



Ministry of Science and Higher Education of the Russian Federation
Federal State Budgetary Educational Institution of Higher Education
NOVOSIBIRSK STATE UNIVERSITY OF ARCHITECTURE and CIVIL
ENGINEERING (SIBSTRIN)



Organizational and Technological Solutions for Improving Labor Productivity in the Construction of Industrial Facilities

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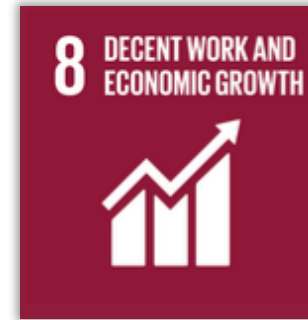
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SUSTAINABLE DEVELOPMENT GOALS

- Goal 8: Promote inclusive and sustainable economic growth, employment and decent work for all;
- Goal 9: Build resilient infrastructure, promote sustainable industrialization and foster innovation;
- Goal 12: Ensure sustainable consumption and production patterns.

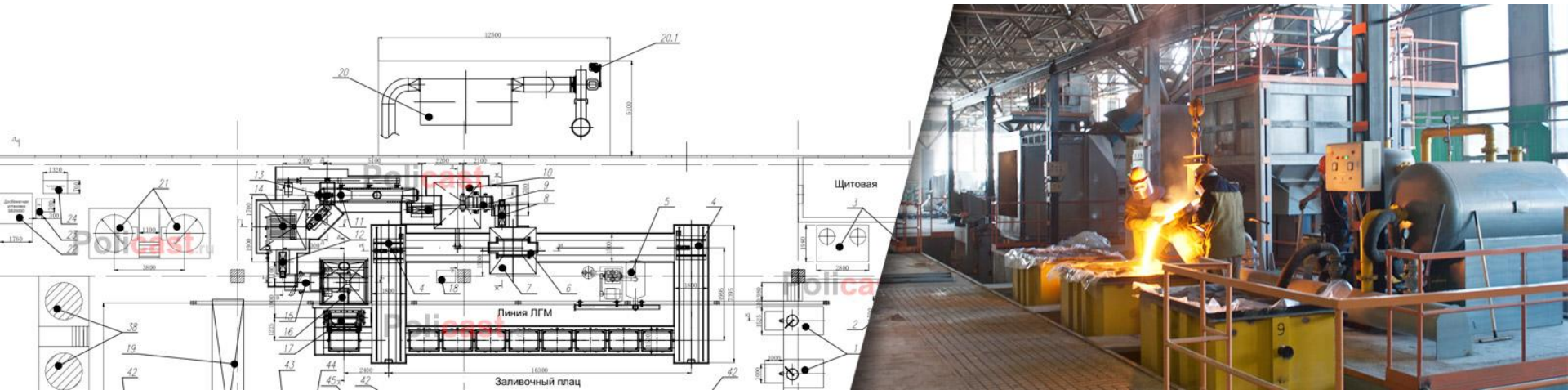
Relevance of the Research Topic



- Improving labor productivity is a key factor in achieving national construction industry goals and the Sustainable Development Goals (SDGs) - reducing construction timelines, budgets, and quality (SDG 8).
- Existing methods do not sufficiently address the specifics of industrial construction, particularly foundry buildings, which hinders technological modernization (SDG 9.2).

Goal and Objectives

- Goal: Formation of a set of organizational and technological solutions (as an element of the Organizational and Technological Platform (OTP)) aimed at increasing labor productivity in the construction of foundry facilities, as a tool for the efficient use of resources and innovative development of the industry.



Goal and Objectives

- Objectives:

1. Conduct a comprehensive analysis of domestic and international literary sources;
2. Identify and systematize key factors influencing labor productivity during the construction of industrial facilities, taking into account their technological specifics and innovations;
3. Develop a mathematical model of the dependence of productivity on the identified factors;
4. Develop a set of solutions for optimizing construction processes to increase labor productivity and staff training.

