tasks prioritization

In general, the effectiveness of the system for assigning staff to project tasks depends on the quality of the task implementation by the employee assigned to it

$$P = F\ (W_1, \dots, W_i, \dots, W_N,), \tag{1}$$

where W_i – probability of timely and correct resolution i – of that task by a designated project employee.

When decomposing a function into a McLaurin series and when imposing priority constraints [18], we will get

$$P \approx P_0 + \sum_{i=1}^{N} \frac{\partial P}{\partial W_i} \partial W_i, \tag{2}$$

where $P_0 = F\ (0, \dots, 0)$ – the efficiency of the distribution system, without the influence of the project manager with the manual assignment of resources;

$\frac{\partial P}{\partial W_i} = S_i$ – value characterizing the degree of influence i – of that task on the implementation of the project as a whole (coefficient of importance of the i-th task).

When combining tasks with the same competence requirements, we get

$$P \approx P_0 + \sum_{i=1}^{N} S_i\ N_i\ W_i, \tag{3}$$

where N_i - number of problems i – of that priority that arise in the process of project implementation;

W_i – the probability of a timely and correct solution of tasks of the i - priority that arise in the process of project implementation.

The sum of expression (3) represents the totality of the list of project tasks that must be implemented by each individual executor involved in the project, with the appropriate qualifications, taking into account the seriousness and priority of the task

$$Q_{w_1} = \sum_{i=1}^{N} S_i\ N_i\ W_i, \tag{4}$$

In accordance with the specifics of project implementation, the project manager or other members of the project team determine the priority of the task and its seriousness in relation to all project tasks – S_i . At the same time, when projects are implemented using iterative methods and the number of tasks is constantly changing in the project, the value N_i can be represented as the probability (relative frequency) of the occurrence of tasks i - of that priority – W_i^k.

From here we get a standardized criterion [19] for the performance of tasks by an individual performer on the project

$$Q_w = \sum_{i=1}^{N} S_i\ W_i^k\ W_i, \tag{5}$$

$$W_i^k = \frac{\beta_i}{\sum_{i=1}^{N} \beta_i}, \tag{6}$$

where β_i – frequency of occurrence i – that task in a certain segment (iteration, sprint) of project implementation.

We will use the received criterion Q, to substantiate the optimality of appointing an executor to work on a project with a defined priority.

In this case, the probability of high-quality implementation of the task by the executor W_i depends on the structure and complex of all works of the project

$$W_i = W_i\,(K_l\,), \tag{7}$$

where $K_l = p_1, \dots, p_j, \dots, p_m$ – a set of prioritization parameters imposed on project tasks.

When decomposing the function $W_i\ (K_l\,)$ in the McLaurin series, identifying the priority of tasks from the highest, we obtain

$$W_i(p_j) \approx W_i + \sum_{i=1}^{M} \frac{\partial W_i}{\partial p_j} \Delta p_j, \tag{8}$$

$$q_{ij} = \frac{\partial W_i}{\partial p_j}, \tag{9}$$

where q_{ij} – characterizes the increase in the probability of a solution i – of this task in the relevant project implementation period by including j – of the task prioritization parameter and represents the priority j – of the parameter to be solved i – of the task;

Δp_j – priority conditions contained in the j – that parameter.

Let's single out the value of $\varphi_{ij} \Delta p_j = \sigma_{ij}$ to represent it as a weight j – of the solution priority parameter i – of that task [20]. Then the criterion for the optimal model of involving performers in project tasks

$$Q_l = \sum_{i=1}^{N} \sum_{i=1}^{N} S_i \; W_i^k \; q_{ij}, \tag{10}$$

To formalize the problem of modeling the system of labor resources allocation, we will use the following notations:

K_{max} - the maximum number of tasks in a single iteration or sprint of the project;

K_w - number of tasks in a separate iteration or sprint of the project w – of that priority ($w = \overline{1, W}$);

L_w - number of options for performers for the project task w – of that priority.

