



*Research Article*

## Multi-Objective Optimization of Labor Allocation in Surface Field Development Projects

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**Abstract:** Modern capital construction projects in the oil and gas industry are characterized by a high degree of complexity due to the multi-level structure of work, the significant duration of technological stages, and the strict dependence of task completion dates on available labor resources. In such conditions, traditional calendar and resource planning methods are insufficient to find a balance between the project's duration and the amount of labor required, which requires the use of multi-criteria optimization methods. The purpose of this study is to develop and test an approach to optimizing the allocation of labor resources using the example of a project for the construction of SDFs. The methodological basis of the work is to use a Pareto optimization model for the composition of project teams, adapted to the company's organizational and production structure. The Pareto front was obtained as a result of the computational experiments, reflecting compromise solutions between the duration of the project and the total labor costs, and 21 implementation scenarios were identified, of which 17 meet the customer's time requirements. An analysis of the obtained scenarios showed that the proposed approach provides flexibility in choosing a strategy: from minimizing deadlines while increasing resource costs to optimizing labor costs while maintaining the allowable duration. The use of multi-criteria optimization methods makes it possible to reduce risks and improve the quality of management decisions in projects implemented using a cascade management model.

**Keywords:** Allocation of labor resources; Calendar and network planning; Multi-objective optimization; Pareto optimization; Surface field development project

### 1. Introduction

In recent years, the management of capital construction projects, especially in the oil and gas industry, has become an increasingly complex task requiring the use of precise calendar, network, and resource planning methods. The contradiction between the goals of reducing implementation time, minimizing costs, ensuring quality, and adhering to the principles of sustainability necessitates the use of multi-criteria approaches that go beyond the traditional single-criteria models (An et al., 2025; Pospelov et al., 2023). The problem of the trade-off between time and cost, management of a multi-project environment, consideration of various categories of labor resources, the impact of the organizational structure of the enterprise, and the uncertainty of the external environment remain the subject of active discussions in the scientific literature of recent years (Aghileh et al., 2025; Keynezhad and Goharshenasan, 2022; Iskandar and Allmendinger, 2021).

One of the key areas of research has become the development of models for the allocation of labor resources, the task of which is not only to ensure a sufficient number of performers but also to form optimal combinations of resources, taking into account qualifications, skills, costs of staff mobilization and release, as well as possible downtime (Dabirian et al., 2022; Liu, 2022; Liang et al., 2021). In particular, Iskandar and Allmendinger proposed a multi-criteria labor allocation model that simultaneously considers time parameters, financial constraints,

and performers' workload balance. Another important area of research concerns tasks such as "The task of planning projects with limited resources" (Abdolshah, 2014) and their multi-project modifications, in which several projects compete for limited resources. This requires the development of methods to increase the flexibility of resources and adaptability of schedules in uncertain conditions (Farahmand-Mehr and Mousavi, 2025; Aghileh et al., 2024; Rahman et al., 2021).

Modern research demonstrates a growing interest in multi-criteria optimization, in which traditional time-cost indicators act as target functions as well as the quality of the final result, customer satisfaction, environmental and social factors, safety, and carbon footprint. For example, Zohrehvandi et al., 2024 developed a mathematical model for optimizing the calendar plan of a construction project, considering both time, cost, and quality, and analyzed the sensitivity of key parameters of the model. Similar approaches are being developed in studies on resource allocation in the implementation of repetitive construction projects (Sánchez et al., 2023), the inclusion of safety and sustainability indicators in multi-criteria models (Yang and Men, 2025; Zhan et al., 2024), and the use of fuzzy logic methods and multi-mode problem statements for more flexible representation of real-world conditions (Tackleef et al., 2025; Kaveh and Rajabi, 2022).

Despite significant progress, gaps remain in the literature that need to be addressed. First, comprehensive coverage of the full life cycle of a project is extremely rare: most models are limited to the construction or installation stage, not covering the engineering, survey and design work, commissioning, and commissioning of facilities. Second, common approaches use detailed categories of performers (for example, welders, installers, and electricians), whereas in real organizations, the allocation of resources is subordinated to the organizational and production structure. Third, it is necessary to consider uncertainty, and in practice, it is also necessary to create a variety of implementation scenarios considering the company's resource and time constraints and subsequent analysis of the solutions obtained. Fourth, many studies are primarily theoretical in nature, are not adapted to the internal processes of specific organizations, and are therefore difficult to apply in management practice. Finally, the search for optimal project implementation options is of particular importance for the oil and gas industry because delays in project implementation can lead to enormous financial losses and excessive staff increases lead to inefficient costs.

