This document explains the concepts and definitions within the Exploration and Mining business reference model – the first reference model delivered by the Exploration, Mining, Metals and Minerals vertical.
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1 Introduction

1.1 What is the EM (Exploration and Mining) Business Reference Model?

The Exploration and Mining Business Reference Model (or the EM Model) is an industry business process model, defining the standard business activities for organisations that operate in the exploration and mining sectors with a focus on metals and minerals. The model is the first deliverable from The Open Group’s EMMMv™ Forum, and the first of a set of reference models focused on establishing a blueprint for organisations.

Organisations will be able to use the EM Model to guide their business operations. As there is no requirement to perform all activities listed in this standard, some organisations will perform all the business activities listed in the reference model, whereas, others will only perform a particular subset of activities applicable to their core business focus.

The model provides a categorisation of the business activities applicable to the sector, so that mines and their suppliers and partners are in a position to speak a common language when they are considering the support of specific activities (processes) in the business.

1.2 Objectives of the EM Model

The main objectives of the EM Model are to:

- Provide an overarching standard for business activities in the exploration and mining sectors focused on all metals and minerals.
- Provide a common definition for describing business processes (activities) in the industry.
- Create a common understanding of the information that will be required to execute the business activities.
- Enable sharing through understanding, amongst exploration and mining organisation and internally within these organisations.

1.3 What is the Exploration, Mining, Metals and Minerals vertical (EMMMv™)?

The Exploration, Mining, Metals and Minerals vertical (EMMMv™) is an industry forum operating under the auspices of The Open Group. The forum is responsible for delivering the applicable models and standards for the exploration and mining industry, focusing on metals and minerals, and thus owns the EM Model.

The forum is a collaboration between organisations in the exploration, mining, metals, and minerals industry sectors and the suppliers to these industries. The name was selected to differentiate it from Exploration in the Oil and Gas industry where similar activities around standardisation already exist.

It is specifically identified as an industry vertical effort, since it does not extend its focus beyond the specific industry and the term vertical specifies a particular industry group or a grouping of enterprises where similar products or services are developed. Examples of typical verticals are: insurance, real estate, banking, retail, and government.

The Forum operates under the auspices of The Open Group, a standards focused industry and vendor neutral organisation. Also see About The Open Group.

EMMMv™ applies a disciplined approach to produce a set of reference models to the industry that spans both business and technology in order to increase business agility, reduce cost, and accelerate change towards goals such as shared services.
1.4 How to use the EM Model

The Exploration and Mining (EM) Business Process Reference model must be read from top to bottom and from left to right. Read in this manner the inherent sequence in the inner processes can be followed.

The EM Model should always be used as a reference and does not attempt to replace process analysis and definition activities within the enterprise. With the EM Model in hand, an organisation should be able to kick-start a process mapping exercise and have a good grasp of the operational activities they should expect to find and own within the various areas of the business.

1.5 Changes to the Model

The EM model is a living model and may therefore change as a result of revision or new input. Versioning will be used as a mechanism for maintaining integrity and control of the changes that are made. Versioning will distinguish between major and minor versions using the following convention:

- Major version: depicts a step change to the model
  - Version numbers: 1.00, 2.00 etc
- Minor version: depicts a minor change to the content within the major version.
  - Version numbers: 1.01, 2.03 etc

As a guideline, minor versions will be released quarterly but it will be driven by member need.

2 Context of the Exploration and Mining (EM) Business Model

2.1 Conceptual view

The EM model uses the technique of nested box diagrams. The semantics of the nesting of boxes are as follows:

- Outer boxes/ sheet:
  - Business focus (e.g. Strategic, Tactical, and Operational/ Mine Site)
- Horizontal cross-boxes:
  - Cross-business management processes (e.g. Plan and Measure)
- Vertical boxes:
  - Enterprise level processes (e.g. Discover, Exploit, and Enterprise Support)
- Inner-inner boxes:
  - Business processes within the enterprise level processes (e.g. Remove Rock and Initiate Rehabilitation). These processes will be broken down into lower level processes, each time with an increasing level of granularity.

The conceptual view of the EM Business reference model below depicts a specific structure with meaning. To differentiate the various aspects, each will be discussed in more detail.

Processes are grouped into different levels of processes. The highest level processes are named Enterprise Processes and they are depicted by the vertical boxes. The next level of processes is Value Chain Processes and they will appear as inner-boxes (i.e. contained within the vertical box).
The core enterprise processes for the Exploration and Mining industry are described by the six vertical light blue boxes, forming the central component of the model. These six core enterprise processes are Discover, Establish, Exploit, Beneficiate, Sell, and Rehabilitate, and they describe the sequential nature of the exploration and mining business. This sequential nature does not imply that the sequence will always be followed rigorously, but merely that in most cases the activities will occur in this sequence.

All of the enterprise processes can be executed with a strategic, tactical or operational/ mine site focus. This is depicted by the outer boxes, namely, the Strategic, Tactical, and Operational/ Mine Site boxes. These focuses can also exist at the same time and therefore they are depicted as ‘slices’ existing one behind the other.

