Development of a mathematical model for planning team readiness for IT solution implementation projects

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Abstract: Due to the emergence of new business lines and areas requiring automation, there is a need for planning and managing project work. Information technology (IT) projects contribute to organizational transformation and business growth. Despite the contribution of project management methodologies and structures, the share of unsuccessful IT projects remains high; thus, the study of critical success factors of IT projects remains an important problem for researchers and practitioners [1]. An analysis of the success of IT projects shows that 17% of projects are completed so unsuccessfully that they can threaten the state of the entire company as a whole. 45% of projects go beyond the budget. 56% of projects bring less profit than expected. 109 million dollars - average losses for every 1 billion dollars spent on projects [2]. The working conditions of the Information Technology department presuppose the existence of an effectively organized project work process. The success of the tasks depends largely on the distribution of the load between the members of the project team. The correct allocation of labor resources determines the timing and quality of project implementation.

Keywords: Project management, project team, optimization, agile development.

1 Introduction

Modern business sets more and more tasks for companies to automate business processes. In order to remain competitive in the market in these conditions, companies must adapt to changing requirements. IT provides multidimensional changes in organizations, and changes are increasingly taking a project-based approach [3].

Agile software development methods have become used by organizations as a template for creating new products Today, companies apply flexible methods to a certain extent, although with varying degrees of success [4]. At the project level, it is widely believed that

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flexible methods provide greater returns compared to traditional systems. Productivity in software development is an important topic for research in software engineering [5] and project management in software development. Productivity is defined as the ratio between the resources expended and the benefits received from the development result.[5].

Unlike traditional project management, this study considers the possibility of creating a coalition among employees available to perform project tasks. Tasks can be performed by more than one employee. The coalition of personnel reduces the time required to complete tasks. This study examines the proposal of a mathematical model in order to maximize the goals of both the project owner and the staff in a difficult situation.[5].

Performance measurement in software development projects is essential to monitor and improve the efficiency of software development. For example, by identifying role models (e.g. projects, individuals, tasks) when comparing performance data.[6].

Software development is mainly regulated by human-oriented activities, and therefore a number of social factors and individual characteristics of people should have a significant impact on the productivity of software development, as well as on effectiveness of software development teams [7, 8].

Output data refers to the quantity produced (software artifacts or services, tasks performed, quality, quantity in terms of functions, lines of code, implemented changes, among others), and input data refers to efforts aimed at achieving a result (time, effort, labor, resources) [6], [7]. Consequently, productivity is a key factor in project management and its success [5].

Software productivity can be observed from different points of view, namely at the development level, at the user level and at the management level. Companies involved in the implementation of information technologies need to measure the effectiveness of their projects, as this allows them to obtain indicators for managing and evaluating processes, projects, products and people. The results of these measurements are used for decision-making and will improve the quality of software projects [9].

Performance measurement is used as a comparison tool for projects and developers [10], [11]). Thus, it provides performance data to support monitoring and management of software development projects [12, 13]. Performance measurement is also suitable for improving the quality of decisions on the management of software projects, determining strategies to improve and achieve a high level of maturity in the organization, leading to more competitive company[14].

In addition, it is important to consider productivity when managing a team of software developers, as the software product "is a direct product of the intellectual processes of the team involved in the creation of intelligent and innovative product"[15].

Software development productivity is of particular interest to software development companies [16] because personal aspects and human activities provide an opportunity to increase project productivity[17].

This study is aimed at identifying, selecting and defining performance indicators that measure the readiness of the project team associated with software development [18]. The purpose of the work:

- identify problems in the business process of forming a project team and justify the existence of this problem;
- explore the possibilities of solving the problem;
- offer a suitable IT solution to automate the project implementation process.

2 Individual assignment and adaptation of a project team member

Employees work as part of project teams with different levels of involvement and interdependence. However, teams cannot do without individual members. Each member of the project team is supported and limited by the organization, while the organization will not be able to achieve anything if individual employees do not fulfil their assigned and special tasks. Subsequent specific problems and lessons are easier to identify from the perspective of individuals working in groups) [19]. This can be divided into areas of responsibility issues related to the characteristics of people involved in agile development and adaptation, issues related to procedures, interactions and effects covering the trends of the entire project [20].