With the introduced notations, taking into account the main parameters imposed on the conditions for the selection of personnel for the implementation of design work, taking into account their priority, we will get the following display

$$\sum_{i=1}^{N} \sum_{j=1}^{M} \mu_{ij} Z_j \to max, \tag{11}$$

$$\sum_{j=1}^{M} l_j Z_j \leq K, \tag{12}$$

$$\mu_{ij} = S_i \; W_i^k q_{ij}, \tag{13}$$

$$L = \sum_{w=1}^{W} L_w, \tag{14}$$

$$K_{max} = \sum_{w=1}^{W} K_w\,, \tag{15}$$

where $Z_j = \begin{cases} 1\,, if \; selected \;\; i - \text{the priority of the task} \\ 0 \; in \; other \; cases \end{cases}$

The search for an optimal solution to allocate overstaffing to project work is carried out by reviewing and probing all possible options for engaging staff in project work in accordance with their qualifications, with priority assignment to tasks of the highest priority and downgrading at each subsequent iteration.

3.3. Modelling the algorithm for prioritizing project problems

To model project problems, we will choose the BPMN notation, which will allow us to present the logic of implementing the assignment of performers to project work, taking into account the competence indicators of each employee that meets the competence requirements for each individual project task, as well as taking into account the priority criterion of the task in relation to all project tasks [7,21].

Accordingly, Figure 1 shows a visual algorithm that highlights manual tasks, scripted tasks, and a nested distribution process in accordance with all the imposed parameters and project constraints.

In accordance with the described algorithm, the automated allocation application takes into account the task priority criteria, implementing the allocation by the top-down method: from the highest to the lowest. In case tasks are added during the project implementation that also have priority, or existing tasks that have already been allocated but have not yet moved to the status of execution can be reallocated to obtain the most efficient allocation.

4. Practical Implementation

For practical implementation, a software application has been developed to distribute tasks among performers based on the following input parameters:

- a list of performers with their skills and workload;
- a list of tasks with their requirements, priorities and deadlines;
- matrixes of compatibility between the skills of the performers and the requirements of the tasks.

Let's present a simplified model of the implemented functions, which demonstrates the main idea of the application for distributing tasks between performers in accordance with the imposed criteria.

- Implement the creation of classes to represent performers and tasks:

```
class Employee:
    def __init__(self, name, skills, workload):
        self.name = name
        self.skills = skills
        self.workload = workload

class Task:
    def __init__(self, name, requirements, priority, deadline):
        self.name = name
        self.requirements = requirements
        self.priority = priority
        self.deadline = deadline
```

- Implementing a function for calculating the compatibility of a performer and a task:

```
def compatibility(employee, task):
    # A simplified model: counting the number of common skills
    return len(set(employee.skills) & set(task.requirements))

# Function for calculating compatibility
def calculate_compatibility(employee, task):
    # Implementation of skill-based compatibility calculations
```

