Engineering Cup Challenge

IMPROVING THE OPERATIONAL EFFICIENCY OF MINING AND HAULAGE EQUIPMENT

Focus Area

Solutions in the field of optimizing the performance of mining and haulage equipment and improving the efficiency of production processes in the mining and chemical industry.

Objective

Develop an engineering solution aimed at increasing the Technical Availability Factor (TAF) and the Equipment Utilization Factor (EUF) by optimizing technical, organizational, and technological processes in the operation of mining and haulage equipment.

Company Overview

EuroChem is an international mineral and chemical company producing a wide range of nitrogen, phosphate, and NPK fertilizers, as well as industrial chemical products. The total number of employees exceeds 13,500 people.

This challenge was developed for the operations of JSC Kovdorsky Mining and Processing Plant (Kovdorsky GOK)and EuroChem-Fertilizers LLP.

Context and Relevance

Improving the efficiency of mining and haulage equipment enables enterprises to:

- reduce production costs
- increase operational productivity
- enhance the stability of the production process
- ensure more effective utilization of machinery

High downtime levels — both technical and technological — directly reduce the Technical Availability Factor (TAF) and the Equipment Utilization Factor (EUF).
Enterprises record significant volumes of organizational and technical downtime, including emergency shutdowns, unprepared benches, and prolonged waiting for haul trucks.

Problem Statement

High downtime of mining and haulage equipment leads to:

- a decrease in TAF
- a decrease in EUF
- loss of productivity
- increased production costs

Task for Participants

Develop a set of technical and organizational measures aimed at improving the efficiency of mining equipment operation.

Participants must propose solutions that can increase:

- the Technical Availability Factor (TAF)
- the Equipment Utilization Factor (EUF)

Possible areas of improvement include:

- engineering and technical measures
- process digitalization
- improvements in work organization
- analysis and optimization of downtime causes
- enhancing coordination between departments and service teams

Input Data

Technical Parameters

A detailed list of downtime types and operational cycle elements for drilling rigs, excavators, and both mining and haul trucks is provided in the appendix.

Current Economic Indicators

- EUF = 0.6
- TAF = 0.8

Constraints

- significant organizational and technical downtime
- emergency shutdowns
- unprepared mining faces
- prolonged waiting for haul trucks

Expected Deliverables

The team must propose a comprehensive set of actions (technical and organizational) aimed at increasing TAF and EUF.

The final solution should include:

1. Analysis of current technical and technological downtime using the provided datasets.
2. A set of engineering and organizational measures to improve TAF and EUF.
3. Proposals for improving coordination between departments and optimizing production processes.

4. Measures for reducing emergency and unplanned shutdowns.
5. Proposals for improving the efficiency of drilling rigs, excavators, and haul trucks.
6. A roadmap for implementing the proposed solution.

Additional Materials

Appendix 1. Information about EuroChem.
Appendix 2. Table: “Downtime and Operational Cycle Elements for Drilling Rigs, Excavators, Mining and Haul Trucks.”
Appendix 3. Records of technological downtime and operational cycles for various types of mining equipment.
Appendix 4. Downtime and operational cycle elements for chemical complex equipment.

Appendix 1. EuroChem Company Information

1. Name

Mineral and Chemical Company “EuroChem”

2. Industry

Chemical industry, production of mineral fertilizers and industrial chemical products.

3. Main Activities

The company specializes in producing nitrogen, phosphorus, and complex fertilizers, as well as a range of industrial chemicals. EuroChem integrates companies across the full production cycle, including raw material extraction, processing, fertilizer production, logistics, and service divisions.

4. Company Structure

The group includes:

- EuroChem-BMU LLC
- Phosphorit Industrial Group LLC
- EuroChem North-West LLC
- Nevinnomysskiy Azot
- NAC “Azot” JSC with the “Novomoskovsky Chlor” branch
- Kingisepp-Remstroyservice LLC
- Nevinnomyssk-Remstroyservice LLC
- Novomoskovsk-Remstroyservice LLC
- ProTech Engineering LLC
- Pro Tech Lab LLC

5. Number of Employees

Total: 13,500+, including:

- EuroChem-BMU — 878
- Phosphorit Industrial Group — 1,154
- EuroChem North-West — 239
- Nevinnomysskiy Azot — 3,150
- NAC “Azot” & Novomoskovsky Chlor — 3,696
- Nevinnomyssk Remstroyservice — 1,340
- Kingisepp-Remstroyservice — 839
- Novomoskovsk Remstroyservice — 1,099
- ProTech Engineering — 1,058
- Pro Tech Lab — 100+

6. Core Values and Approach

EuroChem prioritizes:

- Innovation and technological development
- Process efficiency
- Environmental responsibility
- Workplace safety
- Employee development

Appendix 2. Downtime and Operational Cycle Elements for Drilling Rigs, Excavators, Mining and Haul Trucks.