In addition to the strategic, tactical, and operational mine site business focuses, the Discover and Establish processes are also relevant in a green fields and brown fields state or location. This distinction is depicted by the green and brown boxes underlying these two enterprise processes and is made because of the detailed deliverables and or processes that may differ for a particular state or location.

“Strategic”, as a business focus area, covers life of mine and mining business, whereas “Tactical” relates to medium term mine planning for validating the strategic plan, including resourcing and re-planning (i.e. tactical moves to achieve the strategic plan), and “Operational/ Mine Site” relates to the efficient use of the resources in order to execute the tactical plans.

The managerial focus across the Enterprise Processes and throughout the Operational, Tactical, and Strategic layers is further expanded by the depiction of the horizontal boxes named Control, Measure, Report, and Plan.
The Enterprise Support processes are separated from the core enterprise processes within the exploration and mining business since these support the operation of the business and do not constitute a core process focused on creating value within the enterprise.
3 Enterprise Processes

From Section 3.1 onwards, all the processes referred to within the Exploration and Mining Business Reference model will be defined. Although the complete graphic depicting the specific version of the model is available as a separate Visio and .pdf deliverable, it is also used in this document at various applicable points. It may however be beneficial to the reader to keep the complete graphic handy when reading this document.

Enterprise Processes (Sections 3.1 to 3.6) are the highest level, or the most coarse grain, processes executed within the exploration and mining organisation. They are depicted in the diagram as the six vertical blue boxes.

3.1 Discover

Defines the process by which an exploration target and/or a mineral resource is articulated and defined for acquisition purposes. The process includes:

- Evaluation of grade and tonnes.
- A pre-feasibility phase.
- Examining the production options.
- Acquisition of the necessary rights.

**At a Strategic level:**
Discover involves the exploration strategy and associated activities to find new or unknown mineral deposits.

**At a Tactical level:**
Discover involves the evaluation of existing or known mineral deposits with the objective of expanding the existing knowledge base.

**At an operational level:**
Discover involves the day to day enhancement of the level of confidence in the geological model.

**Output:**

**Strategic level:**
Exploration Strategy
Exploration projects
Quantification of a potential exploitable mineral resource

**Tactical level:**
Mineral Deposit evaluation report
Quantification of a potential extension to known mineral resource
Updated geological model
Expanded mineral inventory

**Operational level:**
Operational budget/ updated short-term exploration plan
Routine updated geological model
Definition of ore reserves
3.2 Establish

This process focuses on all the activities needed to create a mining environment (i.e. the full infrastructure).

At a Strategic level:
Develop a long-term vision and plan for the mine, beneficiation plant, environment, supporting facilities and communities, including the associated financing of such.

At a Tactical level:
Ensuring medium-term viability and continuity of the mining operation. Typically this would be funded by capital expenditure (capex) (e.g. sinking a new shaft, or, planning and building extensions to an existing mine).

At an operational level:
The creation of further access to the ore body with all the associated supporting engineering infrastructure. Funded by operational budget (opex).

Synonyms:
Launch
Create

Output:

Strategic level:
Long-term plan (LoM) and finance for the operational mining and beneficiation environment, up to and including trial mining and beneficiation to the desired level of performance.

Tactical level:
Medium-term plan, budgets and specific establishment projects.
Commitment to a budgeted time-frame.

Operational level:
Detailed plan, budgets and execution of specific establishment projects.
Safe, environmentally sound, access to the ore body and related infrastructure, facilities and processing capabilities.

3.3 Exploit

For a given mine type, rock type, and mining type, this process includes the breaking and removal of 'rock'. Rock is a generic term used to describe all types of mineral resource host material. It also includes the transport of the broken rock and waste material from the working place to the plant and/or stockpile.

Synonyms:
Mine
Develop
Utilise

Output:
Classified, stockpiled broken material at grade (e.g. Waste or graded ore).
### 3.4 Beneficiate

The Beneficiate process focuses on the processing of ores for the purpose of:
- regulating the physical properties of the desired product (e.g. size),
- removing unwanted constituents, and
- improving the quality, purity, or assay grade of a desired product.

Concentration or other preparation of ores, for example, milling, flotation, magnetic separation, leaching, gravity separation, centrifugal separation, drying, and smelting.

Improvement of the grade of the desired product by other metallurgical processes, such as, dissolution and selective precipitation or reduction, solvent extraction, selective exchange technologies (e.g. ion-exchange), electro-winning, calcining, cementation, smelting, washing, and distillation.

Examples:
Refined Product(s), Cast Product and By Products, Saleable products, Classified Blended, Raw Material, Dry Concentrated product.

**Synonyms:**
Liberate
Concentrate
Recover
Upgrade
Refine
Purify
Enrich
Enhance value of feed material.

**Output:**
Saleable products.

### 3.5 Sell

This process focuses on dealing with customers in order to dispose of the product and attain revenue. This process also includes product marketing.

**Synonyms:**
Trade
Vend
Transact

**Output:**
Revenue.
3.6 Rehabilitate

This process focuses on returning the mining site to a desired state concurrently with, or after, the primary mining and associated activities. Planning for rehabilitation is now a key deliverable of any Exploration or Mining plan and must generally be approved before any Exploration or mining tasks can be undertaken.