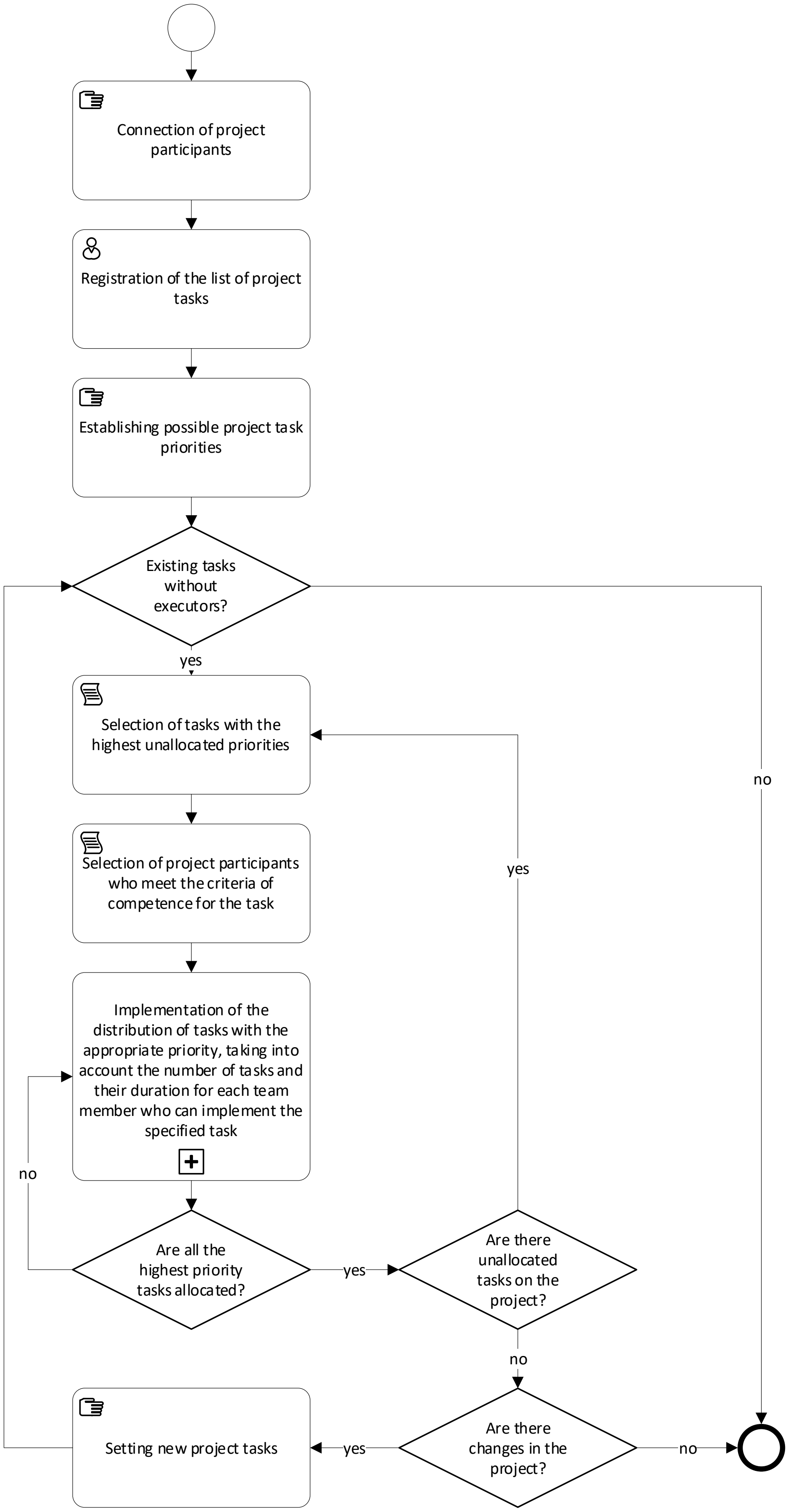

Figure 1: Algorithm for assigning executives to project work based on task priority.

- Implement a function for assigning executives

```
def assign_tasks(employees, tasks):
    # Sort tasks by priority and dependencies
    # Alternate selection of tasks with priority from highest to lowest

    # Cycle through all tasks
    for task in sorted_tasks:
        # Finding the right performers
        # Compatibility calculations
        # Choosing a contractor
        # Accessing the function of appointing an executor
```

When implementing the software application, we will be able to find the performer for each task who is most suitable in terms of skills and has the least workload, with the alternate assignment of performers to the highest priority tasks of the project [22,23]. The implementation takes into account not only the priority and timing of the task, but also the availability of a performer with the right competence at the right time.

5. Results

Implementing a model that takes into account task priorities when implementing IT projects using agile methodologies can be quite significant, as this approach directly affects team efficiency, product quality, and overall project success [16,24].

The main positive results include the following:

- Flexible methodologies such as Scrum or Kanban allow teams to adapt quickly to changes. By regularly reviewing priorities based on current business needs or changes in customer requirements, the team can quickly adjust its work plan. This reduces risks and avoids delays caused by untimely responses to changes, and projects are more likely to adapt to external changes without compromising the overall timeline or quality of the final product.
- Prioritizing tasks by importance and value helps to avoid overloading the team with minor or secondary tasks. This allows key specialists to focus on the tasks that bring the most business value, while less critical tasks are delegated or completed later. Efficient use of team time and resources, increased productivity and employee motivation through a clear understanding of priorities.
- Prioritizing the tasks that bring the most business value allows you to deliver parts of the product faster (through the MVP approach) and receive feedback from customers or users. This helps to make timely adjustments and improve functionality based on real needs. The client or end users receive a working product earlier, which allows them to experience the benefits of new features faster and the team to make the necessary improvements before the project is completed.
- High-priority tasks are usually the most critical to project success. By completing them early on, the team reduces uncertainty about product development because the basic features are ready earlier. This allows potential problems to be identified at an early stage and resolved in time to avoid unforeseen problems in the later stages of the project, reducing the risk of delay or budget overruns.
- Using flexible tools, such as Scrum boards or Kanban, provides visualization of the entire task execution process. This allows the team to see which tasks are prioritized, how much time is spent on each task, and where delays are possible. Better control over the project and the ability to quickly intervene in case of deviations from the plan, and transparency of distribution helps to increase trust between the team, management, and clients.

