End-to-End Solution For Mining Industry

K-MINE
REACH NEW LEVEL

End-to-End Solution For Mining Industry

K-MINE excels in the mining industry by combining expert consulting services with advanced software solutions, catering comprehensively to the mining cycle. Our stand-alone application covers most operational needs in the mining industry.

Leveraging capabilities such as 3D modeling, resource estimation, and equipment management, K-MINE is widely used by companies of different sizes for open pit and underground mining. Over 5,000 surveyors, geologists, mining engineers, designers, and technicians leverage K-MINE modules and their solutions on a daily basis.

EXPLORATION ⟶ **PRE/FEASIBILITY STUDY** ⟶ **DEVELOPMENT** ⟶ **PRODUCTION**

Software For Open Pit Mining

Surveying
Functionality for accurate analysis, monitoring, and optimization of surveying data.

Geology
Structural 3D modeling of mineral deposits

Open Pit Design
All tools you need to design pits, dumps, railways, haul roads, and other structures

Scheduling
All tools you need for Long-, Middle-, and Short-term planning abilities.

Pit Optimizer
Analysis and definition of optimal pit contours with provided deposit economic data

Drill & Blast Design
All necessary functions you need to design drilling & blasting processes

Infrastructure
Online maps creation and update with 3D elements of industrial sites and maintenance of objects database.

Stability Analysis
Stability assessment of open pit walls and bench, and dump lifts in various rock mass

Software For Underground Mining

Surveying
Advanced solution for automating surveying data management processes in underground mining

Geology
Structural 3D modeling of mineral deposits

Underground Design
Solutions for underground projects during the initial mine development and further operations

Stope Optimization
Tool for determining the most efficient stope boundaries in underground mining

Ventilation
Simulation of different ventilation modes to determine pollution state and plan accident elimination

Infrastructure
Online maps creation and update with 3D elements of industrial sites and maintenance of objects database.

Custom Solutions

End-to-End Planning
Automation of planning for all stages of the production's technological process with shifts distribution of staff, and equipment load distribution.

lot Platform
Data collection from IoT devices in real-time. Data analysis and advanced analytics.

Integration with Dispatch Systems (Open Pit)

Integration with Dispatch Systems (Underground)
Obtaining and visualizing information from dispatch systems by engineers of different departments for the operational management of open-pit and underground mining.

K-MINE HIGHLIGHTS

30 years on the market   QP for **NI 43-101**   CP for **JORC**   over **7,500** licenses sold

over **300** projects   **Offices** in UK, Europe, USA, Canada   over **100** team members

| Chrysotile Asbestos | Granite | Kaolin | Graphite | Coal |

| 26 Fe 55.845 Iron | 79 Au 196.967 Gold | 25 Mn 54.938 Manganese | 29 Cu 63.546 Copper | 47 Ag 107.8682 Silver | 3 Li 6.941 Lithium | 4 Be 9.012 Beryllium | 92 U 238.02891 Uranium | 22 Ti 47.867 Titanium |

| Polymetals | Clay | 13 Al 26.982 Aluminium | 27 Co 58.933 Cobalt | 28 Ni 58.693 Nickel | 24 Cr 51.996 Chromium | Limestone |

Services

Engineering, Planning and Optimization

- Detailed Mine Design and Engineering
- Mining Method Selection
- Strategic Mine Planning
- Pit Wall Design and Stability Analysis
- Cut-off Grade Optimization
- Optimization Services
- Environmental Impact Assessment
- Mine Closure Planning and Rehabilitation
- Ventilation System Design (for Underground Mines)

Geological Services and Economic Assessment

- 3D Modeling of Deposits
- Geological Mapping
- Resource and Reserve Estimation
- Geostatistical Analysis and Kriging
- Compliance with Reporting Standards (NI 43-101, JORC, etc.)
- Exploration Targeting and Assessment
- Drillhole Planning and Management
- Geotechnical Data Interpretation and Analysis

### Financial and Investment Services

- Scoping, Pre-Feasibility, and Feasibility Studies
- Deposit Investment Opportunity Analysis
- Competent Person Reports
- Independent Mine Audit
- Independent Financial Project Audit
- Financial Modeling and evaluation
- Risk Assessment and Management

Digital and Innovative Solutions

- Digital Twins for Mine Operations
- Advanced Analytics and Machine Learning
- Automated Reporting Systems
- Integration with IoT Devices for Real-Time Monitoring
- Predictive Maintenance Systems
- Cloud-Based Data Management Solutions

REQUEST PROPOSAL FROM K-MINE
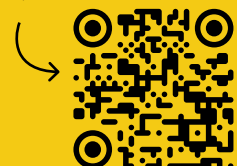
Exploration STAGE