**Synonyms:**
Regenerate
Restore
Re-establish

**Output:**
A restored environmental circumstance that meets legislative requirements and is acceptable to the majority of stakeholders.
4 Value Chain Processes

Value Chain processes are the next level of processes or business activities defined per enterprise process (Section 3). Value chain processes are sequential by nature and are therefore typically executed as they are described, from left to right. There may be cases where an organisation skips a process completely because of their specific business focus – this does not violate the sequence or the nature of the process at all and should not cause alarm.

In other cases, one value chain process may still be executing when another has started already – this is also no cause for alarm as long as the outputs of the one process are available at some level of confidence to continue with the next process.

1. Discover

1.1 Prospect/Explore

Explore aims to locate the presence of economic deposits and establish their nature, extent, and grade. The investigation may be divided into (1) greenfields, (2) brownfields, and (3) mine site/operational. Exploration techniques include:

- Geological surveys
- Geophysical prospecting (may be ground, aerial, or both).
- Soil and grab samples, geochemical, boreholes, and trial pits.
- Surface or underground headings, drifts, or tunnels.

The surface discovery of coal or another mineral only proves its superficial existence and further work is needed to establish its quality and extent. The term exploration is sometimes applied to this extension of the discovery work.

Output: Geological and mineralogical data with spatial attributes.

1.2 Assess Mineral Resource

This process focuses on considering the attributes of structure, density, grade, and tonnage.

Synonym: Assay Grade Value Average Assay Value

Output: A geological model used as a basis for mine planning.
1.3 Examine Production Options

This process involves the production of a technical mine and beneficiation plan at an appropriate level of confidence. The process is focused on improving levels of confidence moving from greenfields, through brownfields to mine site/operational.

**Synonym:** Feasibilities, Mining plans (Some may consider it a subset of mine planning)

**Output:** Technical Mine Plan(i.e. volume and product profiles over time)

1.4 Develop Business Plan

This process is focused on the analysis (including options) and creation of the financial viability plan associated to the establishment of a particular site in order to be able to make a go/no-go decision.

**Output:** Documented business case to enable a decision making.

- Greenfields: Bankable feasibility study (for investment related decisions).
- Brownfields: Internal project proposal (for capital cost related decisions).
- Mine site/ Operational: Production forecast and budget (for operational costs).

1.5 Acquire

This process involves the securing all the necessary rights applicable to mine a particular site, including:

- Mineral rights
- Environmental Impact Assessment (EIA)
- Approved environmental plan
- Surface rights
- Access rights
- Approved social and labour plan
- Water (riparian) rights

**Outputs:**
- Secured rights
- Sufficient information to take investment decision

2. Establish

2.1 Initiate Establishment

This process is focused on marshalling all necessary resources required to start the project.
**Synonym:** CommenceKick off

**Outputs:**
- Established project (approved project plan)
- Marshalled resources

### 2.2. Engineering Design

This process aims to produce the necessary alternative designs in order to be in a position to embark on design selection and construction on the site.

**Synonym:**
Design Sequence and Schedule

**Outputs:**
- Final (approved) Engineering Design
- Final Mining Layout Designs including all mining technical inputs (e.g. ventilation and rock engineering).

### 2.3. Construct

This process develops all the facilities and infrastructure necessary to start the mining operation according to the engineered design.

**Synonym:**
Build
Erect
Assemble

**Output:**
- Constructed facilities and infrastructure
- Operational mine site
- Operational beneficiation site

### 2.4. Commission

This process involves ensuring operational readiness by piloting the operational environment and the handing over of this environment to operations.

**Synonym:**
Start up

**Outputs:**
- Accepted operational environment (mine) - as per specification.
- Signed acceptance certificate
3. Exploit

In the Exploit process, the mining method is added as a point of departure for distinguishing process information differences. The reasoning behind this is as follows:

- Generally processes at the enterprise and value chain levels, can be handled generically in respect of the terminology used to describe the processes at various levels of detail.
- However, at the business process level the processes involved cannot intelligently be discussed without having some insight into the mining method being used as the mining method determines:
  - Terminology usage
  - People, process and technology requirements
  - Information requirements
  - Specifics such as excavation support
- Whilst information requirements can be discussed generically, for example, as quantity and quality parameters, the detail differs significantly depending on the mining method employed (e.g. kg, ounces, % of dilution, % waste, % contaminants etc.).
- A review of the naming conventions used in the different mining methods showed:
  - There is not a definitive, or complete, listing to cover all known variations and local, colloquial naming conventions.
  - Text books do not agree.
  - New methods, and hence new terms, evolve along with technology or when required to suit particular geological conditions.
- For the purposes of the EM Model initiative the AIME SME Mining Engineering Handbook,\(^{(1)}\), was used as reference. The AIME text book has only recently been supplanted as a reference\(^{(2)}\) which itself has no significant omissions or useful additions.
  Hence, in order to identify a specific Mining Method (or group of similar methods), one first needs to determine the Mining Type, which is dependent on both the Mine Type and Rock type. This 3-step approach is depicted in the matrixes below:
  - Step 1 – What is the mine type, underground or surface?
  - Step 2 – What is the rock type, hard or soft?
  - Step 3 – What is the mining type? These have been limited to two options per mine and rock type in the matrix above.
Further details regarding naming conventions for underground methods mostly relates to the support pattern employed for the excavations which do not materially impact information requirements for production per se. The exception is the Solution category of Mining Methods, which in itself is a niche environment.