- Prioritizing tasks by importance helps you focus on the critical functional elements of the product that need to work flawlessly. Lower-priority tasks that have less impact on the overall success of the product can be completed later or adjusted to meet the needs after receiving feedback. Higher quality of the final product due to the fact that the most important functions are worked out with maximum emphasis on details and testing.
- With the right prioritization, the team can avoid performing secondary tasks that can distract from key goals. This helps to maintain a balanced workload, which has a positive impact on productivity and team morale. Increased employee satisfaction, reduced stress and fatigue, leading to better results in the long run.

The correct prioritization of tasks in projects implemented using agile methodologies yields a number of practical results: increased flexibility and speed of adaptation to changes, optimized resource utilization, reduced time to product delivery, improved quality, and transparency of the process [25,26]. All of this contributes to the overall efficiency and success of IT projects.

6. Conclusions

The optimal allocation of labor resources is a key factor in the successful management of IT projects in today's rapidly evolving technology and highly competitive environment [27]. Assignment of specialists to tasks should take into account not only their professional skills and competencies, but also the importance and priority of individual tasks. The model of labor resources assignment proposed in this article, based on the analysis of the importance and priorities of tasks, ensures more efficient use of resources and makes it possible to complete the most critical project tasks in a timely manner.

One of the main advantages of this model is the ability to reduce the risks associated with delays, team overload, and misplaced priorities. This allows for greater flexibility in the project management process, especially in the face of unforeseen changes in requirements or the external environment [28,29]. In addition, the use of this model helps to reduce operating costs and increase productivity by avoiding inefficient resource allocation, when critical tasks can be postponed in favor of less important ones.

Flexible task prioritization also helps teams focus on the most important stages of product development, which allows for faster time to market and faster response to customer feedback [30,31]. This approach helps to improve the quality of the final product, as the tasks that have the greatest impact on user satisfaction come to the fore [32].

In addition, the model ensures better transparency of management decisions, as all participants in the process have a clear understanding of priorities and tasks [33, 34]. This helps to avoid misunderstandings and improves communication within the team, which, in turn, has a positive impact on overall productivity and employee motivation.

In accordance with the results of the implementation of this methodology for the distribution of labor resources in the company's IT project for the integration of CRM solutions [35], the project implementation time was reduced by 5%. This result was achieved due to the implementation of automated task allocation using the priority and criticality of tasks, which was implemented on three standard projects by a team of 5-8 performers.

Thus, implementing a model for assigning labor resources based on the analysis of the importance and priority of tasks becomes a powerful tool for improving the efficiency of IT project management. It allows you to achieve your goals while maintaining a balance between quality, timing, and costs, which is especially important for the successful implementation of projects in the dynamic environment of the modern IT industry [36, 37].

Declaration on Generative AI

The authors have not employed any Generative AI tools.

References

[1] Gladka M., Kravchenko O., Hladkyi Ya., Borashova Sh. Qualification and appointment of staff for project work in implementing IT systems under conditions of uncertainty. 2021 IEEE International Conference on Smart Information Systems and Technologies. Astana IT University. NUR-SULTAN, KAZAKHSTAN. APRIL 28-30, 2021. DOI: 10.1109/SIST50301.2021.9465897.

[2] Schefer-Wenzl, S., Strembeck, M. Modeling support for role-based delegation in process-aware information systems/ 2014. Business and Information Systems Engineering, 6 (4), pp. 215-237. DOI: 10.1007/s12599-014-0343-3.

[3] Gladka, M., Kuchanskyi, O., Kostikov, M., & Lisnevskyi, R. (2023, May). Method of Allocation of Labor Resources for IT Project Based on Expert Assessements of Delphi. In 2023 IEEE International Conference on Smart Information Systems and Technologies (SIST) (pp. 545-551). IEEE. doi: 10.1109/SIST58284.2023.10223549.

[4] A Guide to the Project Management Body of Knowledge (PMBOK® Guide) (2016). Project Management Institute, 618. Available at: https://pdfroom.com/books/a-guide-to-the-project-management-body-of-knowledge-pmbok-guide/Zavd9vZOgKD.