№	Names of Downtimes and Operating Cycle Elements According to the Methodology	Unit	Drilling Rigs	Excavators	Mining Haul Trucks	Highway Haul Trucks
1	**Operating Cycle**	h				
1.1	Excavation of rock mass (loading)	h	no	yes	yes	yes
1.2	Ore haulage	h	no	no	yes	yes
1.3	Dump truck unloading	h	no	no	yes	yes
1.4	Travel time	h	no	no	yes	yes
1.5	Drilling	h	yes	no	no	no
2	**Maintenance Downtime (affecting Availability Factor)**	h				
2.1	**Scheduled Maintenance Downtime**	h				
2.1.1	Scheduled preventive maintenance	h	yes	yes	yes	yes
2.1.2	Routine maintenance	h	yes	yes	yes	yes
2.1.3	Commissioning and adjustment operations (maintenance-related)	h	yes	yes	yes	yes
2.1.4	Shift maintenance (oil refill, tire inflation)	h	yes	yes	yes	yes
2.1.5	Tire replacement	h	no	no	yes	yes
2.1.6	Overhaul (restorative repair)	h	yes	yes	yes	yes
2.2	**Unscheduled Maintenance Downtime**	h				
2.2.1	Unscheduled mechanical repair	h	yes	yes	yes	yes
2.2.2	Unscheduled electrical repair	h	yes	yes	yes	yes
2.2.3	Waiting for maintenance personnel	h	yes	yes	yes	yes
2.2.4	Waiting for spare parts	h	yes	yes	yes	yes
2.2.5	Waiting for special equipment	h	yes	yes	yes	yes
2.2.6	Waiting for repair start	h	yes	yes	yes	yes
2.2.7	Waiting for repair crew	h	yes	yes	yes	yes
2.2.8	Other	h	yes	yes	yes	yes

Appendix 3. Records of technological downtime and operational cycles for various types of mining equipment.

№	Names of Downtimes and Operating Cycle Elements According to the Methodology	Unit	Drilling Rigs	Excavators	Mining Haul Trucks	Highway Haul Trucks
3	**Technological Downtime (affecting the Equipment Utilization Factor — EUF)**	h				
3.1	***Scheduled Technological Downtime***	h				
3.1.1	Equipment reserve	h	no	yes	yes	yes
3.1.2	Shift handover	h	yes	yes	yes	yes
3.1.4	Refueling	h	yes	yes	yes	yes
3.1.5	Meal break	h	yes	yes	yes	yes
3.1.6	Relocation	h	yes	yes	no	no
3.1.7	Auxiliary operations (bulldozer cleanup, drill-hole alignment, casing, etc.)	h	yes	yes	yes	yes
3.1.8	Blasting operations	h	yes	yes	yes	yes
3.2	***Unscheduled Technological Downtime***	h				
3.2.1	Operator absence	h	yes	yes	yes	yes
3.2.2	Lack of fuel and lubricants	h	yes	yes	yes	yes
3.2.3	Lack of tools and materials (for drilling rigs)	h	yes	no	no	no
3.2.4	Lack of water	h	yes	no	no	no
3.2.5	Gas contamination / dust pollution	h	yes	yes	yes	yes
3.2.6	Lack of access roads	h	yes	yes	yes	yes
3.2.7	Adverse weather conditions	h	yes	yes	yes	yes
3.2.8	Waiting for transport	h	yes	yes	yes	yes
3.2.9	Malfunction / absence of loading equipment	h	no	no	yes	yes
3.2.10	Waiting for loading	h	no	no	yes	yes
3.2.11	Waiting for unloading	h	no	no	no	yes
3.2.12	Waiting for refueling	h	yes	yes	yes	yes
3.2.13	Other	h	yes	yes	yes	yes

Appendix 4. Downtime and operational cycle elements for chemical complex equipment.

№	Names of Downtimes and Operating Cycle Elements According to the Methodology	Unit	Фабрика
1	Technological cycle	h	
1.1	FM production	h	yes
2	Maintenance Downtime (affects MTAR — Mechanical Availability Rate)	h	
2.1	Scheduled maintenance downtime	h	
2.1.1	Scheduled preventive maintenance	h	yes
2.1.2	Commissioning and adjustment work (time for/to maintenance and repair)	h	yes
2.1.3	Technical servicing	h	yes
2.1.4	Daily servicing (inspection/tightening of bolted joints, oil top-up)	h	yes
2.1.5	Tire replacement for wheeled equipment	h	yes
2.1.6	Major (restorative) overhaul	h	yes
2.2	Unscheduled maintenance downtime	h	
2.2.1	Unscheduled mechanical repair	h	yes
2.2.2	Unscheduled electrical repair	h	yes
2.2.3.	Unscheduled instrumentation & automation repair (I&C)	h	yes
2.2.4.	Waiting for maintenance personnel	h	yes
2.2.5.	Waiting for spare parts	h	yes
2.2.6.	Waiting for special equipment	h	yes
2.2.7.	Other	h	yes
3	Technological Downtime (affects OEE/Utilization Rate)	h	
3.1	Scheduled technological downtime	h	
3.1.1	Reconfiguration / construction of power transmission lines (during commissioning of the Chemical Complex)	h	yes
3.2	Unscheduled technological downtime	h	
3.2.1	Limitations / shortage of materials or feedstock (supply restrictions, production limits)	h	yes
3.2.2	Absence of fuel and lubricants	h	yes
3.2.3	Substation failure (KEGOC) — external impact	h	yes
3.2.4	Restriction of feedstock/product/material intake in the downstream process	h	yes
3.2.5	Equipment clogging with product/feedstock	h	yes
3.2.6	Waiting for transport	h	yes
3.2.7	Malfunction / unavailability of loading equipment	h	yes
3.2.8	Waiting for furnace-fuel refueling	h	yes
3.2.9	Emergency repair of power transmission lines (internal lines)	h	yes
3.2.10	Other	h	yes