Further detail in terms of naming conventions for surface methods mostly relates to technologies employed in rock removal.

The generic nature of mining falls away beyond the second level of process as defined here, and hence, asking three questions listed above puts the user firmly into the detail of a particular mining method and its specific processes and information requirements. Providing appropriate software functionality, however, is entirely dependent on understanding the non-generic nature of the third and lower level processes.

3.1. Break Rock

For a given mine type, rock type, rock type and mining type, this process includes having access to the ore body, mining the ore body, and extending any necessary infrastructure.

Output: Broken rock as per approved plan (e.g. Waste or graded ore)
3.2. Remove Rock

For a given mine type, rock type, and mining type this process includes classifying, moving (transporting), and stockpiling the broken material. Rock can be move by various means, for example:

- Hopper tramming
- Hoisting
- Conveyor belt
- Hauling and Trucking (dump trucks)
- Train / ship / barge
- Front-end loaders

**Synonym:** Transport  
**Output:** Transported rock (e.g. to beneficiation plant or waste dump)  
Stockpiled ore

4. Beneficiate

4.1. Handle Material

This process involves the collection of all material required for processing, and if needed, includes the blending of material. It also involves getting the material ready for input to the plant and subsequent treatment. (Blending is about mixing materials from different sources which may have differing grades or compositions).

It is also possible that, in certain cases, the material generated at this stage is a saleable product.

**Synonym:**  
Material selection  
Preparation  
Amassing material  
Storage  
Manipulate and/or move

**Outputs:**  
Blended material (no re-agents)  
Classified material(s)  
Readied for treatment
4.2. Treat Material

This process focuses on liberating the mineral/metal from the ore (including crushing and/or grinding), concentration of the desired material (adding of re-agents), separation and removal of waste, and recovery of the desired final material (drying, sizing etc). The process also includes all the associated chemical and metallurgical processes, storage of waste, and discarding of tailings or waste product. Typical processes include:

- Crushing
- Milling
- Floatation
- Magnetic Separation
- Gavimetric Separation
- Leaching
- Filtration
- Cementation
- Calcination
- Sizing
- Sorting
- Blending
- Washing
- Drying
- Roasting
- Smelting

It is also possible that, in certain cases, the material generated at this stage is a saleable product.

**Synonym:**
Concentrate

**Output:**
Concentrated material(s) Classified material(s) (e.g. sized, graded)
Managed Waste (e.g. solid, liquid, solution, suspension, or gaseous)

4.3. Refine Material

The process(es) by which the material is treated further in order to separate the desired material(s) from its unwanted matrix (gangue) material and so generate a purified product. Typical processes include:

- Electrowinning
- Solvent Extraction
- Ion Exchange
- Dissolution and selective precipitation
- Osmosis
- Leaching
- Gravimetric separation
- Magnetic separation
- Adsorption
- Calcination
- Cementation
- Distillation
- Filtration
- Washing
- Roasting
• Drying
• Reduction
• Oxidation
• Smelting

**Synonym:** Purification process

**Output:**
- Refined Product(s)
- Managed Waste Material(s) (e.g. solid, liquid, solution, suspension, or gaseous)

### 4.4. Handle Product

This process includes the classification, blending, packaging and storage of saleable materials, including by-products.

**Output:** Saleable product(s)

### 5. Sell

#### 5.1. Engage Customer

This process focuses on the interaction with the customer, including the necessary information to identify and interact with the customer.

#### 5.2. Handle Order

This process focuses on obtaining the correct information regarding the specific products and associated quality and quantities ordered so that the organisation is in a position to fulfil the order and analyse trends regarding customer preferences.

#### 5.3. Ship and Distribute

This process executes the shipping and distribution of products ordered to the correct customers.

#### 5.4. Process Financial Transaction

The financial transaction that occurred as a result of an order being fulfilled needs to be completed in order to recognise the revenue and/ or follow up on the debt.
5.5. Support Product Marketing

Product marketing requires information from customers and orders as well as input of a strategic nature to ensure that the correct products are marketed to the correct customers in line with the organisational strategy.

6. Rehabilitate

6.1. Initiate Rehabilitation

This process is focused on marshalling all necessary resources in order to follow through on previous rehabilitation commitments (e.g. EIA) as well as on decisions regarding the final state of the rehabilitated site.

**Synonyms:**
Start re-establishment, restoration, regeneration

**Outputs:**
- Final rehabilitation proposal(s)
- Marshalled resources
- Approvals, objectives, governance models and business case(s)

6.2. Design Rehabilitation

This process aims to produce the necessary alternative designs, approaches, and methods in order to be in a position to embark on returning the site to the desired final state.

**Synonyms:**
Examine alternatives
Ascertain options

**Outputs:**
- Final (approved) Rehabilitation Design
- Final Site Designs including all sustainable environmental inputs (e.g. water management, vegetation etc).