2.1 Definition of the approach

As a rule, flexible approaches to project management require a transition to a different style of work of project team members. Some of those who are used to traditional approaches do not have the experience, imagination or habits to start taking the initiative and taking responsibility for completion, which requires a fully implemented flexible approach. Management approaches include careful selection of team members with a preference for responsibility and incentives/encouragement for taking initiative - note that this may require a larger range of diverse approaches and opportunities for some failures (with opportunities for correction and improvement). Acceptance, even the desire to move to flexible approaches, as a rule, correlate with features of a higher level of comfort in communication. Managers are encouraged to seek and develop this characteristic when structuring a high communication culture. Successful project management using flexible technology is helped by experience [21].

This is manifested in terms of confidence in making key decisions, determining which problems are normal and which require special attention, and so on. Experienced leaders may not be available for all (or any) projects, especially at the beginning of a new program, or during the transition from traditional to flexible. Management approaches include: attracting external trainers, ensuring some delay in the schedule and costs[22].

Development of judgment and self-management. In traditional project teams, a lot of responsibility is embedded in individual roles. A database specialist verifies that the tables are configured correctly, and a network specialist verifies that the connection between the components is reliable. However, in Agile teams, responsibility is shifted to the entire team. People may have a specialty, but they are expected to act in different ways, demonstrating what are often referred to as "T-shaped skills" [23].

In a well-functioning team, people express conflicting views and take measures to solve their problems. In poorly functioning groups, people tend to shy away from these responsibilities.[24].

Many leaders and team members are aware of the freedom and responsibility associated with the transition to agile development and its use. a penchant for self-managed teams. However, not all key employees are likely to perceive this to the same extent, especially when they come to see the hard work as well as the influential aspects of management.

2.2 Adaptation

The user history is the smallest unit of work in the agile methodology. This is the ultimate goal, not an opportunity formulated from the point of view of the software user [25]

Splitting the work into user-friendly stories. Use cases are more related to traditional than flexible methods. The use case describes how the system will operate[26].

User stories do not take into account the details that the agile team can study. When developers use exclusively Agile methods, they usually focus only on user stories. Hybrid methods sometimes extend the range of methods to specific end results to include information requirements and use cases along with user stories. User stories differ from information requirements in their main task to create ultimate value for users[27].

As a result, the emphasis shifts from a detailed enumeration of all functions in the new system to create concrete results using only general mechanisms. This shift of attention from means achieving goals [28] .

Team members immersed in the traditional development of information requirements, as a rule, experience discomfort Due to the fact that not all specifications are detailed before the start of the development process. This is one area where "new" teams are more likely to focus directly on creating value as quickly and as efficiently as possible [29].

More specific problems for Agile teams related to user stories include combining stories from multiple users and tasks that are likely solved by one or related applications; ensuring that all steps are included; separating continuous user actions into separate value-adding tasks; and focusing on translating physical processes into manageable or digitally accepted ones.[30].

Management approaches include constant and consistent focus on value creation throughout the development process, supporting flexible thinking [31].

3 Development of a mathematical model

To optimize the workload of the project team on implementation projects, the task was formalized in the form of a linear objective function and a system of limiting functions. Planning is done for each implementation project. Next, the initial data for the planning task is formalized.

There is a set of employees identified as members of one of the role clusters on the project[31].

Each employee is assigned a competence indicator for this role (a qualification weighting factor). This indicator is expressed in relation to the indicator of professionalism of this employee to the indicator of professionalism of the reference employee. In addition, there is a set of tasks on the project that require the allocation of employees to them. [32].

At the same time, each employee has a limited number of hours that this employee can spend on this project, and the minimum number of hours of work in the evaluation for the reference employee for the project. The data is presented in table 1. In the left column, the work that needs to be done on the project is entered, in the top row, the names of the employees selected for planning are entered. At the intersection of the line of work n and employee m is the ratio coefficient of the indicator of professionalism of the employee m to the indicator of professionalism of the reference employee of the corresponding role cluster (Knm).