REQUEST PROPOSAL FROM K-MINE

✓ **Searching for mineral deposits**

✓ **Collect data in a geological database**

✓ **Creation of a block model of a mineral deposit**

✓ **Provide mapping and report**

OUR EXPLORATION SOFTWARE

K-Mine software will provide you with the necessary functionality for all operational needs at the exploration stage. From field modeling based on exploration data to resource estimation and reporting.
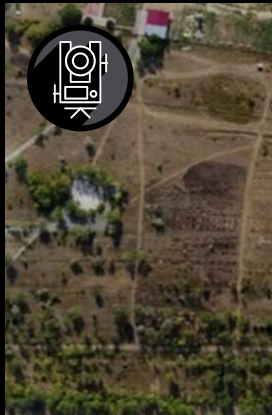
Surveying

top features for exploration stage

· 3D Models creation of mining objects and areas
· Processing of instrumental survey data
· Uploading and processing of point clouds
· Surveying reports

Geology

top features for exploration stage

· Data processing and analysis of geological exploration results
· Database maintenance of geological sampling
· 3D modeling of deposits
· Reserve and resource estimation
· Automation of geological works
· Creations of the geological reports

OUR EXPLORATION SERVICES

Utilize advanced technology and extensive geological knowledge to identify and evaluate potential mineral deposits. This crucial first step is essential for any successful mining project.

▼ Initial Desk Study

Before setting out, it's crucial to know what we're looking for. In this step, we:

- **Collect and Analyse:** accumulate existing geological data, maps, and reports to construct a well-informed background of the target area.

▼ Identify Potential Zones:

Employing a combination of data and expertise to pinpoint areas likely to harbour valuable mineral resources.

▼ Database Creation

We create a treasure map for your project by compiling all the important information, such as:

- **Stratigraphic Data:** for insights into the layers of rock formations.
- **Geochemical Data:** to understand the chemical properties and composition of the earth in the target area.
- **Geophysical Data:** analysing physical properties of the subsurface.

▼ Mapping Services

It's easier to understand information when you can see it. We make various maps that show:

- **Isohypses:** to represent elevations and understand the terrain's topography.
- **Isocontours:** highlighting specific attributes such as temperature or mineral content.
- **Horizontal Plans:** showing the boundaries of the exits of various geological formations
- **Profiles:** cross-sectional views for depth analysis.
- **Combined Maps:** integrated views for a comprehensive understanding.

▼ Block Modeling & Scoping Stage

Clarity through visualization is a key. We create:

- **Technical Reports & Interpretation:** demystifying data.
- **Geological Assessment:** evaluating geological formations and mineral occurrences.
- **Economic Evaluation:** assessing financial feasibility.
- **Environmental Considerations:** ensuring sustainable practices.
- **Risk Factors:** unveiling and addressing uncertainties.
- **Competent Person Statement:** an assurance from an expert regarding the veracity of the information.

▼ Mineral Resource Estimation

Our crowning service lies in the estimation of mineral resources, done in compliance with internationally revered standards, ensuring global recognition. We are adept in: **CRIRSCO, JORC, NI 43-101, PERC**

Pre-feasibility and Feasibility STUDIES

During the pre/feasibility stages, K-Mine will help you determine the technical and economic feasibility of extracting minerals from a particular deposit. Using K-Mine you can determine if a mining project is worth further investment and development.

✓ **Finding the final contours of a pit** based on economic indicators

✓ **Estimate the size, grade, and extent of mineral resources** using a combination of data from exploration, sampling and drilling

✓ **Determination the technical and economic viability of the project** (more detailed assessment of the resource estimate, mining methods, infrastructure requirements, and environmental considerations)

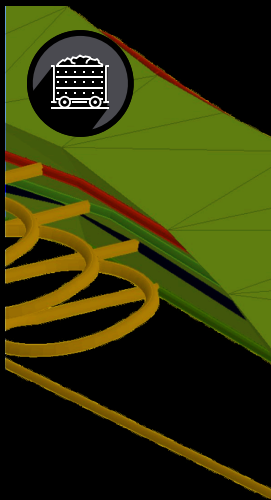✓ **Assessment of reserves/resources of mineral materials**

OUR PFS/FS SOFTWARE
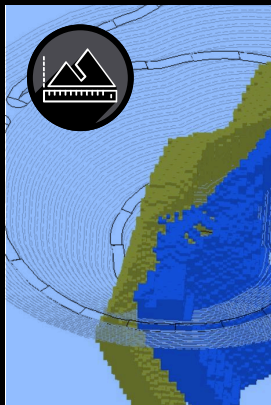
Open Pit Design

top features for PFS/FS studies

· Automatic final open pit design

· Roads Design and Transportation Scheme

· Dump design

· Pushbacks design

· Super-fast creations of open pit and dumps progression for different time intervals

· Preliminary Infrastructure designing

Underground Design

top features for PFS/FS studies

· Design of capital underground workings

· Design of Underground Infrastructure

· Road System Design

· Preliminary division of the ore body into blocks

· Working with graphic data

Geology

- Data processing and analysis of geological exploration results
- Database maintenance of geological sampling
- 3D Geological Modeling of deposits
- Statistical Data Processing
- Geostatistics&Kriging
- Reserve and resource estimation
- Automation of geological works
- Creations of the geological reports