This study aimed to overcome these limitations. Within its framework, a multicriteria model has been developed to optimize the allocation of labor resources for the onshore field development project, which includes a full work lifecycle in accordance with the project's network diagram. Unlike the traditional approach, the model uses a classification of performers corresponding to the company's organizational and production structure, which makes it possible to increase the realism and application value of the solutions obtained. The optimization problem statement is based on two key criteria—the project duration and total labor costs—and its solution forms a variety of alternative implementation scenarios. Additionally, the uncertainty factor is considered, which makes it possible to assess the sustainability of the solutions obtained and identify the range of acceptable strategies.

Thus, the purpose of this study is to show how the application of multicriteria optimization methods makes it possible to form a flexible set of management solutions for capital construction projects in the oil and gas industry. It is expected that the results obtained will not only clarify scientific ideas about performance criteria in complex construction projects but also offer a practical decision support tool that will allow the company's management to choose between strategies for accelerated implementation and optimization of human resources, depending on external and internal conditions.

## 2. Methodology

The methodological basis of this research is the application of multicriteria optimization methods to solve labor allocation problems in capital construction projects in the oil and gas

industry. The task was made in the form of a multipurpose optimization model that considers the specifics of field development projects. In contrast to the classical formulations of the calendar and resource planning problem (RCPSP), which are widely presented in the literature (Hartmann and Briskorn, 2022; Kellenbrink and Helber, 2015), the developed approach assumes an increased detail of resources in accordance with the customer company's organizational and production structure.

## 2.1 Setting the task

The mathematical model minimized two objective functions simultaneously: the total duration of the project  $T$  and the total labor costs  $L$ . This formulation of the problem reflects the contradiction between the desire to reduce construction time and the need for rational use of labor resources (Talbi, 2021; Deb, 2001).

The objective function has the following form (Equation 1):

$$\min F = \{T, L\} \quad (1)$$

The restrictions included the following:

- logical and technological dependencies between jobs (i.e., network schedule);
- the balance of labor resources attracted by category;
- the project implementation deadline (156 weeks in accordance with the terms of the contract).

The formalized resource limit is expressed as follows (Equation 2):

$$\sum_{i=1}^n R_i \cdot t_i \geq W_j, \quad j = 1, \dots, m \quad (2)$$

where  $R_i$  is the number of performers of category  $i$ ,  $t_i$  is their working time, and  $W_j$  is the complexity of task  $j$ .

## 2.2 Classification of the labor resources

In contrast to the traditional detailing by profession (welders, installers, electricians), the study used enlarged categories corresponding to the internal organizational structure: planning and technical department (role 1), geodetic group (role 2), engineering survey department (role 3), electrical department (role 4), control and measuring devices and automation group (role 5), occupational safety and industrial safety department (role 6), construction (role 7), installation (role 8) and welding and assembly teams (role 9). This approach has made it possible to increase the managerial interpretability of solutions and reduce the model's computational complexity, which corresponds to current trends in pooling resources in construction tasks.

## 2.3 Optimization algorithm

The Pareto optimization method was applied to solve the problem, which proved to be one of the most effective tools for multi-criteria optimization (Wajanawichakon et al., 2025; Deb, 2001). Its effectiveness has been repeatedly confirmed in studies related to PM, construction, and energy (Yılmaz and Dede, 2025; Nasouri and Delgarm, 2024; Majid et al., 2021). In this study, single-level stochastic optimization is used, and Pareto optimization is chosen to account for the multiplicity of criteria. Genetic algorithms can be used in research to compare different optimization methods within Pareto optimization (e.g., algorithm execution time and accuracy).

The algorithm was modified to consider the uncertainty of the initial data:

- variability in work complexity (Acar et al., 2021);

- changing resource availability;
- Impact of organizational risks

The Monte Carlo method group was used to model uncertainty (1000 iterations) (Wang et al., 2023; Li et al., 2022; Zhang, 2021; Wicaksono et al., 2019).

### 2.4 The experimental base

The calendar and network schedule of the III level of the real project for constructing ground facilities were used as the initial data. The schedule included all the main stages: preparatory work, engineering surveys, design, construction and installation work, and commissioning. This completeness reflects the entire capital construction life cycle.