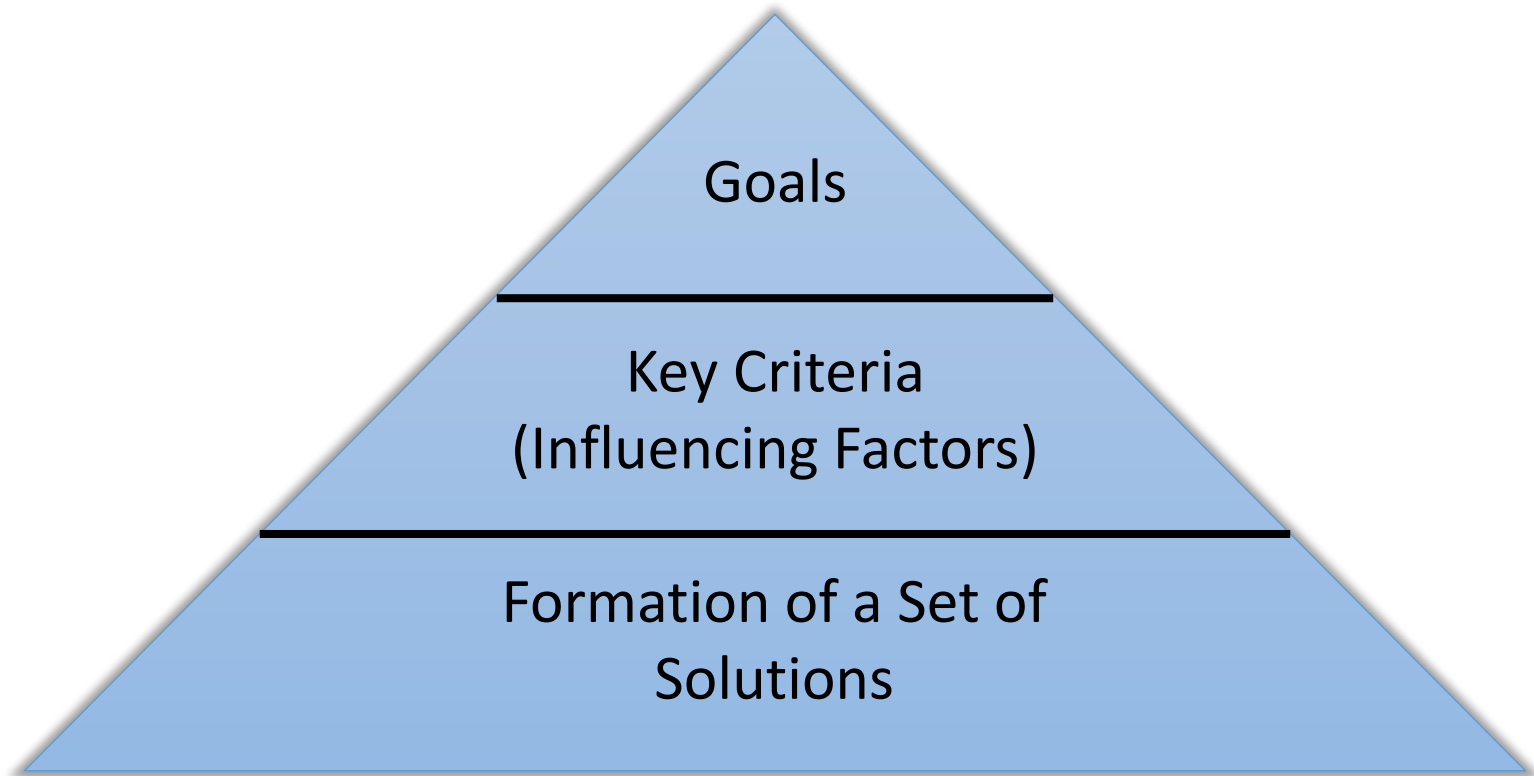
Scientific Novelty

- Systematization and adaptation to modern conditions of theoretical and practical approaches to improving labor productivity in relation to sustainable industrial construction.
- Development of a framework for organizational and technological solutions as an element of the lifecycle management of foundry facilities (SDG 12).

Methodology and Research Methods

- The methodology is based on a systems approach, within which labor productivity is considered as a complex construction system possessing the properties of hierarchy, flexibility, and adaptability.
- Research Methods:
 1. Theoretical analysis;
 2. Mathematical modeling.

A Systems Approach Based on the OTP



- Basic levels of the Goal Tree of the organizational and technological construction platform

Hypothesis

- Increased labor productivity during the construction of foundry facilities can be achieved by optimizing the function of key organizational and technological factors at the design and construction stage, where the greatest labor costs are concentrated.
- Construction efficiency depends not on isolated innovations, but on the development of a comprehensive set of solutions that takes into account the specific technological organization of the production line.