Pit Optimizer

top features for PFS/FS studies

- Determination of the optimal contour of the open pit.
- Calculation of all possible variations of the final contours by the price adjustment factor and setting complex conditions using dependence formulas.
- Pushbacks defining by two methods (auto and manual)
- Assigning parameters to blocks belonging to: final contour, pushback, planning period.
- Scheduling based on panels principle.
- Project evaluation using an automated sensitivity analysis tool.
- Final pit designs comparison
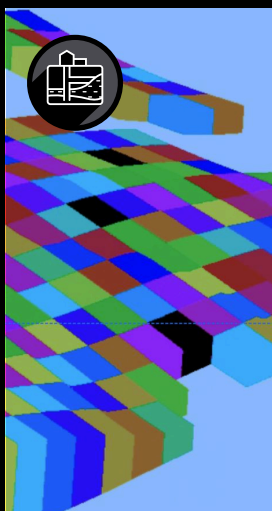
Stope Optimization

top features for PFS/FS studies

- Seamlessly adapts to various deposit types to ensure optimal project feasibility assessment.
- Provides tools to assess and prioritize economically viable stopes for detailed FS analysis.
- Offers three distinct stope optimization methods to cater to diverse geological and economic scenarios.
- Utilizes adaptive clustering to align with project-specific geological conditions.
- Incorporates advanced risk evaluation to enhance decision-making accuracy.

OUR PFS/FS SERVICES

Delve into our comprehensive Pre-feasibility and Feasibility Studies, where we employ rigorous analysis and innovative tools to evaluate the viability and economic potential of your mining project. This phase ensures a practical, cost-effective, and environmentally responsible approach to your mining endeavor.

Initial Desk Study

- **Analyze the geological data** and previous research to assess the site's potential for exploration and reserve growth
- **Conduct audits of existing geological and historical data**, including maps, reports, and other available information
- **Develop a preliminary project description** outlining the scope and objectives

Mineral Resource Estimation

- Evaluate the quantity and quality of minerals in the deposit
- Comply with international standards including **CRIRSCO, JORC, NI 43-101, and PERC**

Pre-Feasibility Studies (PFS)

- Evaluate the potential viability of the mining project
- Identify potential challenges and risks

Feasibility Studies (FS)

- Conduct a detailed study assessing technical and financial feasibility
- Includes resource estimation, mine planning, testing, and cost analysis

Preliminary Engineering Design

- Zone the open pit field to define mining areas
- Design the opening system and develop productivity schedules
- Develop road and infrastructure designs

Financial Analysis

- Create an economic model including capital and operating costs
- Plan the payback period and evaluate financial indicators such as NPV and IRR
- Assess procurement and construction planning

Open Pit Mine Planning and Optimization

- Determine optimal mining limits considering economic criteria
- Design the configuration of the open pit for maximum efficiency
- Develop pit phasing and scheduling to maximize NPV

Underground Mine Planning and Optimization

- Design efficient underground mine layouts and extraction sequences
- Optimize operations for safety, production rates, and costs

Risk Assessment

- Evaluate and plan for technical, economic, environmental, and regulatory risks

Environmental Assessment

- Assess the environmental impacts and ensure compliance with regulations
- Develop strategies for minimizing environmental footprint