Table 1. Initial data of the task

Work	Staff_1	Staff_2	Staff_3
Work_1	K_{11}	K_{12}	K_{13}
Work_2	K_{21}	K_{22}	K_{23}
Work_3	K_{31}	K_{32}	K_{33}

The unknowns are the number of hours spent by each employee on each job, i.e.

X_{nm} – the number of hours spent by employee m on work n.

A_n – the minimum number of hours of work of the reference employee corresponding to the role cluster required to perform the work n.

B_m – the maximum number of employee hours allocated for the planned project.

Task: to select the number of hours spent by each employee on each job to minimize the execution time.

In this way, you can create a target function:

$$\sum X_{mn} * K_{mn} \rightarrow \min$$

$$\sum X_{1n} <= B_1$$
$$\sum X_{2n} <= B_2$$
$$\ldots\ldots\ldots\ldots$$
$$\sum X_{mn} <= B_m$$

A system of limiting equations for works:

$$\sum X_{m1} >= A_1$$
$$\sum X_{m2} >= A_2$$
$$\ldots\ldots\ldots\ldots$$
$$\sum X_{mn} >= A_n$$

Thus, the task of linear programming is set. Justification of the choice of mathematical apparatus for solving the problem of linear programming. To solve the problem of linear programming, the simplex method was chosen as the most common method of solving the problem. Implementation of the test calculation of the project team load planning on the implementation project.

The input conditions are three jobs required on the project, three employees. At the intersection of rows and columns are the coefficients of employee competencies. The input conditions are presented in Table 2.

Table 2. Input conditions of the problem

Works	Adamson	Evans	Johnson
Testing	0,85	0	0,5
Development	0	1	0
Analytics	1	0	0,75

The number of Adamson watches is limited to 120 hours.

The number of Evans watches is limited to 110 hours

The number of Johnson watches is limited to 90 hours.

The amount of work for the testing task is estimated at 45 standard hours

The amount of work for the development task is estimated at 50 standard hours

The amount of work for the Analytics task is estimated at 100 standard hours

Task: To optimize the workload of personnel on the project.

x_1, x_2, x_3– the number of hours Adamson works on testing, development and analytics, respectively

x_4, x_5, x_6 – the number of hours Evans works on testing, development and analytics, respectively

x_7, x_8, x_9 – the number of hours Johnson works on testing, development and analytics, respectively

Thus, we can represent the objective function as follows:

$0.85*x_1+0*x_2+1*x_3+0*x_4+1*x_5+0*x_6+0.5*x_7+0*x_8+0.75*x_9 \rightarrow \min$

In this case, the system of limiting conditions will look like this:

$$x_1+x_2+x_3 \leq 120$$
$$x_4+x_5+x_6 \leq 110$$
$$x_7+x_8+x_9 \leq 90$$
$$0,85*x_1+0,5*x_7 \geq 45$$
$$x_5 \geq 50$$
$$x_3+0,75*x_9 \geq 100$$

Decision:

To begin with, it is necessary to bring the system of constraints to a canonical form, that is, to a form where non-trivial constraints will be equalities. The transition to the canonical form is carried out by adding additional variables. If the transformed inequality has the sign ≥, the transition to equality will occur with the replacement of the signs of all its free terms and coefficients by the opposite ones.

That is, the system will look like this:

$$1x_1+1x_2+1x_3+0x_4+0x_5+0x_6+0x_7+0x_8+0x_9+1x_{10}+0x_{11}+0x_{12}+0x_{13}+0x_{14}+0x_{15}=120$$
$$0x_1+0x_2+0x_3+1x_4+1x_5+1x_6+0x_7+0x_8+0x_9+0x_{10}+1x_{11}+0x_{12}+0x_{13}+0x_{14}+0x_{15}=110$$
$$0x_1+0x_2+0x_3+0x_4+0x_5+0x_6+1x_7+1x_8+1x_9+0x_{10}+0x_{11}+1x_{12}+0x_{13}+0x_{14}+0x_{15}=90$$
$$0,85x_1+0x_2+0x_3+0x_4+0x_5+0x_6+0,5x_7+0x_8+0x_9+0x_{10}+0x_{11}+0x_{12}-1x_{13}+0x_{14}+0x_{15}=45$$
$$0x_1+0x_2+0x_3+0x_4+1x_5+0x_6+0x_7+0x_8+0x_9+0x_{10}+0x_{11}+0x_{12}+0x_{13}-1x_{14}+0x_{15}=50$$
$$0x_1+0x_2+1x_3+0x_4+0x_5+0x_6+0x_7+0x_8+0,75x_9+0x_{10}+0x_{11}+0x_{12}+0x_{13}+0x_{14}-1x_{15}=100.$$