6.3. Execute Rehabilitation

This process delivers the projects focused on returning the site to the desired state. It also includes the ongoing maintenance activities (as required/ prescribed) required for minimizing the degradation and ensuring that the site is in an acceptable state (as defined) after end of mine life.
(Get input into the statutory impacts)
Synonyms:
Perform restoration
Perform regeneration
Perform re-establishment

Outputs:  Rehabilitated site
5 Business Processes

Figure 4: The Exploration and Mining Business model

5.1 Discover

5.1.1 Prospect/ Explore

5.1.1.1 Identify Area of Interest

Greenfields: Recognize an anomaly worthy of further investigation.
**Brownfields:** Logical extensions to the existing operations/ore-body.  
**Mine site/Operational:** Search for continuity of ore-body.

**Synonym:**
Recognize  
Discover

**Output:**
Potential exploration target. (Greenfields)  
Potential mine extension. (Brownfields)  
Potential extraction target. (Mine Site/Operational)

### 5.1.1.2 Acquire Prospecting rights

**Greenfields:** Procure all rights and obligations that are necessary to initiate the prospecting process.  
**Brownfields:** If required, procure all rights and obligations that are necessary to initiate the prospecting process.

**Synonym:** ObtainAttain  
**Output:** Right to prospect

### 5.1.1.3 Execute Sampling Process

**Greenfields:** Identify the necessary sampling interval, sample parameters/characteristics and effect the appropriate sampling methods, measurements, and analyses/assays to adequately delineate/characterize the ore-body.  
**Brownfields:** Effect the appropriate sampling methods, measurements, and analyses/assays to adequately delineate/characterize the ore-body continuity with an accepted level of confidence.  
**Mine Site/Operational:** Effect the appropriate sampling methods, measurements, and analyses/assays to adequately delineate/characterize the ore-body continuity with an accepted level of confidence.

**Synonym:** Perform

**Output:** Spatially coordinated measurements and assays.
5.1.2 Assess Mineral Resources

5.1.2.1 Cleanse Data

Apply appropriate techniques to raw data to achieve resultant data having an acceptable level of accuracy in full compliance to QA/QC guidelines as required by all Reporting Codes.

**Synonym:**
Clean

**Output:** Validated measurement and assay data.

5.1.2.2 Produce Structural Analysis

**Greenfields:** Create appropriate geo-models to render size, volumetric shape, and spatial location of the ore-body and its environs.

**Brownfields:** Updated geo-models based on new data to extend and improve the resolution of the size, volumetric shape, and spatial location of the ore-body and its environs.

**Mine site/Operational:** Updated geo-models based on routinely acquired data to improve the resolution of the size, volumetric shape, and spatial location of the ore-body and its environs.

**Synonym:**
Create
Generate
Study

**Output:** Spatial representation of the ore-body and its environs.

5.1.2.3 Produce Grade Analysis

**Greenfields:** Create appropriate grade-models to render the spatial grade distribution and mineralogical characteristics of the ore-body and its environs.

**Brownfields:** Update the grade-models to extend and improve the resolution of the spatial grade distribution and mineralogical characteristics of the ore-body and its environs.
**Mine site/Operational:** Update the grade-models based on routinely acquired data to improve the resolution of the spatial grade distribution and mineralogical characteristics of the ore-body and its environs.

**Synonym:**
Create
Generate
Study

**Output:** Spatial representation of the grade distribution in the ore-body and its environs.

5.1.3 Examine Production Options

1.3 Examine Production Options

1.3.1 Produce Mining Layout Analysis
Consider viable options for relevant alternative mining methods.

**Synonym:**
Create
Generate
Study
Plan

**Output:** Proposed mine layout.

1.3.2 Produce Engineering Infrastructure Analysis
Consider viable options for the supply of relevant engineering services and utilities.

**Synonym:**
Create
Generenete
Study

**Output:** Proposed infrastructure and utilities.
5.1.3.3 Produce Beneficiation Analysis

Consider viable options for relevant alternative mineral processing methods.

**Synonym:**
Create
Generate
Study

**Output:** Proposed beneficiation method(s).

5.1.4 Develop Business Plan

5.1.4.1 Consider Economic Options

Gather all relevant commercial (PESTE: Political, Economic, Social, Technological, and Environmental) parameters impacting cost and revenue.

**Synonym:**
Weigh-up
Commercial
Financial
Alternatives

**Output:** Compilation of economic options and variables.

5.1.4.2 Produce Costing Model

Generate the expected expenditure profiles for the respective technical and economic alternatives considered.

**Synonym:**
Create
Generate
Cost

**Output:** Proposed cost model.
5.1.4.3 Examine Financial Alternatives

Generate and analyse projected revenues, costs, profits, cash flows, and funding sources for the relevant alternative production options and timeframes.

**Synonym:**
Look at
Inspect
Options
Monetary
Fiscal

**Output:** Financial analysis.

5.1.4.4 Complete Business Analysis

Produce a business recommendation based on the relevant financial and technical modelling and the given business context.