Project Execution Plan

- Develop a comprehensive plan for the implementation of the mining project
- Include detailed planning, scheduling, and resource allocation
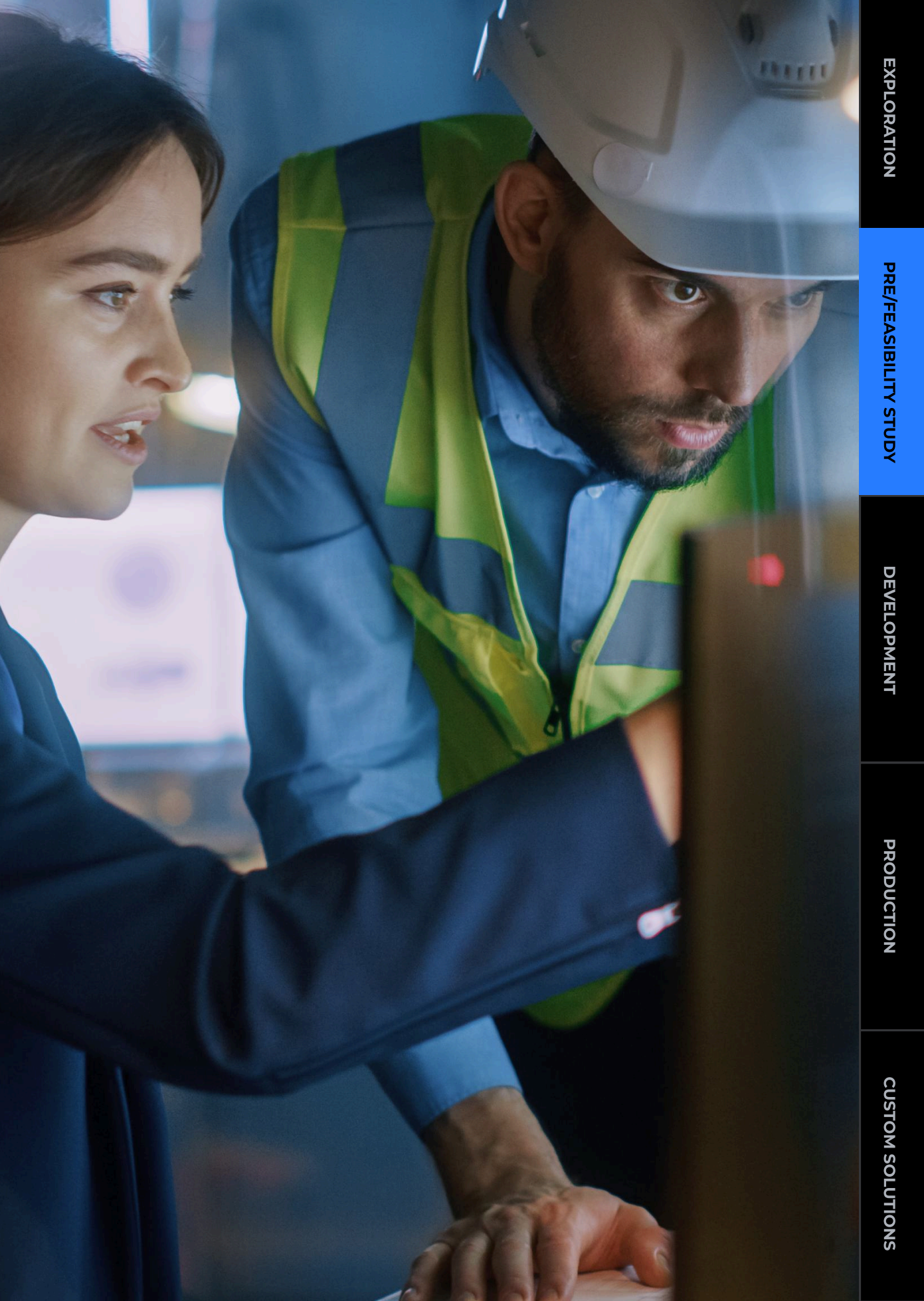
Development STAGE

REQUEST PROPOSAL FROM K-MINE

The development stage is characterized by a wide variety of technological operations. K-Mine can fully cover the needs of the user at this stage. You can easily and correctly implement any projects of your mining enterprise.

✓ **Detailed design and engineering**

✓ **Development of detailed plans and specifications** for the mining operation (mine design, plant design, infrastructure etc)

✓ **Development of construction stage which includes building the mine infrastructure,** such as roads, processing plants, power supplies, and accommodations for the workforce

✓ **Planning of mining operations:** strategic, calendar, operational

✓ **Calculation of the stability of the pit walls and dump tiers, etc.**

OUR DEVELOPMENT SOFTWARE

Surveying

top features for development stage

· Processing of instrumental survey data
· Uploading and processing of point clouds
· Different types of volume calculation
· Sliding wedge creation
· Transport scheme creation
· Section creation

Geology

top features for development stage

· Data processing and analysis of geological exploration results
· Database maintenance of geological sampling
· 3D Geological Modeling of deposits
· Statistical Data Processing
· Geostatistics&Kriging
· Reserve and resource estimation
· Automation of geological works
· Geological section creation
· Creations of the geological reports
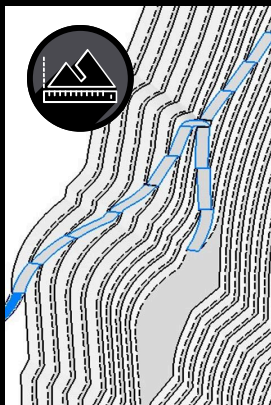
# Open Pit Design

top features for development stage

- Automatic Open Pit Design
- Roads Design and Transportation Scheme Calculation
- Dump design
- Creation of ramps
- 2D/3D Creation of Sections
- Bench Design
- Calculate Volumes using wireframes and Block Model
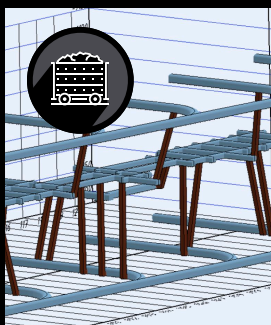
Underground Design