[5] Toxanov, S., Abzhanova, D., Mukhatayev, A., Biloshchytskyi, A., & Kassenov, K. (2024). METHODOLOGY FOR ASSESSING THE LEVEL OF METHODOLOGICAL COMPETENCE OF IT TEACHERS. Scientific Journal of Astana IT University, June 2024, 120-130. DOI:10.37943/18BTZP2235.

[6] Luis Ballesteros-Sánchez, Isabel Ortiz-Marcos, Rocío Rodríguez-Rivero. The project managers' challenges in a projectification environment. (2019) International Journal of Managing Projects in Business, Volume 12 (3): Sep 2, 2019 DOI:10.1108/IJMPB-09-2018-0195.

[7] Mark von Rosing, August-Wilhelm Scheer, Heinrich von Scheel. The Complete Business Process Handbook: Body of Knowledge from Process Modeling to BPM, Volume 1. Elsevier. 2014. p. 776. ISBN 9780127999593.

[8] HBR Guide to Project Management. Ingram Publisher Services. HBR Guide . 2016. p. 181. ISBN 9781422187296.

[9] Müller, R., & Turner, R. (2007). The influence of project managers on project success criteria and project success by type of project. European management journal, 25(4), 298-309. https://doi.org/10.1016/j.emj.2007.06.003.

[10] Masood, M., Khan, R. A., & Shaikh, S. (2018). Impact of personality traits of project manager on project success. Journal of Business Strategies, 12(1), 21. https://greenwichjournals.com/index.php/businessstudies/article/view/351.

[11] Shastri, Y., Hoda, R., & Amor, R. (2021). The role of the project manager in agile software development projects. Journal of Systems and Software, 173, 110871. https://doi.org/10.1016/j.jss.2020.110871.

[12] Gladka M., Kuchansky A. & Lisnevskyi R. (2021). Teamsformation for it projects implementation on the basis of the model of limited rationality. Management of Development of Complex Systems, 48, 17–23, dx.doi.org\10.32347/2412-9933.2021.48.17-23.

[13] McArdle, R. (2022). Flexible methodologies: A case for approaching research with fluidity. The Professional Geographer, 74(4), 620-627. https://doi.org/10.1080/00330124.2021.2023593.

[14] Islam, A. K. M. Z., & Ferworn, A. (2020). A Comparison between agile and traditional software development methodologies. Global Journal of Computer Science and Technology, 20(2), 7-42. ISSN: 0975-4350.