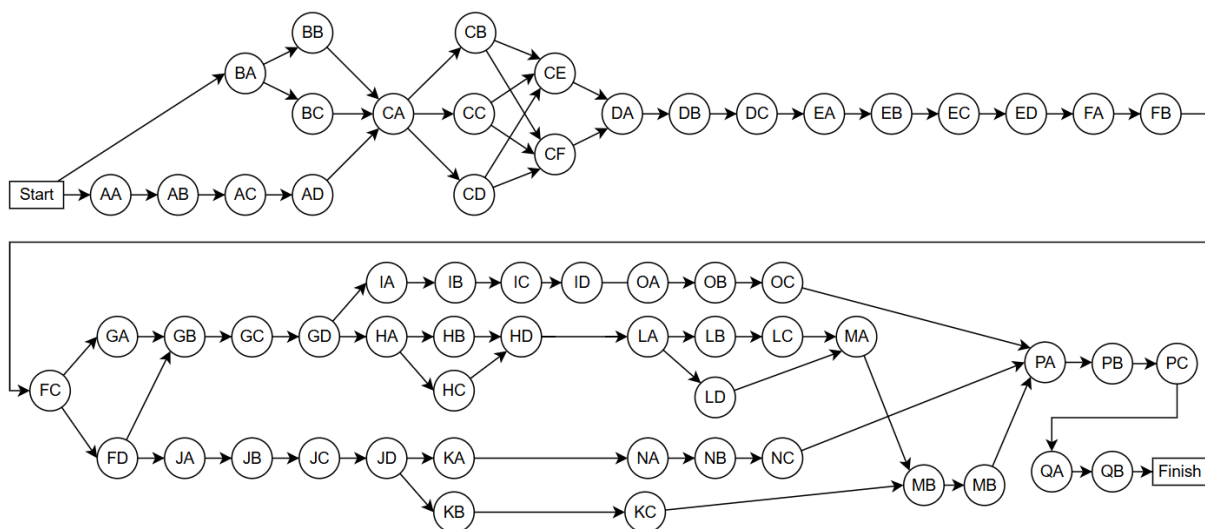
Computational experiments were conducted to test the algorithm, including:

- Variation in the number of labor resources in each category
- Analysis of trade-offs between time and labor costs (Wang et al., 2021); and
- Building a Pareto front and highlighting the acceptable solution set (Rebello et al., 2021).

All experiments were conducted using Python libraries for multi-criteria optimization and data analysis (DEAP, NumPy, Matplotlib), which ensures the reproducibility of the experiment (Kizielewicz et al., 2023; Wang et al., 2022; Abdolshah, 2014).

### 3. Results and Discussion

The project in question reflected the full cycle of capital construction implementation, making it a particularly revealing base for testing the effectiveness of the developed optimization algorithms. The network diagram of the project "Development of algorithms for optimizing Level III calendar and network schedules in projects for onshore field development" is shown in Figure 1.



**Figure 1** Network diagram of the project "Development of algorithms for optimizing level III calendar and network schedules in projects for onshore field development"

The project is implemented in several stages, representing a sequential chain of work: from engineering surveys and design to construction, equipment installation, and facility commissioning. At the initial stage, preparatory activities, including the development of technical specifications and a project for the production of works for geodetic surveys, are carried out.

Next, a complex of geodetic works is carried out: field measurements, camera data processing, basic grid construction, axis removal, and zero-cycle executive survey. In parallel, a block of engineering and geological studies is being carried out: drilling of wells and pits, laboratory soil tests, as well as hydrogeological observations, the results of which are recorded in the relevant reporting materials.

Based on the initial data, the design stage begins. A technological scheme with a capacity balance is being developed, and key sections of the design documentation are being formed, including the master plan, building structures, power supply and lighting systems, and a set of instrumentation and control systems and automated control systems. The received materials are being examined from the point of view of fire and industrial safety and are also supplemented with statements of work volumes, specifications, and estimated documentation. The preparation of sections on environmental protection and environmental impact assessment (EIA) is important. On the basis of the final package of project documentation, the supervisory authorities approve the project, and a construction permit is obtained. The next stage includes the construction site preparation. It covers the development of a PPR for construction and installation work, the organization of a labor protection system, resource mobilization, and the establishment of a shift camp and temporary infrastructure. After the construction of temporary networks and fences, the site is planned, and the axes are laid out for the start of construction work.

The zero cycle begins with the development of excavation pits and trenches, drainage and drainage system installation, foundation preparation, and geodetic acceptance. Then, work is carried out on the construction of foundations: manufacture and installation of RFs, installation of formwork, concreting, waterproofing, and protection of structures. At the next stage, work is underway on the construction of the ground part: installation of metal structures of buildings, enclosing structures, roofing and drainage systems, and interior finishing works. In parallel, tanks, apparatuses, and pumping equipment are installed, including anchoring and fastening operations. Simultaneously, the construction of engineering networks and pipeline infrastructure is being carried out: route marking, preliminary assembly of nodes, highway welding, quality control, and shut-off valve installation with subsequent corrosion protection.

The electrical installation and automation work are of particular importance. At this stage, cable trays and overpasses are being installed, power cables are being laid, switchgear is being installed, and lighting and low-current systems are being installed. Control cabinets and programmable logic controllers (PLCs) are mounted in parallel, and their configuration, instrumentation and control equipment sensors verification, and integration tests are performed. The final stage is related to the complex commissioning works. This includes cold testing of pipelines and equipment, individual and functional testing of systems, verification of protections and interlocks, and conducting 72-hour complex tests. The final stage is the commissioning of the facility with operational personnel training.