**Synonym:**
Finalise
Study

**Output:** Business recommendation.

5.1.5 Acquire

5.1.5.1 Confirm Acquisition Scope

Verify that all necessary permissions and ownerships to execute the business plan have been identified and their status confirmed.

**Synonym:**
Corroborate
Verify
Validate
Attain
Purchase
Extent

**Output:** Confirmed permissions and ownerships.
5.1.5.2 Secure Rights

Guarantee all necessary permissions, options, and ownerships to enable the project.

**Synonym:**
Make safe
Privileges

**Output:** Guaranteed permissions, options, and ownerships.

5.2 Establish

5.2.1 Initiate Establishment

5.2.1.1 Approve the Project

Obtain business authorisation/consent to proceed with the project.

**Synonym:**
Endorse
Agree
Consent

**Output:** Project approval.

5.2.1.2 Finance the Project

Obtain the necessary funding.

**Synonym:**
Monetary backing
Funding

**Output:** Secured funding.
5.2.1.3 Resource the Project

Identify and secure the necessary human resource, materials, and equipment to enable project execution.

**Synonym:**
Supply

**Output:** Resourced project.

5.2.2 Engineering Design

2.2 Engineering Design

2.2.1 Collect Engineering Design Criteria

Obtain and confirm all relevant technical parameters and standards that will be required to produce the requisite designs.

**Synonym:**
Gather
Amass
Assemble
Plan

**Output:** Engineering design criteria.

2.2.2 Produce Conceptual Engineering Designs

Produce alternative designs based on relevant criteria.

**Synonym:**
Create
Generate
Theoretical plan

**Output:** Conceptual engineering designs.

2.2.3 Select Final Engineering Designs

Consider and choose the appropriate design.
Synonym:
Choose theoretical plan.

Output:  Selected final design.
5.2.3 Construct

5.2.3.1 Develop Operational Capability
Acquire and deploy the necessary human resource, materials, and equipment to execute the project.

**Synonym:**
Develop effective means or competence.

**Output:** Execution team and resources.

5.2.3.2 Build Mineral Resource/ Reserve Extraction Capability
Create access to the orebody and establish the necessary materials handling infrastructure (e.g. shafts, haulages, cross-cuts, rolling stock, hoists, conveyors, waste dumps, and tailings dams).

**Synonym:**
Construct/develop effective mining means and competence.

**Output:** Accessible ore-body.

5.2.3.3 Build Beneficiation Capability
Create the necessary processing capability (e.g. concentrating, smelting, and refining plants).

**Synonym:**
Construct/develop effective processing means and competence.

**Output:** Processing plant(s).

5.2.3.4 Build Facilities
Create necessary operational infrastructure (e.g. roads, rail, office blocks, housing)

**Synonym:**
Construct amenities/services.

**Output:** Facilities and infrastructure.
5.2.3.5  Deploy Utilities

Establish services networks to support production activities (e.g. electrical power, water, compressed air, chilled air)

**Synonym:**
Rollout engineering services.

**Output:**  Utilities networks.

5.2.4 Commission

5.2.4.1  Run Pilot Operation

Prove, on a trial basis, the mining and processing capabilities against the design specifications, including trouble-shooting, before commissioning.

**Synonym:**
Trial process.

**Output:**  Proven operational capability (i.e. project delivered to specification).

5.2.4.2  Handover to Operations

Formal transfer of an operational mining environment (i.e. custodianship and accountability) from the project team to operational management.

**Synonym:**
Give/relinquish/transfer.

**Output:**  Operational mine.

5.3  Exploit

5.3.1 Break Rock
5.3.1.1  Create Access

In the operational phase, develop and establish new entry points to support the mining activity.

**Synonym:**
Make
Produce
Build
Entry

**Output:** Exposed mining face.

5.3.1.2  Mine Ore Body

Extract/liberate desired material from the ore body (deposit).

**Synonym:** Drill and Blast
Mine Deposit

**Output:** Mined material, waste, and resultant voids.

5.3.1.3  Extend Infrastructure

Establish facilities and utilities necessary to sustain a given production profile.

**Synonym:**
Expand, enlarge infrastructure.

**Output:** Extended infrastructure.

5.3.2 Remove Rock

3.2 Remove Rock

3.2.1  Classify Rock
3.2.2  Move Rock
3.2.3  Stockpile Ore or Waste
5.3.2.1 Classify Rock

Identify and separate desired material from waste.

**Synonym:**
Sort
Grade
Categorise

**Output:** Classified ore and waste.

5.3.2.2 Move Rock

Transfer material from source to destination. (e.g. backfill, stockpile, crushing, hopper, silo)

**Synonym:**
Shift
Transport
Transfer

**Output:** Relocated ore and waste.

5.3.2.3 Stockpile Ore or Waste

Temporary storage of desired material or waste.

**Synonym:**
Hoard

**Output:** Stockpiled ore and dumped waste.

5.4 Beneficiate

5.4.1 Handle Material

5.4.1.1 Classify Material

The process of classifying materials in order to allocate it to the correct blending process (if applicable).

**Synonym:**
Sort
Grade
Categorise

Output: Classified material

5.4.1.2 Blend Material

The process of mixing classified materials in order to achieve an end-product of desired characteristics.