It is necessary to introduce artificial variables. The system will look like this:

$$1x_1+1x_2+1x_3+0x_4+0x_5+0x_6+0x_7+0x_8+0x_9+1x_{10}+0x_{11}+0x_{12}+0x_{13}+0x_{14}+0x_{15}+0x_{16}+0x_{17}+0x_{18}=120$$
$$0x_1+0x_2+0x_3+1x_4+1x_5+1x_6+0x_7+0x_8+0x_9+0x_{10}+1x_{11}+0x_{12}+0x_{13}+0x_{14}+0x_{15}+0x_{16}+0x_{17}+0x_{18}=110$$
$$0x_1+0x_2+0x_3+0x_4+0x_5+0x_6+1x_7+1x_8+1x_9+0x_{10}+0x_{11}+1x_{12}+0x_{13}+0x_{14}+0x_{15}+0x_{16}+0x_{17}+0x_{18}=90$$
$$0.85x_1+0x_2+0x_3+0x_4+0x_5+0x_6+0.5x_7+0x_8+0x_9+0x_{10}+0x_{11}+0x_{12}-1x_{13}+0x_{14}+0x_{15}+1x_{16}+0x_{17}+0x_{18}=45$$
$$0x_1+0x_2+0x_3+0x_4+1x_5+0x_6+0x_7+0x_8+0x_9+0x_{10}+0x_{11}+0x_{12}+0x_{13}-1x_{14}+0x_{15}+0x_{16}+1x_{17}+0x_{18}=50$$
$$0x_1+0x_2+1x_3+0x_4+0x_5+0x_6+0x_7+0x_8+0.75x_9+0x_{10}+0x_{11}+0x_{12}+0x_{13}+0x_{14}-1x_{15}+0x_{16}+0x_{17}+1x_{18}=100.$$

Due to the introduction of artificial variables, the objective function will be written as:

$$F(X)=0,85x_1+x_3+x_5+0,5x_7+0,75x_9+Mx_{16}+Mx_{17}+Mx_{18}\rightarrow min, \text{ where}$$

M is a penalty for using artificial variables.

Next, it is necessary to express artificial variables from the equations:

$$x_{16}=45-0,85x_1-0,5x_7+x_{13}$$
$$x_{17}=50-x_5+x_{14}$$
$$x_{18}=100-x_3-0,75x_9+x_{15}$$

When substituting them into the target function, it will have the form:

$F(X)=(0,85-0,85M)\ x_1+(1-M)\ x_3+(1-M)\ x_5+(0,5-0,5M)\ x_7+(0,75-\ 0,75M)\ x_9+(M)\ x_{13}+(M)\ x_{14}+(M)\ x_{15}+(195M)\rightarrow min$

The next step is to form the original simplex table. Row F of the table is filled with coefficients of the objective function. Free members are entered in column B. Columns $x_1,...,x_{18}$ are filled with coefficients for these variables, respectively. The basic variables are x_{10}, x_{11}, x_{12}, x_{16}, x_{17}, x_{18}. The completed simplex table will be presented in Table 3.

Table 3. Filled simplex table

Basis	B	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}
x_{10}	120	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
x_{11}	110	0	0	0	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0
x_{12}	90	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	0	0
x_{16}	45	0,85	0	0	0	0	0	0.5	0	0	0	0	0	-1	0	0	1	0	0
x_{17}	50	0	0	0	0	1	0	0	0	0	0	0	0	0	-1	0	0	1	0
x_{18}	100	0	0	1	0	0	0	0	0	0,75	0	0	0	0	0	-1	0	0	1
F(X0)	195M	-0,85+0,85M	0	-1+M	0	-1+M	0	-0,5+0,5M	0	-0,75+0,75M	0	0	0	-M	-M	-M	0	0	0

Since there are positive coefficients in the index row, the reference plan is not optimal. The maximum modulo element in the index row is -1+M. The leading column will be column x_5. The leading line will be x_{17}. The recalculated simplex table is presented in table 4.