Thus, the project activity has a clearly structured character, reflecting the modern practice of phased implementation of large capital facilities, where the logical sequence of work ensures reliable consistency of engineering solutions and minimizes risks during the construction and commissioning phases. Next, we determined the complexity of each task and an acceptable error of 10% of the initial task duration (standard deviation with a normal distribution). Thus, the initial data are presented in Table 1.

Then, a Pareto optimization model for the composition of project teams was launched based on the initial data. The main goal was to determine the optimal composition of project teams under various resource and time constraints. During the calculations, the number of labor resources in each of the allocated departments varied, allowing the formation of a set of alternative scenarios for the implementation of the project. Figure 2 shows a graphical interpretation of the possible scenarios.

**Table 1** Initial data

ID	Task name	Acting role	Predecessor	Labor inten- sity per person per week
AA	Preparation of the technical specifications and PPR for the geodetic work	1	–	60
AB	Field geodetic measurements	2	AA	120
AC	Desk processing and basic grid building	2	AB	80
AD	Axis removal and zero-cycle executive shooting	2	AC	100
BA	Field geological surveys (wells and pits)	3	–	250
BB	Laboratory soil tests	3	BA	180
BC	Report of hydrogeological observations	1	BA	200
CA	Flow chart and capacity balance	1	AD, BB, BC	150
CB	Master plan and structure building	1	CA	350
CC	Power supply and lighting	4	CA	250
CD	Instrumentation and Control System Project	5	CA	220
CE	Assessment of fire and industrial safety	6	CB, CC, CD	100
CF	Volume statements, specifications, and estimates	1	CB, CC, CD	180
DA	EIA/EPA and environmental support	6	CE, CF	200
DB	Approval from the supervisory authorities	1	DA	300
DC	Obtaining a building permit	1	DB	80
EA	PPR for CMP, admissions, and briefings	6	DC	100
EB	Mobilization, shift camp, and household town	7	EA	200
EC	Temporary networks and fencing	7	EB	250
ED	Site layout and axis removal	7	EC	220
FA	Development of excavation pits and trenches	7	ED	600
FB	Drainage and drainage	7	FA	300
FC	Preparation of the bases	7	FB	250
FD	Acceptance of the grounds	2	FC	80
GA	Reinforcement Frames and Mortgages	7	FD	400
GB	Shuttering device	7	FD, GA	250
GC	Concreting the foundations	7	GB	500
GD	Waterproofing and concrete protection	7	GC	150
HA	Installation of the metal frames of buildings	8	GD	800
HB	Enclosing structures	7	HA	600
HC	Roof and gutters	8	HA	350

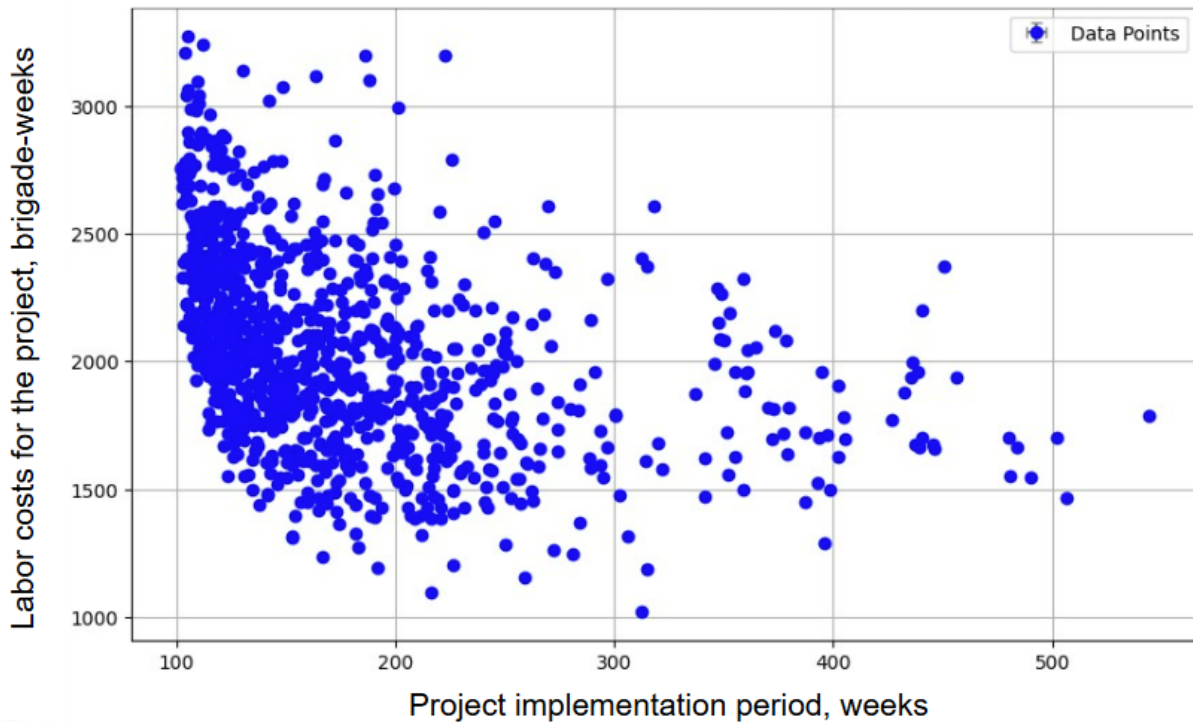
**Table 1** Initial data (cont.)