Synonym: Combine Mix
Output: Desired end-product.

5.4.1.3 Store Material

This process accumulates material in, for example, stockpiles, bags, or silos.

Synonym: Stockpile
Stock
Hoard
Amass
Output: Stored Material

5.4.2 Treat Material

4.2 Treat Material

4.2.1 Prepare Material
4.2.2 Concentrate Material

5.4.2.1 Prepare Material

This is the process of pre-treating material prior to subsequent processing. For example:

- Crushing
- Grinding
- Milling
- Sizing
- Washing
- Slurrying
- Filter (e.g. from sea-bed)
- Drying
- De-watering

Synonym: Treat material
Pre-condition
Pre-treat
Output: Pre-treated/ prepared material

5.4.2.2 Concentrate Material

Using physical/chemical techniques to enrich the desired material and to separate the waste.
Types of concentration processes include:
- Electrostatic separation
- Gravimetric/Density separation
- Magnetic separation
- Flotation
- Washing
- Leaching (Chemical or Biological)
- Screening
- Centrifugal separation

Synonym: Enriched material
Output: Enriched material, Separated waste

5.4.3 Refine Material

5.4.3.1 Smelt Material

The process by which the solid material is treated pyrometallurgically in order to separate and enriched the desired material from the slag (waste).
Synonym: Melting material with specific reagents (flux). Separate according to high temperature characteristics
Output: Further enriched material, Slag (waste).

5.4.3.2 Refine Material

The metallurgical process(es) by which the material is treated in order to separate the desired material(s) from its unwanted matrix material (i.e. gangue). Typical process include the following:

- Electrowinning
- Solvent Extraction
- Ion Exchange
- Dissolution and selective precipitation
- Osmosis
• Leaching
• Gravimetric separation
• Magnetic separation
• Adsorption
• Calcination
• Cementation
• Distillation
• Filtration
• Washing
• Roasting
• Drying
• Reduction
• Oxidation
• Smelting

**Synonym:** Purification process  
**Output:** Refined product(s)  
Waste

### 5.4.4 Handle Product

4.4 Handle Product

4.4.1 Classify Product
4.4.2 Blend Product
4.4.3 Package Product
4.4.4 Store Product

### 5.4.4.1 Classify Product

The process of identifying or characterizing a product(s) according to specific physical and/or chemical attributes.

**Synonym:** Sort  
Grade  
Categorise

**Output:** Classified product(s).

### 5.4.4.2 Blend Product

The process of mixing classified products in order to achieve an end-product of desired characteristics.

**Synonym:** Mix  
Combine

**Output:** Desired end-product.
5.4.4.3 Package Product

The process of containing the end-product which is suitable for safe/secure transport and/or storage.

Synonym: Contain

Deliverable goods /commodity

Output: Packaged finished product

5.4.4.4 Store Product

The process of retaining unsold product in safe custody.

Synonym: Warehouse
Stockpile
Hoard

Output: Saleable finished product

5.5 Sell

5.5.1 Engage Customer

5.5.1.1 Follow up Leads

This process involves the gathering of sales leads and the necessary processes to obtain their information and engage with them.

Synonym: Go after
Pursue

Output: Captured leads

5.5.1.2 Manage Customer Relationship

As soon as a lead becomes a customer, the relationship needs to be managed. This includes all information related to the customer and the tracking of engagements, orders, and interactions.

Synonym: Administer association
Purchaser
5.5.2 Handle Order

5.5.2.1 Take Order

The order information is gathered and captured, to ensure the appropriate understanding exists of what the customer wants and what will be delivered.

**Synonym:**
Receive instruction
Capture instruction

**Output:** Confirmed Order

5.5.2.2 Bill and Collect

This process focuses on the creation of a bill/invoice against the order, and the collection processes to collect the monies against outstanding invoices.

**Synonym:**
Invoice customer
Obtain payment

**Output:** Customer Invoice
Debtors’ Information
Payment by customer.

5.5.3 Ship and Distribute
5.5.3.1 Manage Demand

This process focuses on managing the overall demand against the supply in order to ensure orders can be placed and delivered on.

**Synonym:**
Administer market requirement/trends.

**Output:** Managed demand

5.5.3.2 Plan Distribution

This process ensures that the necessary mechanisms are in place in order to fulfil orders at the various distributions centres.

**Synonym:**
Prepare for supply of goods/commodities.

**Output:** Distribution Plans

5.5.3.3 Ship Order

The order will be shipped or dispatched to the customer using the most appropriate mechanisms.

**Synonym:**
Send/transport/dispatch goods/commodities.

**Output:** Dispatched Order
5.5.4 Process Financial Transaction

5.5.4.1 Capture Data

This process focuses on the capturing of the necessary financial data.

**Synonym:**
Record records

**Output:** Financial Data

5.5.4.2 Review and Approve Transaction

The financial transaction is reviewed and approved as per the organisational governance mechanisms.

**Synonym:**
Assess
Endorse
Grant
Deal

**Output:** Approved transactions

5.5.5 Support Product Marketing

5.5.5.1 Define Marketing Strategy and Policy

This process focuses on putting in place the necessary mechanisms to ensure that a marketing strategy and related policies are in place.