[15] Reiff, J., & Schlegel, D. (2022). Hybrid project management–a systematic literature review. International journal of information systems and project management, 10(2), 45-63. DOI: 10.12821/ijispm100203.
[16] Roser, C., & Kazmer, D. (2000, September). Flexible design methodology. In International Design Engineering Technical Conferences and Computers and Information in Engineering Conference (Vol. 35135, pp. 139-148). American Society of Mechanical Engineers. https://doi.org/10.1115/DETC2000/DFM-14016.
[17] Xu, H., Kuchansky, A., Gladka, M. (2021). Devising an individually oriented method for selection of scientific activity subjects for implementing scientific projects based on scientometric analysis. Eastern-European Journal of Enterprise Technologies, 6 (3 (114)), 93–100. doi: https://doi.org/10.15587/1729-4061.2021.248040.
[18] Onwuka, D. O., Ibearugbulem, O. M., Abamara, A. C., Njoku, C. F., & Agbo, S. I. (2016). Free vibration analysis of an alround-clamped rectangular thin orthotropic plate using Taylor-Mclaurin shape function. American Journal of Engineering Research, 5(5), 190-197. ISSN: 2320-0847.
[19] Beylkin, G., & Monzón, L. (2010). Approximation by exponential sums revisited. Applied and Computational Harmonic Analysis, 28(2), 131-149. https://doi.org/10.1016/j.acha.2009.08.011.
[20] Gnatienko G., Snytyuk V. Expert technologies of decision making: monograph. K.: LC «Maklaut», 2008. 444 c.
[21] Andreas Gadach. Business Process Management: Analysis, Modelling, Optimisation and Controlling of Processes. Springer.2023. p. 222. ISBN 9783658415839.
[22] Andrashko, Y., Kuchanskyi, O., Biloshchytskyi, A., Pohoriliak, O., Gladka, M., Slyvka-Tylyshchak, G., Khlaponin, D., & Chychkan (2023). A method for assessing the productivity trends of collective scientific subjects based on the modified PageRank algorithm. Eastern-European Journal of Enterprise Technologies, 1 (4 (121)), p. 41–47. doi: https://doi.org/10.15587/1729-4061.2023.273929.
[23] Borysenko, I., Petrenko, K., Skorobogatova, N., Ivanova, T. (2024). Organisational Mechanism of the System of the Monitoring and Environmental Control for the Transport of Dangerous Goods. In: Faure, E., et al. Information Technology for Education, Science, and Technics. ITEST 2024. Lecture Notes on Data Engineering and Communications Technologies, vol 221. Springer, Cham. https://doi.org/10.1007/978-3-031-71801-4_1.
[24] Chen, R., Liang, C., Gu, D., & Zhao, H. (2020). A competence-time-quality scheduling model of multi-skilled staff for IT project portfolio. Computers & Industrial Engineering, 139, 106183. https://doi.org/10.1016/j.seps.2021.101182.
[25] Lj, M., Todorović, D. Č. Petrović, M. M. Mihić, V. Lj. Obradović, S. D. Bushuyev. Project success analysis framework: A knowledge-based approach in project management (2015) International Journal of Project Management. Vol. 33, Issue 4. – P. 772–783. DOI: 10.1016/j.ijproman.2014.10.009.
[26] Tasevska F., Damij T., Damij N. Project planning practices based on enterprise resource planning systems in small and medium enterprises – A case study from the Republic of Macedonia. International Journal of Project Management. 2014. Vol. 32, Issue 3. pp. 529–539. DOI: 10.1016/j.ijproman.2013.08.001.
[27] Cholyshkina, Olga, Andrii Onyshchenko, Volodymyr Kudin, Myroslava Gladka, Serhii Oleksiienko. “The use of artificial intelligence in optimising education management processes”. Információs Társadalom XXIV, no. 2 (2024): 33–47. https://dx.doi.org/10.22503/inftars.XXIV.2024.2.2
[28] Wang, X., Ferreira, F. A., & Chang, C. T. (2022). Multi-objective competency-based approach to project scheduling and staff assignment: Case study of an internal audit project. Socio-Economic Planning Sciences, 81, 101182. https://doi.org/10.1016/j.seps.2021.101182.

[29] Bańka, M., Salwin, M., Tylżanowski, R., Miciuła, I., Sychowicz, M., Chmiel, N., Kopytowski, A. (2023). Start-up accelerators and their impact on entrepreneurship and social responsibility of the manager. Sustainability, 15(11), 8892. https://doi.org/10.3390/su15118892.
[30] Brewer, J. L., & Dittman, K. C. (2018). Methods of IT project management. Purdue University Press. ISBN – 13: 978-1-55753-832-1.
[31] Carboni, J., Duncan, W. R., Gonzalez, M., Pace, M., Smyth, D., & Young, M. (2024). Sustainable Project Management: The GPM Practice Guide. GPM Global. Publisher: Independently published (September 27, 2024). 209 pages.
[32] Gray, C. F. (2018). Project management: The managerial process. http://thuvienso.thanglong.edu.vn//handle/TLU/10218.
[33] Gido, J., Clements, J., & Baker, R. (2018). Successful project management. Cengage Learning. 524 p. CN 02-200-203.
[34] Costantino, F., Di Gravio, G., & Nonino, F. (2015). Project selection in project portfolio management: An artificial neural network model based on critical success factors. International Journal of Project Management, 33(8), 1744-1754. https://doi.org/10.1016/j.ijproman.2015.07.003.
[35] Gladka M. V. Models and methods of multi-agent distribution of labor resources in IT projects under conditions of uncertainty. Dissertation. K. NTU - 2021. 247 p URL: https://uacademic.info/en/document/0421U000100.
[36] Jafari, M., Zahedi, M., & Khanachah, S. N. (2024). Identify and Prioritize the Challenges of Customer Knowledge in Successful Project Management: An Agile Project Management Approach. Journal of Information & Knowledge Management, 23(02), 2350060. https://doi.org/10.1142/S0219649223500600.
[37] Ebirim, W., Montero, D. J. P., Ani, E. C., Ninduwezuor-Ehiobu, N., Usman, F. O., & Olu-lawal, K. A. (2024). The role of agile project management in driving innovation in energy-efficient hvac solutions. Engineering Science & Technology Journal, 5(3), 662-673. https://doi.org/10.51594/estj.v5i3.864.