ID	Task name	Acting role	Predecessor	Labor intensity per person per week
HD	Interior finishing works	7	HB, HC	500
IA	Safety acceptance	6	GD	150
IB	Installation of tanks and apparatus	2	IA	600
IC	Installation of the pumps	9	IB	350
ID	Keywords: anchoring fasteners, idle run	9	IC	200
JA	Marking of the pipeline routes	2	ID	200
JB	Pre-fabrication of the pipe assemblies	8	JA	500
JC	Highway welding and strapping	9	JB	1000
JD	Non-destructive testing and improvements	9	JC	250
KA	Installation of the shut-off valves	9	JD	300
KB	Installation of the instrumentation and control systems	5	JD	400
KC	Verification and calibration of the sensors	5	KB	200
LA	Cable trays and trestles	4	HD	350
LB	Laying of the power cables	4	LA	600
LC	Installation of billboards and RU	4	LB	400
LD	Lighting and low-current systems	7	LA	300
MA	Installation of the control cabinets and the PLC	5	LC, LD	350
MB	PLC/SCADA Configuration	5	MA, KC	400
MC	Loop-checking and integration tests	4	MB	300
NA	Preparation of pipe surface	8	KA	150
NB	Application of the insulation/AKZ	8	NA	400
NC	Coverage control	8	NB	100
OA	Layout and blind areas	7	ID	250
OB	Roads and playgrounds	7	OA	600
OC	Perimeter fencing and marking	7	OB	200
PA	Cold testing of pipes and apparatus	9	OC, MC, NC	400
PB	Individual testing equipment	5	PA	500
PC	Checking the protections and interlocks	4	PB	450
QA	Comprehensive testing (72 h)	4	PC	600
QB	Commissioning and staff training	1	QA	300

The above figure shows the project implementation scenarios. Each point on this graph corresponds to a certain composition of the project team, the results of which are the project duration (X-axis, weeks) and the labor costs for its implementation in accordance with the coordinates of this point (Y-axis, man-weeks).

As a result of the computational experiments carried out and the analysis of the generated project scenarios, a Pareto front was built, considering the influence of uncertainty factors inevitably present in the management of large construction projects. The Pareto front reflects a

variety of solutions, each of which is characterized by an optimal ratio between two key criteria: the total project duration and the total labor costs.



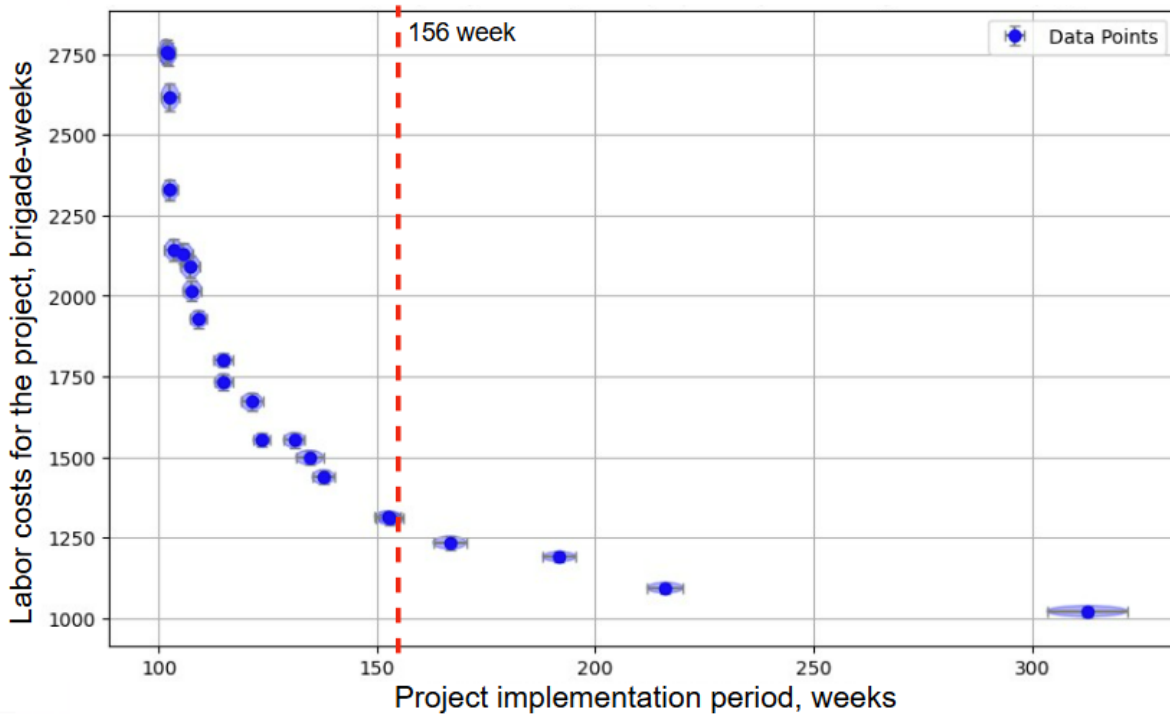
**Figure 2** Project implementation scenarios