Table 4. Filled simplex table

Basis	B	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}
x_{10}	120	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
x_{11}	60	0	0	0	1	0	1	0	0	0	0	1	0	0	1	0	0	-1	0
x_{12}	90	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	0	0
x_{16}	45	0,85	0	0	0	0	0	0.5	0	0	0	0	0	-1	0	0	1	0	0
x_5	50	0	0	0	0	1	0	0	0	0	0	0	0	0	-1	0	0	1	0
x_{18}	100	0	0	1	0	0	0	0	0	0.75	0	0	0	0	0	-1	0	0	1
F(X1)	50+ 145M	-0,85+ 0,85M	0	-1+M	0	0	0	-0,5 +0,5M	0	-0,75 +0,75M	0	0	0	-M	-1	-M	0	1-M	0

Since there are positive coefficients in the index row, the reference plan is not optimal. The leading column will be column x_3. The leading row will be x_{18}. The recalculated simplex table is presented in Table 5.

Table 5. Filled simplex table

Basis	B	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}
x_{10}	20	1	1	0	0	0	0	0	0	-0.75	1	0	0	0	0	1	0	0	-1
x_{11}	60	0	0	0	1	0	1	0	0	0	0	1	0	0	1	0	0	-1	0
x_{12}	90	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	0	0
x_{16}	45	0.85	0	0	0	0	0	0.5	0	0	0	0	0	-1	0	0	1	0	0
x_5	50	0	0	0	0	1	0	0	0	0	0	0	0	0	-1	0	0	1	0
x_3	100	0	0	1	0	0	0	0	0	0.75	0	0	0	0	0	-1	0	0	1
F(X2)	150 +45M	-0.85 +0.85M	0	0	0	0	0	-0.5 +0.5M	0	0	0	0	0	-M	-1	-1	0	1-M	1-M

Since there are positive coefficients in the index row, the reference plan is not optimal. The leading column will be column x_1. The leading line will be x_{10}. The recalculated simplex table is presented in Table 6.

Table 6. Filled simplex table

Basis	B	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}
x_1	20	1	1	0	0	0	0	0	0	-0,75	1	0	0	0	0	1	0	0	-1
x_{11}	60	0	0	0	1	0	1	0	0	0	0	1	0	0	1	0	0	-1	0
x_{12}	90	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	0	0
x_{16}	28	0	-0,85	0	0	0	0	0,5	0	0,64	-0,85	0	0	-1	0	-0,85	1	0	0.85
x_5	50	0	0	0	0	1	0	0	0	0	0	0	0	0	-1	0	0	1	0
x_3	100	0	0	1	0	0	0	0	0	0,75	0	0	0	0	0	-1	0	0	1
F(X3)	167+28M	0	0,85-0.85M	0	0	0	0	-0.5+0.5M	0	-0,64+0,64M	0,85-0,85M	0	0	-M	-1	-0,15-0,85M	0	1-M	0,15-0,15M

Since there are positive coefficients in the index row, the reference plan is not optimal. The leading column will be column x_9. The leading row will be x_{16}. The recalculated simplex table is presented in Table 7.

Table 7. Filled simplex table

Basis	B	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}
x_1	52.94	1	0	0	0	0	0	0.59	0	0	0	0	0	-1.18	0	0	1.18	0	0
x_{11}	60	0	0	0	1	0	1	0	0	0	0	1	0	0	1	0	0	-1	0
x_{12}	46.08	0	1.33	0	0	0	0	0.22	1	0	1.33	0	1	1.57	0	1.33	-1.57	0	-1.33
x_9	43.92	0	-1.33	0	0	0	0	0.78	0	1	-1.33	0	0	-1.57	0	-1.33	1.57	0	1.33
x_5	50	0	0	0	0	1	0	0	0	0	0	0	0	0	-1	0	0	1	0
x_3	67.06	0	1	1	0	0	0	-0.59	0	0	1	0	0	1.18	0	0	-1.18	0	0
F(X4)	195	0	0	0	0	0	0	0	0	0	0	0	0	-1	-1	-1	1-M	1-M	1-M

Since the index row does not contain positive values, it means that the optimal task plan has been found. There are no artificial variables in the optimal solution, so the solution is valid.