Main Focus of the Research

- The share of construction preparation (CP) in total labor costs during industrial construction ranges from 38% to 61%.
- Optimizing organizational and technological solutions during the CP stage provides the greatest potential for increased productivity and a reduced environmental footprint through intelligent logistics and resource planning.

Factor Model

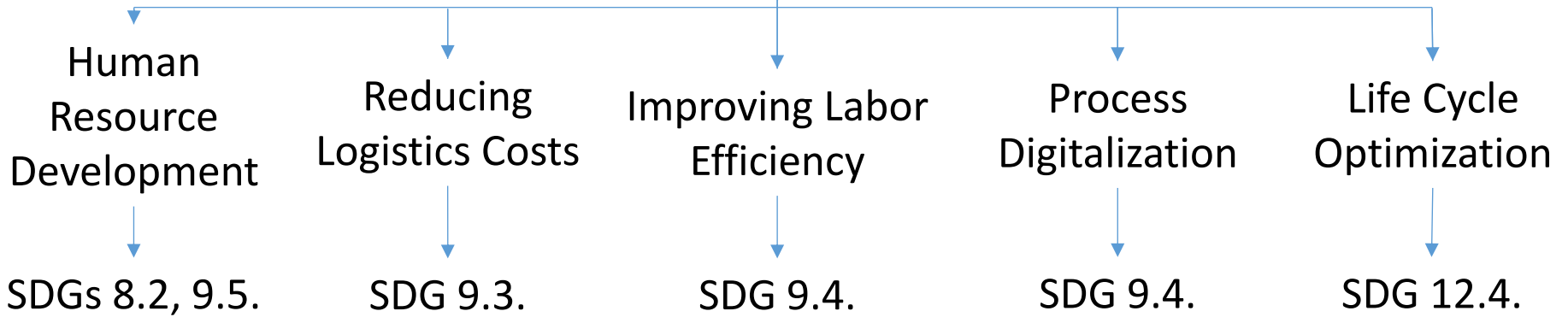
- Mathematical model:

$$LP_{fact} = f(F_i, Par_{ij})$$

where: F_i - Influencing Factors ($i = 1 \dots 10$);

Par_{ij} - parameters that shape each factor.

LP



Mathematical Model

A Set of OTS

The Objective Function for Minimizing Project Costs:

- $$M = \sum_{i=1}^m \sum_{j=1}^n (d_j \cdot l_{ij} + b_i) + B + \mu \cdot \max(0, C_{nm} - L)$$

where: d_j - is the direct cost rate of contractor j ;

l_{ij} - is the duration of task i when performing task j ;

b_i - is the overhead cost for task i ;

B - is the general overhead cost;

μ - is the penalty for late delivery;

C_{nm} - is the actual duration of the project;

L - is the duration limit.

Contribution of the research to the Sustainable Development Goals

Sustainable Development Goals	Contribution
SDG 8	Increase labor productivity through process optimization
SDG 9	Implement digital technologies and modern methods in foundry construction
SDG 9.5	Develop mathematical models and adapt methodologies
SDG 12	Reduce labor costs and material losses through the PSP stage

Results and Further Research

Completed at this stage	Further research
<p>Systematization of LP factors (5 groups) (Contribution: Technological modernization of industries - SDG 9.4)</p>	<p>Calibration of the optimization model (Contribution: Improving resource efficiency - SDG 9.4)</p>
<p>Formalization of parameters for foundry production (Contribution: Transition to sustainable production models - SDG 12.A)</p>	<p>Developing an algorithm for selecting the OTS (Contribution: Encouraging innovation and scientific research - SDG 9.5)</p>
<p>Adaptation of the Factor Model $LP_{fact} = f(F_i, Par_{ij})$ (Contribution: Modernization of technological potential - SDG 9.5)</p>	<p>Testing a set of solutions (Contribution: Growth of economic productivity and decent work - SDG 8.2)</p>
<p>Defining the focus on the CP (reserve 38-61%) (Contribution: Integration into production chains - SDG 9.3)</p>	<p>Sustainability assessment Infrastructure (Contribution to sustainable infrastructure - SDG 9.1)</p>
<p>Integration of OTP methods, analysis, and optimization (Contribution: Diversification and economic growth - SDG 8.2)</p>	<p>Testing a set of solutions within the framework of the Master's Student's Final Qualification Work</p>

Interim Conclusion

- The integration of OTP, factor analysis, and optimization methods enables the achievement of SDG goals at the local project level.



Thank you for your
attention!