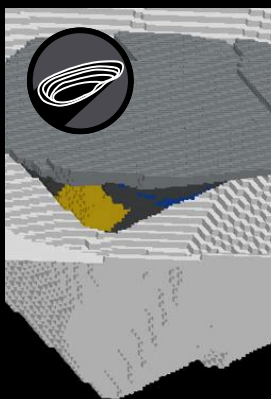top features for development stage

- Design underground workings
- Design of Underground Infrastructure
- Road System Design
- Calculation of support materials
- Underground Drilling&Blasting design
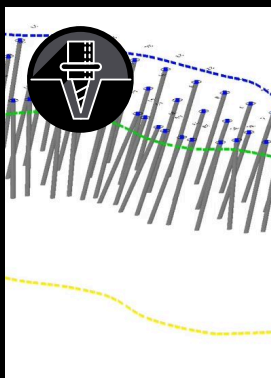
Drill & Blast Design

top features for development stage

- Creation of a drilling and blasting project for the required performance
- Calculation of blasthole parameters
- Charge design
- Design of explosion initiation circuits (commutation or electronic detonators)
- Estimation of explosion hazard zones

# Pit Optimizer

top features for development stage

- Determination of the optimal contour of the open pit.
- Calculation of all possible variations of the final contours by the price adjustment factor and setting complex conditions using dependence formulas.
- Construction of pushbacks by two methods (auto and manual)
- Assigning parameters to blocks belonging to: final contour, pushback, planning period.
- Scheduling based on panels principals.
- Project evaluation using an automated sensitivity analysis tool.
- Final pit designs comparison

Scheduling

· Scheduling Areas Identifying by different methods
· Automatic search for the Optimum Sequence of Mined Rock Extraction
· Project Timeline
· Equipment Deployment
· Integration and Dependencies
· Mining Operations Monitoring
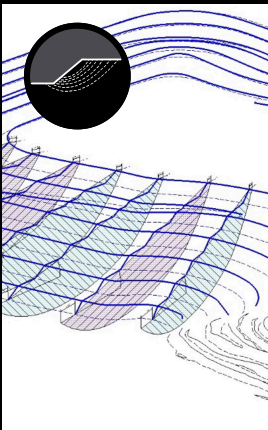
Stability Analysis

· Evaluation of the stability of open pit walls and dump tiers in a homogeneous and heterogeneous rock massif using a geomechanical model
· Analysis of the stability of open pit walls and dump tiers using a block model for various mining positions
· Possibility to draw a line of the recommended angle of inclination of the wall based on the given stability coefficient
· Stability assessment using the Finite Element Method
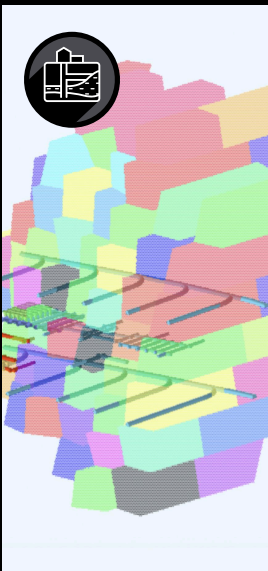
Stope Optimization

· Facilitates the creation of efficient stope layouts to minimize development costs.
· Offers detailed stope geometry editing for compatibility with surrounding infrastructure.
· Provides excellent data from optimization results as a starting point for project design.
· Supports tailored design parameters to meet regulatory and operational requirements.
· Flexible tools for comparing different scenarios across multiple parameters with convenient reporting.

+ **Infrastructure**

+ **Ventilation**

OUR DEVELOPMENT SERVICES

Our team specializes in guiding your project from feasibility to a fully operational mine with a focus on efficiency, safety, and cost-effectiveness. We prioritize sustainability in our mine designs and operational plans.

Audit of Previous Stages

- Review prior stages of the project, identifying gaps and opportunities by experienced team.
- Verify geological models, resource estimates, and prior technical reports by Qualified Persons.

Detailed Engineering and Design

- Develop rock mechanics analysis for optimal drilling and blasting operations.
- Design deposit opening with selection of mining methods.
- Develop mining sequences and production scheduling.
- Create excavation and loading workflow designs using cutting-edge technology.
- Optimize open pit and underground transport systems, including haulage routes and materials handling systems.
- Conduct geotechnical analysis for pit wall stability.
- Develop processing facilities layout and flow sheet design.
- Design infrastructure including utilities, workshops, and accommodation.

Open Pit Optimization

- Use advanced software tools for geometric optimization of pit configuration.
- Enhance haulage and transport system efficiency.
- Maximize Net Present Value (NPV) through strategic scheduling.
- Develop pit phasing and cut-backs strategy for operational efficiency

Underground Optimization

- Analyze and optimize stope and development design considering geological and geotechnical constraints.
- Optimize ventilation and backfill systems.
- Design and optimize ground support systems.
- Develop extraction sequences to minimize dilution and maximize ore recovery.

Mine Planning

- Develop Life of Mine (LoM) planning integrating resources, reserves, and economic factors.
- Create short-term and long-term schedules with consideration of production targets and equipment constraints.
- Implement real-time adjustments to operational plans for agile decision-making.

Permitting and Approvals

- Secure permits, licenses, and approvals from governmental and regulatory bodies.
- Develop environmental management plans and ensure adherence to health and safety standards.

Construction and Site Preparation

- Engineer utility systems including water supply, power distribution, and communications infrastructure.
- Manage construction for buildings, processing plants, and storage facilities.