Therefore, the optimal plan looks like this:

x_1=52.941, x_2=0, x_3=67.059, x_4=0, x_5=50, x_6=0, x_7=0, x_8=0, x_9=43.922
F(X)=0,85*52,941+1*67,059+1*50+0,5*0+0,75*43,922=195

Results

Thus, Adamson will spend 52,941 hours on testing and 67,059 hours on analytics. Evans will spend 50 hours developing. Johnson will spend 43,922 hours on testing.

3.1 Calculation of professional qualities of an employee

To evaluate candidates for roles to participate in the implementation project, an indicator was developed: "Indicator of staff professionalism depending on the role." This indicator consists of the components of practical experience in a specific role and the number of relevant courses completed by the employee.

To calculate this indicator, the following formula was determined:

$$S = K*q + L*b, \text{ where:}$$

S is the total employee competence indicator for each role;

K is the coefficient of relevant experience;

The coefficient is taken from the table "Coefficients of relevance of work experience.

Q - weight of relevant experience;

This coefficient is indicated individually based on the discrepancy between the importance of work experience and other parameters in the calculated indicator. The use of the default weight value of 5 is justified.

L is the coefficient of the number of relevant courses completed and certificates received;

b - coefficient of importance of courses and certificates;

This coefficient is indicated individually, based on the discrepancy between the significance of courses and certificates and other parameters in the calculated indicator. By default, the coefficient is 1.

This formula has the possibility to expand the input parameter. For example, you can improve it by adding an internal employee evaluation coefficient for each role.

The result of these calculations is information for those responsible for planning the readiness of the implementation team, which allows you to get additional information about the selection of candidates for roles in the project team.

3.2 Creating a logical model of the system

When creating data models, the ERwin Data Modeler program was used. [Erwin.com] A logical data model is designed to represent elements in terms of business processes. Entity-relationship diagrams are used for modelling. The entity-relationship diagram is a top-level data model. It includes entities and relationships reflecting the basic business rules of the subject area [33].

Figure 1 shows a logical data model.

The entities of the ER model correspond to the following tables:

- project
- employee
- roles
- types of work.

The "Project" table contains the main data about the company's projects (the name of the project, the description of the project, the start date of the project, the completion of the project and the person responsible for the project). The fields and data type are presented in Table 8. A relationship is established between the projects and the types of work that can be performed in the project. The unique field is the project code.

The table "Type of work" contains basic data on the types of work performed on projects (code of the type of work, description of the type of work, minimum time for the type of work). The fields and data type are presented in Table 9. A relationship is established between the types of work and the employees performing these works. Unique fields – the project code, the code of the type of work.