Thus, the resulting Pareto front can be considered a tool to support managerial decision-making: it demonstrates which scenarios are rational in terms of optimal resource allocation while maintaining time constraints. Figure 3 shows the Pareto front, considering uncertainty, reflecting the range of possible project trajectories and allowing a visual assessment of the boundaries of acceptable solutions. Each optimal point now has its own margin of error (ellipse) in the figure.

According to the results of the calculations, 21 project implementation scenarios were identified, each of which met the criteria of Pareto optimality. Table 2 presents the characteristics of the solutions obtained. The duration of the project ranged from 101.7 weeks (approximately 2 years) to 312.68 weeks (approximately 6 years). These deadlines are calculated based on the outcome of the input data on the quantitative and qualitative composition of resources and do not include separate buffers and delays. The total labor costs ranged from 1021.2 to 2757.49 brigade-weeks (provided that there are 20 people in a team).

Such an amplitude of values demonstrates the high variability of possible organizational strategies: in some scenarios, the emphasis is on reducing deadlines by attracting more labor resources, while in others, deadlines are significantly increased. Next, we compared two basic indicators: “as-planned” staffing (company standard) and the classic heuristic (resource leveling rule). The comparison is shown in Table 3.

Compliance with the established deadlines was a priority optimization factor within the project framework. According to the customer’s terms of reference, the project should be completed within 156 calendar years (156 weeks). All scenarios whose duration exceeded this threshold were automatically excluded from the analysis. As a result, 17 scenarios are left for practical use in the company, which simultaneously meet deadlines and provide different levels of labor costs.



**Figure 3** Pareto front, considering uncertainty

**Table 2** Pareto-optimal project implementation scenarios

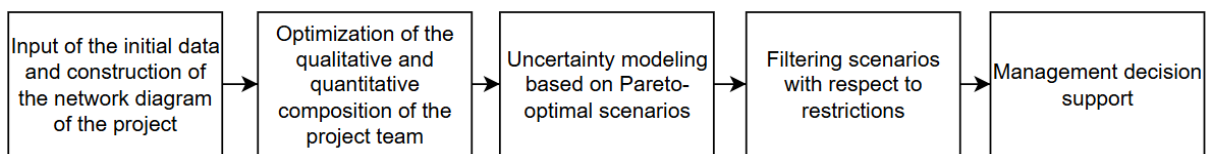
No. iterations	Labor costs	Project duration	Role 1	Role 2	Role 3	Role 4	Role 5	Role 6	Role 7	Role 8	Role 9
213	2757.49	101.70	12	14	16	13	17	16	14	16	16
773	2751.36	102.05	20	13	12	7	12	14	19	15	17
404	2617.41	102.57	12	13	18	16	11	19	14	15	11
813	2328.39	102.62	13	15	8	17	14	13	17	13	11
322	2142.77	103.40	9	15	12	19	17	12	11	11	11
993	2131.45	105.75	14	8	10	16	17	10	16	11	13
729	2091.09	107.22	9	19	7	16	11	15	9	12	8
219	2016.44	107.66	17	8	12	18	9	15	5	11	13
722	1928.35	109.12	16	9	10	14	7	11	14	9	13
878	1799.46	114.73	6	14	8	8	13	15	3	8	15
857	1733.04	114.80	6	8	13	15	10	5	6	10	14
562	1671.13	121.32	19	5	11	8	12	9	7	7	11
332	1552.60	123.57	2	8	12	14	13	12	5	8	7
765	1552.47	131.04	4	14	7	8	3	5	5	11	8
73	1498.48	134.54	6	7	3	6	3	13	7	9	12
451	1437.93	137.70	13	10	5	14	10	6	5	8	4
575	1315.33	152.53	14	9	3	14	4	8	4	5	7
442	1308.08	152.96	11	9	6	17	6	10	2	5	5
208	1234.02	166.66	6	7	2	19	6	9	4	4	8
896	1190.37	191.76	4	6	9	3	2	2	2	9	6
852	1093.79	216.02	4	6	8	6	3	9	5	4	2
841	1021.20	312.68	3	2	8	4	1	2	1	5	3