**Synonym:**
Name/describe
Output: Marketing strategy and associated policies.

5.5.5.2 Articulate Product Portfolio

This process ensures that the product portfolio is continually reviewed following a product lifecycle, to ensure appropriate products are available to the market.

Synonym: Express/communicate what collection of goods are available.

Output: Articulated product portfolio.

5.5.5.3 Prepare Communications and Promotion

The necessary product and promotional material must be made available to market the organisations’ products to the customers.

Synonym: Promotional message
Advertising
Promotions

Output: Approved Promotional and Communication material

5.6 Rehabilitate

5.6.1 Initiate Rehabilitation

6.1.1 Prepare Rehabilitation Proposal

6.1.2 Obtain Approvals for Rehabilitation

This process is focused on putting together a recommendation for the desired final rehabilitated state of the mining site.
Synonym: Document the viability
Recommend rehabilitated state

Output: Rehabilitation proposal
Conceptual rehabilitation designs
High-level schedule
Cost, Resource estimate

5.6.1.2 Obtain Approvals for Rehabilitation

Secure the necessary agreement to proceed with the proposed action including: Funding, Company, Legislative, Environmental, and Social

Synonym: Endorse
Grant

Output: Approved Rehabilitation proposal

5.6.2 Design Rehabilitation

6.2 Design Rehabilitation

6.2.1 Collect Rehabilitation Design Criteria
6.2.2 Produce Final Rehabilitation Designs
6.2.3 Deliver Costed Plan

5.6.2.1 Collect Rehabilitation Design Criteria

This process considers all the various factors and role-players involved in returning a mine site to the desired state. It is driven by the vision for the elements of the desired final state. This includes:
- Environmental
- Societal
- Legal
- Financial

Synonym:
Gather/amass elements of plan.
Investigate rehabilitation
Involve interested parties

Output: Documented design criteria

5.6.2.2 Produce Final Rehabilitation Designs

This process produces the final designs for the rehabilitation.

Synonym:
Create plans

**Output:** Final Rehabilitation Designs
Environmental case study

### 5.6.2.3 Deliver Costed Plan

This process produces the final sequence, schedule, and costs associated with rehabilitation of the mine site.

**Synonym:**
Make plans available.

**Output:** Proposal, final sequence, schedule, resources, and cost associated with the rehabilitation project(s)

### 5.6.3 Execute Rehabilitation

#### 5.6.3.1 Implement Costed Plan

This process proceeds to execute the rehabilitation project(s) as per the defined plan.

**Synonym:** Put into action
Execute
Carry out

**Output:** Rehabilitated mine site.

#### 5.6.3.2 Obtain Stakeholder Acceptance

Secure the necessary approvals from the stakeholders of the rehabilitation initiative. Stakeholders include:
- Legislative
- Environmental
- Societal

**Synonym:**
Get approval from interested parties.

**Output:** Acceptance of rehabilitated mine site.
6 Enterprise Support Processes

Enterprise support processes are the ongoing processes necessary to enable the execution of core processes. In the case of mining this would include processes specific to the industry as well as processes generic to supporting any organisation.

The focus of these types of processes is to produce effective input associated with effectively and efficiently operating the business processes at any given point along the value chain.

6.1 Manage Enterprise Strategy

The process of defining, reviewing and, from time to time, updating the strategy of the enterprise and ensuring that it is executed within the different organisational units.

6.2 Manage Assets

The process of managing the assets of an organisation. This includes the identification of assets and their value, the processes and policies related to these assets, and also the management of the lifecycle of the asset.
6.3 Manage Finances

The process of governance around the finances of the organisation, and the policies and procedures needed to ensure good governance as well as the reporting of the finances in the required format to the stakeholders.

6.4 Manage Human Resources

The process involved in managing human resources operating within the organisation. This includes processes related to remunerations, training, benefits, as well as the interaction with governments and trade unions (stakeholders) specifically focused on human resources.

6.5 Manage Health, Safety and Environment

The process of identifying all aspects of the Enterprise operations that can impact Safety, Health, and the Environment, including defining and putting into practice the necessary standards, policies and procedures to give effect to the SHE efforts.

6.6 Manage Risks

The process of protecting the business by treating, tolerating, terminating, or transferring potential threats, hazards, or uncertainties.

6.7 Manage Information Technology

The process of managing the information technology (ICT) existing within the organisation. Most exploration and mining organisations use information technology extensively to assist with the management of their structured as well as unstructured data.

6.8 Manage Corporate Relations

This process focuses on managing relations with internal and external stakeholders.

6.9 Manage Logistics

The process of managing the logistics of the exploration, mining organisation.

6.10 Manage Material

The process of managing the material required within the exploration and mining organisation. This includes processes such as the requirements definition, planning, procurement and acquisition, storage, and all associated processes.
7 Administration

7.1 Acknowledgements

The release of this document is the result of the collaboration of various individuals from EMMMv™ member organisations. Without the knowledge and commitment of these individuals, the output would not have been possible.

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7.2 Change Record

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8 Works Cited