Commissioning and Testing

- Conduct rigorous testing and validation of systems and equipment.
- Develop documentation and training programs for operational personnel.

Risk Management

- Assess and manage geotechnical, environmental, and market risks.
- Develop contingency plans and emergency response protocols.

Financial Planning

- Create detailed budgeting and financial modeling.
- Assess financing options and conduct cash flow analysis.
- Perform sensitivity analysis of key financial parameters.

Production STAGE

At the production stage, the main goal is to control the safe and efficient extraction of minerals. Also very important is the ability to quickly respond to changes in technological or economic indicators and adapt processes to this. K-Mine software can ensure the speed and security of processing data from a mining enterprise to ensure efficient operation.

- ✓ **Control of volumes of minerals and overburden**
- ✓ **Control and reduction of transportation costs**
- ✓ **Optimization of the final position of the open pit/mine**
- ✓ **Creation of operational working documentation**
- ✓ **Ensuring the safety of mining operations**
- ✓ **Control of the accuracy of the implementation of mine workings**

OUR PRODUCTION SOFTWARE
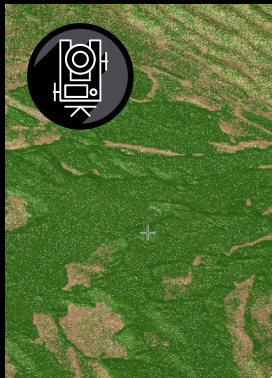
Surveying

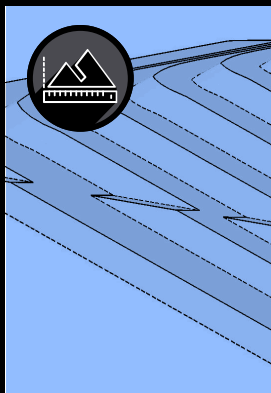top features for production stage

- Uploading and processing of point clouds
- Different types of volume calculation
- Transport scheme creation/correction
- Processing of instrumental survey data
- Sliding wedge creation
- Section creation
- Safety assessment tools
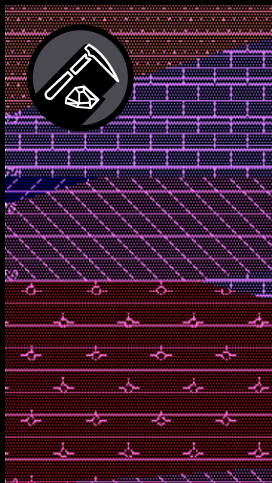
### Geology

top features for production stage

- Analysis and processing of additional exploration data
- Database maintenance of geological sampling
- 3D Geological Modeling of deposits. Upgrading and improving accuracy
- Statistical Data Processing
- Geostatistics&Kriging
- Reserve and resource estimation
- Automation of geological works
- Geological section creation
- Creations of the geological reports

Open Pit Design

- Detailed Open Pit Design
- Roads Design and Transportation Scheme Calculation
- Dump design
- Creation and control of ramps
- 2D/3D Creation of Sections
- Bench Correction
- Calculate Volumes using wireframes and Block Model
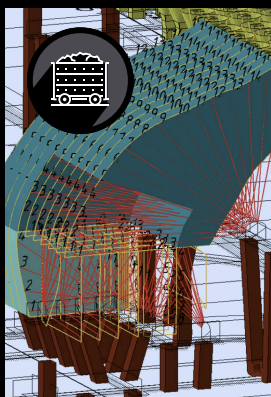
Underground Design

- Design underground workings
- Design of Underground Infrastructure
- Road System Design
- Calculation of support materials
- Underground Design documentation creation
- Calculate Volumes using wireframes and Block Model
- Underground Drilling&Blasting design
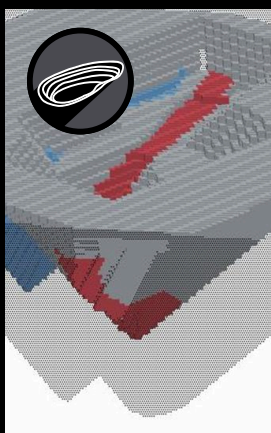
Pit Optimizer

- Determination of the optimal contour of the open pit.
- Calculation of all possible variations of the final contours by the price adjustment factor and setting complex conditions using dependence formulas.
- Construction of pushbacks by two methods (auto and manual)
- Assigning parameters to blocks belonging to: final contour, pushback, planning period.
- Project evaluation using an automated sensitivity analysis tool.
- Final pit designs comparison

Stope Optimization

- Maximizes ore recovery by optimizing stope layouts for production.
- Incorporates production data to adapt stope designs dynamically.
- Evaluates production cost indicators to ensure profitable extraction.
- Implements control measures to minimize ore losses and dilution during production.
- Flexible tools for comparing different scenarios across multiple parameters with convenient reporting.