Each of these 17 scenarios has its own specifics regarding the project team allocation and the amount of resources. Some options make it possible to implement the project in the shortest possible time with relatively high labor costs, which may be advisable if the company has sufficient human and financial potential. Other solutions offer more economical configurations that require less labor but involve a slight increase in time, which remain within acceptable limits. Thus, the company’s management gets a flexible tool for choosing a strategy depending on current priorities and external conditions. Thus, Figure 4 shows the scheme of the “model

pipeline.”

**Table 3** Comparison of the management scenarios

Management scenario	Labor costs, brigade-weeks	Project duration (week)	Percentage reduction in labor costs	Percentage reduction
“As-planned” staffing	1850	156	0	0
Classic heuristic (resource-leveling rule)	1700	150	8.1%	3.85%
Pareto is the optimal scenario (iteration No442)	1308.08	152.96	29.29%	1.9%
Pareto is the optimal scenario (iteration No562)	1671.13	121.32	9.67%	22.23%



**Figure 4** Model pipeline

The value of engineering and management activities is related to the roles that act as bottlenecks of the project. Based on a series of computational experiments, it can be established that the roles associated with critical and poorly parallelizable types of work cause the calendar schedule to be compressed to the greatest extent. An increase in the number of performers in these positions has the greatest impact on shortening the project time because these specialists determine the critical path’s throughput. Next, we will add an analysis of the roles for which the effect of decreasing returns is observed. Modeling will show that for a number of functions with a high degree of task fragmentation, after reaching a certain number threshold, additional employee involvement practically does not shorten the overall project duration and has little effect on economic performance.

The task of management is not only to allocate resources but also to identify each role’s maximum effectiveness, determine rational workload levels, and prevent a shortage of critical specialists and an excessive expansion of secondary functions. Next, the sensitivity of the model to changes in key performance parameters was then analyzed. This stage aimed to assess the stability of the previously obtained conclusions and the change in the Pareto front with varying initial data. As part of the experiment, performance in all major roles varied in the range of  $\pm 10\text{-}20\%$  relative to the baseline scenario. For each set of parameters, a series of repeated launches of the model was performed, followed by the construction of updated sets of effective solutions according to the criteria “project duration total labor costs”. The results of the sensitivity analysis are shown in Figure 5.

The simulation results demonstrate a systematic shift of the Pareto fronts with a change in the performance of performers by  $\pm 10\text{-}20\%$ . The basic scenario forms a typical decreasing relationship between the implementation period and total labor costs: a significant reduction in the project duration is achieved due to a sharp increase in labor intensity, while diminishing returns are manifested in the long-term zone. With a decrease in productivity ( $-10\%$ ,  $-20\%$ ), the front shifts to higher labor costs with comparable deadlines, reflecting the need to compensate for the drop in individual efficiency by increasing the team size.