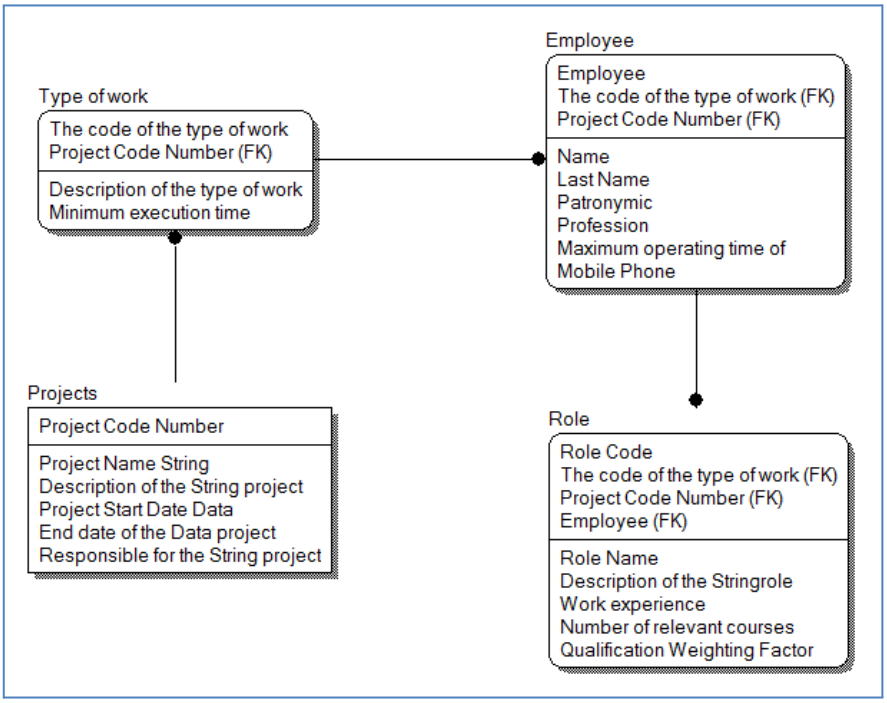

Figure 1. Logical model of the system

Table 8. Projects

Data	Type Fields
Project Code Number	Number
Project Name String	String
Description of the String project	String
Project Start Date Data	Data
End date of the Data project	Data
Responsible for the String project	String

Table 9. Type of work

Data	Type Fields
The code of the type of work	Number
Project Code	Number
Description of the type of work	String
Minimum execution time	Number

The "Employee" table contains basic data about the company's employees (last name, first name, patronymic, profession, maximum working time, mobile phone). The fields and data type are presented in Table 10. A relationship is established between employees and the roles they perform in the project. Unique fields – employee code, type of work code, project code.

Table 10. Employee

Data	Type Fields
Employee	Number
Work type code	Number
Project Code	Number
Last Name	String
Name	String
Patronymic	String
Profession	String
Maximum operating time of	Number
Mobile Phone	Number

The "Role" table contains information about all roles in the project (role name, role description, work experience in this role cluster, the number of relevant courses completed by an employee in this field, the qualification weighting factor). The fields and data type are shown in Table 11. Unique fields – role code, employee code, type of work code, project code.

Table 11. Role

Data Type	Type Fields
Role Code	Number
Employee Code	Number
Work type code	Number
Project Code	Number
Role Name	String
Description of the Stringrole	String
Work experience	Number
Number of relevant courses	Number
Qualification Weighting Factor	Number

4 Results

4.1 Restrictions

By developing the architecture of the solution, the project size scales, creating independent objects that change over time. For the client, it is necessary that all team members develop the same basic product.

It is important that this change becomes part of the presentation of the basic product, in the creation of which all team members are involved.

The following problem is possible: each distributed team can use different tools, even if the final product must be implemented on the same technology platform. Such a problem must be recognized, listed and "limited in time" so that the project manager can solve it, even if a one-sided and possibly arbitrary solution is required. Similarly, risk issues, including potential adverse events, are addressed. you need to create exceptions suggesting changes, etc. For their full usefulness, they should be coupled with monitoring and taking action where necessary.

Management approaches include compiling a list of problems that will be recorded as they arise.

4.2 Conclusion

The study considers the possibility of creating a coalition among employees available to perform the tasks of the project. Tasks can be performed by more than one employee. This study examines the proposal of a mathematical model in order to maximize the goals of both the project owner and the staff in a difficult situation in the agile development mode.

To eliminate the problem of the personnel workload planning process in a project based on the implementation of the agile development method, the goal is to propose a method for evaluating and optimally forming a project team. The need to build a methodology is due to the fact that the main problem in the process of project implementation is the lack of efficiency of technologies for planning and allocating labour resources.

The optimal planning problem was formalized as a linear programming problem. To solve the problem of linear programming, the choice of a mathematical apparatus was

justified, as a result of which a mathematical model was compiled. Based on the mathematical model, the data necessary for the development of a software solution were allocated and structured, an ER data model was compiled to understand the internal content of objects.

Thus, a methodology was proposed for the evaluation and optimal planning of the implementation team, which made it possible to solve problems arising as a result of suboptimal planning of the project team.

The requirements for the system of readiness planning and optimal load distribution of the project team are determined, the choice and justification of the solution is made, a mathematical model is built, a prototype is implemented solutions based on requirements, based on functional models.

In the future, the implementation can be further improved, having previously identified existing shortcomings in practice.

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