Scheduling

- Mining Operations Monitoring
- Automatic search for the Optimum Sequence of Mined Rock Extraction
- Scheduling Areas Identifying
- Equipment Deployment
- Project Timeline
- Integration and Dependencies
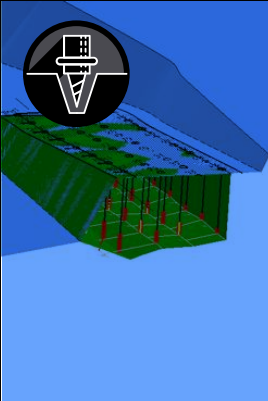
Drill & Blast Design

top features for production stage

- Creation of a drilling and blasting project for the required performance
- Drilling Block design
- Calculation of blasthole parameters
- Charge design
- Design of explosion initiation circuits (commutation or electronic detonators)
- Estimation of explosion hazard zones
- Blasting simulation
- Automatic grain size calculation
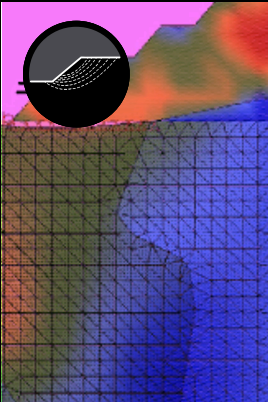
Stability Analysis

top features for production stage

- Possibility to control pit walls and dump tiers stability using sensors and IoT
- Stability assessment using the Finite Element Method
- Analysis of the stability of open pit walls and dump tiers using a block model for various mining positions
- Evaluation of the stability of open pit walls and dump tiers in a homogeneous and heterogeneous rock massif using a geomechanical model
- Possibility to draw a line of the recommended angle of inclination of the wall based on the given stability coefficient

Infrastructure

top features for production stage

- Creation of the master plan of the enterprise. Collection, storage, analysis of information about objects
- Visualization of spatial data. 3D modeling of buildings and structures.
- Working with Google Maps. Ability to load maps of different types.
- Semantic database creation and management
- Setting the access level for employees

+ Ventilation

visit k-mine.com to learn more

OUR PRODUCTION SERVICES

We ensure efficient extraction and processing of minerals. Our commitment to operational excellence and sustainability sets us apart, maximizing your return on investment while prioritizing safety and environmental stewardship.

▌ Mining Consulting

- **Technical Audit:** Our experienced team of competent persons conducts rigorous audits of previous stages, ensuring the integrity and robustness of your mining project.
- **Mine Reconstruction:** Expertise in reconstructing open pits, mines, dumps, and warehouses to meet modern standards and regulatory requirements.
- **Project Refinement:** Proactive correction and refinement of existing projects, incorporating the latest technological advancements.
- **Production Process Optimization:** Enhance efficiency across various production processes including transport systems, loading operations, and drilling and blasting.
- **Equipment Selection and Optimization:** Informed selection and fine-tuning of mining equipment to ensure optimal productivity.
- **Mining Operations Management:** Expert management of mining operations, emphasizing safety, compliance, and efficiency.
- **Loss Reduction:** Strategic interventions to minimize losses through predictive analysis and real-time monitoring.

▌ Production and Operations Management

- **Mining Operations Planning:** Develop detailed plans for mining operations, integrating resources and schedules for maximum yield.
- **Scheduling Optimization:** Create or optimize mining schedules for enhanced productivity and resource allocation.
- **Resource Management and Quality Control:** Implement systems for resource management, and maintain the highest standards of quality control.

▌ Implementation of Dispatching and IoT

- **Control System Automation:** Integrate cutting-edge automation into control systems for improved decision-making and responsiveness.
- **IoT and Sensor Technologies:** Leverage sensors and IoT technologies for real-time monitoring and control of mining parameters and operations.
- **Data Analytics and Optimization:** Employ data analytics to garner insights, optimize operations, and predict trends.

▌ Geological and Geotechnical Services

- **Geological Modeling:** Create and update sophisticated geological models of mining fields.
- **Resource Assessment:** Conduct comprehensive assessments of mining resources, considering geological and market factors.
- **Mining Forecasting:** Develop Create predictive models for mining operations, enabling agile and informed decision-making.
- **Stability Analysis:** Analyze the stability of pit walls, dumps, and other structures, ensuring safety and compliance.