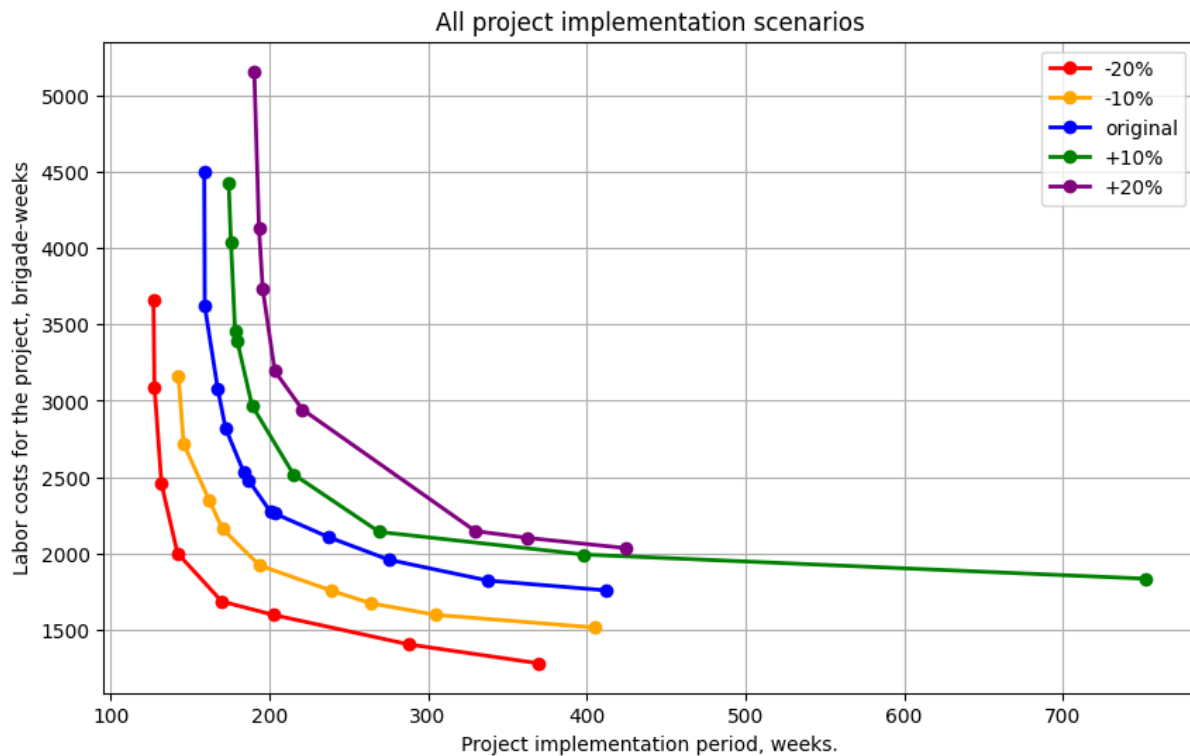


Figure 5 Sensitivity analysis results

On the contrary, with an increase in productivity (+10%, +20%), there is a shift in the front toward more preferable combinations of parameters: less labor is required to meet deadlines, and some previously unattainable "fast" scenarios become feasible without an extreme increase in resources. At the same time, the general shape of the curves remains, indicating the stability of the structure of the "time – labor intensity" compromise, but its quantitative characteristics change depending on the level of productivity.

Simultaneously, further development of the study involves the expansion of sensitivity analysis. Scenarios in which resource constraints are introduced for individual positions (lack of key specialists), as well as cases of an increase in the allowable recycling rate, are considered promising areas. These factors may allow us to further assess the stability of design configurations under organizational and personnel constraints and identify the applicability limits of solutions obtained within the basic problem statement framework. Despite the practical orientation and applied significance of the developed model of workforce optimization, its use is associated with several methodological and applied limitations that must be considered when interpreting the results. The model is based on an aggregated representation of the workforce. The use of expanded role categories increases manageability and reduces the task's computational complexity but does not reflect employees' intra-group specialization, differences in qualifications, productivity, and interchangeability of individual specialists.

Another limitation is the network graph's deterministic structure. The logical and technological connections between the works in the model are fixed and unchangeable. In practice, the sequence of tasks can be adjusted during the project based on organizational decisions, weather conditions, equipment supplies, and other external factors. Thus, the developed model should be considered a tool for strategic and pre-investment analysis, which makes it possible to identify rational directions for resource allocation and the boundaries of a compromise between time and labor intensity. However, it requires adaptation and refinement when moving to detailed operational planning of a specific project.

#### 4. Conclusions

Within the framework of this study, a methodology has been developed for the multi-criteria optimization of labor allocation in capital construction projects in the oil and gas industry with full coverage of the life cycle of land-based facilities. The main contribution of the work is to create a model that simultaneously considers the duration of the project and the total labor costs and uses the classification of performers corresponding to the company's organizational and production structure. This approach makes it possible to model the internal processes of resource allocation more adequately and increases the practical applicability of the solutions obtained in management practice. The conducted computational experiments and the Pareto front analysis have shown a high variability of possible scenarios for the project implementation. Twenty one Pareto optimal solutions have been identified, of which 17 comply with the contractual time limits. The results obtained demonstrate the existence of an obvious compromise between minimizing deadlines and minimizing labor costs, and also provide the company's management with a flexible tool for choosing a project implementation strategy depending on available resources, financial capabilities, and external conditions. An important result of the work is the consideration of uncertainty factors in the optimization process, which enables the assessment of the sustainability of solutions and identification of a range of acceptable project implementation trajectories. This approach provides management with a visual and quantitative decision support tool that allows them to form optimal strategies for allocating project teams under various constraints. Thus, the study shows that the use of multicriteria optimization methods in the management of large investment and construction projects not only increases planning and resource allocation efficiency but also helps reduce risks and improve project manageability. The results obtained are of great theoretical and practical importance and form the basis for further research in the field of adaptive calendar and network schedule optimization, considering organizational structure and external uncertainty.

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#### Author Contributions

The authors have contributed equally.

#### Conflict of Interest

The authors have no conflicts of interest to declare.

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