▌ Development of Operational Working Documentation

- Develop comprehensive operational documentation for all technological processes, ensuring clarity, compliance, and operational excellence.
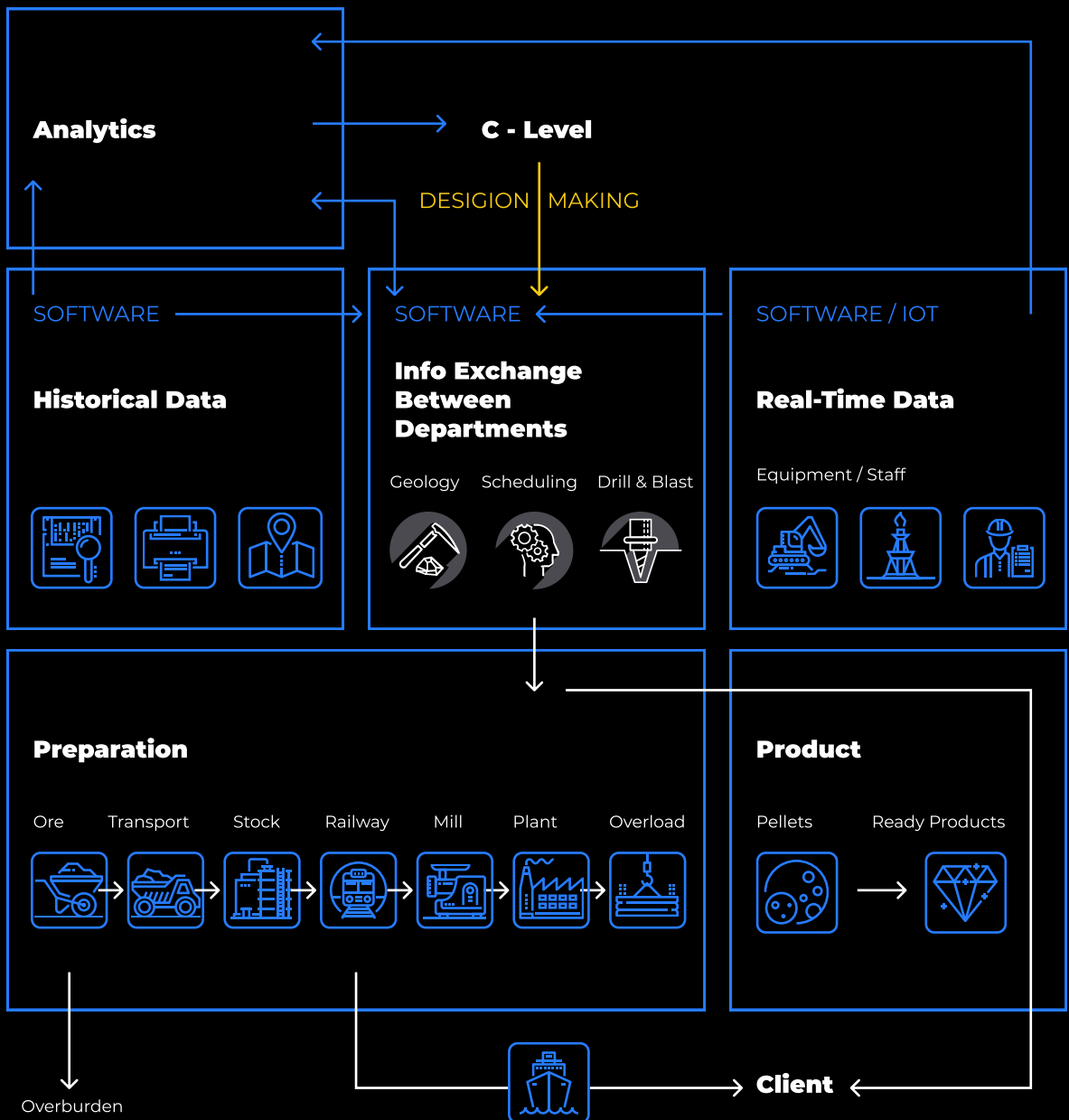
End-to-End Mine Planning

- Establishing the exchange of information between different mining units
- Collection of information from the site in real time
- Updating and comparing the received information with historical data
- Individual reports and analytics are delivered to the control panel of each manager

REQUEST PROPOSAL FROM K-MINE

Analytics

C - Level

DESIGION MAKING

SOFTWARE

Historical Data

SOFTWARE

Info Exchange Between Departments

Geology   Scheduling   Drill & Blast

SOFTWARE / IOT

Real-Time Data

Equipment / Staff

Preparation

Ore   Transport   Stock   Railway   Mill   Plant   Overload

Product

Pellets   Ready Products

Overburden

Client

IoT Platform

Connect all of your hardware, departments and systems to get real-time data and analyze historical information via a web application
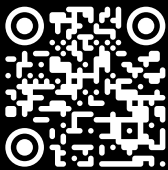
- Asset monitoring and management
- Monitoring and forecast resource usage
- Risk reduction and creation of a safe environment for employees
- Creation of heat maps
- Advanced analytics
- Using data to create digital twins and optimize short-term planning

Integration with **Open Pit Dispatch** systems

- Real time visualization and monitoring of mining equipment work based on open pit's digital model
- Tracking of the equipment and automatic correction of possible deviations
- Visualization and control of the current position, compliance with routes, and traveling speed
- Balanced load assurance on excavation equipment, considering their technical condition
- Management and control of the movement of minerals and overburden

Integration with **Undeground Dispatch** systems

- Control of the current personnel position throughout the whole period of their stay in the mine
- Alerts and notifications of the personnel in the mine in case of an emergency
- Control of personnel access to restricted and dangerous areas
- Maintenance of the positioning and personnel working hours data archives

K-MINE

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k-mine.com