Mining Training Course for Afghanistan Ministry of Mines and Petroleum
Training Manual Workshop II

Review of Mining Fundamentals

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Learning Objectives

The objectives of this unit are to establish a fundamental understanding of the global Mining Industry, with specific emphasis on:

- Corporate Responsibilities
- Industry Dynamics and Structure
- Distinctive Features of the Industry
- Economic Drivers Influencing Decision-Making
- Grade Equivalence
- Important Social, Safety, and Environmental Considerations

Key Learning Concepts I

- Corporate structures and company characteristics heavily influence how companies behave and what they value
- For public companies, net earnings and value creation (market capitalization) are primary criteria for gauging company success
- Nonnegotiable values represent uncompromising priorities of company
- All companies have constituents to who they are responsible (its important to know who they are).

Key Learning Concepts II

- There are numerous reasons for public companies to operate in a responsible manner (be able to list)
- What are the general classes (structure) of mining, what are their characteristics, and how do they interact
- Why is it important to know the different participants that comprise the mining industry
- Know the different stages of the mining life cycle for a property and what occurs at each stage

Key Learning Concepts III

- What are the implications of this life cycle relative to risk, cost vs revenues & scheduling
- What are the distinct features and realities that differentiate mineral development and mining from other industry investments. Why is this important?
- How to calculate grade equivalence, why is it used, and what questions do you need to ask

General Corporate Structures

- Publically Listed Companies
- Nationally (State) Owned Companies
- Privately Held Companies

- Multiple hybrid configurations, where the corporate dynamics and structure are unique to specific countries and commodities
- Motivating Factors and Strategic Objectives vary widely based upon Structure

Implicit Corporate Assumptions (Public Entities)

- Motivation: Profit & Generation of Wealth

  Net Earnings vs. Value Creation
- Acceptable Investor Return
- Social, Environmental & Legal Responsibilities
- Nonnegotiable Values:
  - Employee Safety & Health
  - Environmental Stewardship
  - Community Engagement

Constituents & Responsibilities (Public Entities)

- Stockholders & Investors
- Employees (past & present)
- Communities (local & regional)
- Society
- Government
- Future Generations (?)
- Other (Exchanges)?

Public Mining Companies

Characteristics vary as a function of:

- Relative Size (market cap)
- International Scope
- Commodity
- Market/Exchange
- Country

- **Due to Regulatory, Legal, and "Accepted Norms", most companies of a particular category operate and "behave" in a similar manner.**

Public Entities – Why do the Right Thing?

- Stockholders & Investors
- Exchange Actions
- Lenders/Banks (Equator Principles & Loan Provisions)
- Market Capitalization
- Civil Litigation
- Regulatory Penalties
- Personal & Criminal Liabilities

- **How do privately-held and state owned companies differ?**
- **Different Motivations & Risk Tolerances?**

General Corporate Structures

Major Companies: Market capitalization generally greater than $10 Billion (US), usually multi-national and producing/selling a variety of mineral commodities, structured in numerous operationally focused divisions

Mid Majors/Mid Caps Companies: Market capitalization generally between $750M - $10B (US), usually global focused on a limited number of mineral commodities, often specialized in types of deposits, mining methods/systems, and locations

Junior Companies: Market capitalization generally less than $750M (US), usually publicly listed and highly focused in terms of types of resources, location, and business strategy. High risk tolerance.

General Corporate Structures

Resource Companies: Generally privately held companies with an operating strategy related to the discovery and development of natural resources. Different exit strategies ranging from IPO to the selling of individual assets to entire portfolios.

- Interaction between these entities greatly impacts property development, venture capital, creation of wealth, and how companies grow.

- It's often all about "exit strategies" and corporate motivations (e.g., Majors – earnings; Juniors – share price/market capitalization)

General Corporate Structures

- Case Example – Dynamic Interaction

<u>Important Considerations:</u>

- Economic deposits are rare and difficult to find & develop (Odds generally greater than 3500:1)
- Exploration is a high risk endeavor
- Mine development is time-consuming & expensive
- Bigger the company, the larger the hurdle requirements

Basic Participants of the Mining Industry

- The term "Mining Industry" is often incorrectly used to refer exclusively to operating companies engaged in the actual extraction of minerals and ores.
- In reality, the industry is composed of numerous companies and government entities with diverse, often well-defined and highly specialized missions.
- Unlike other industries, the Minerals Resource Sectors necessitate a large network of companies and professionals that support mine operations where the ratio in North America between those directly involved in mineral production and those engaged in support functions is approximately 1:6.5

Basic Participants of the Mining Industry

- Mining Companies (Majors, Mid-tier, Juniors)
  - Operators vs. Producers
- Exploration & Resource Companies
- Technical, Legal & Economic Consultants
- Contractors & Construction Companies
- OEMs & Vendors
- Product/Mineral End-Users
- Lending & Financial Entities
- Government Agencies & Ministries
- Labor Unions & Representatives
- Universities & Research Organizations
- NGOs & Activist Groups
- Professional Societies
- Land Owners & Lessors

Principle Stages of Resource Development

- **Exploration**
  - Location and definition of the orebody
- **Acquisition**
  - Establishing legal rights to minerals, surface, and water
  - These rights can be established through a wide variety of legal instruments and business agreements
- **Permitting**
  - The process of ascertaining the potential environmental and social impacts of project implementation and the formulation of design alternatives in order to mitigate these possible impacts
  - Activities required to solicit regulatory approval as well as project operating compliance with federal, state, and local regulations and standards
- **Feasibility and Financing**
  - Determination of a projects merit and perceived value
  - Capital budgeting decisions
  - Solicitation of investment capital for mine development

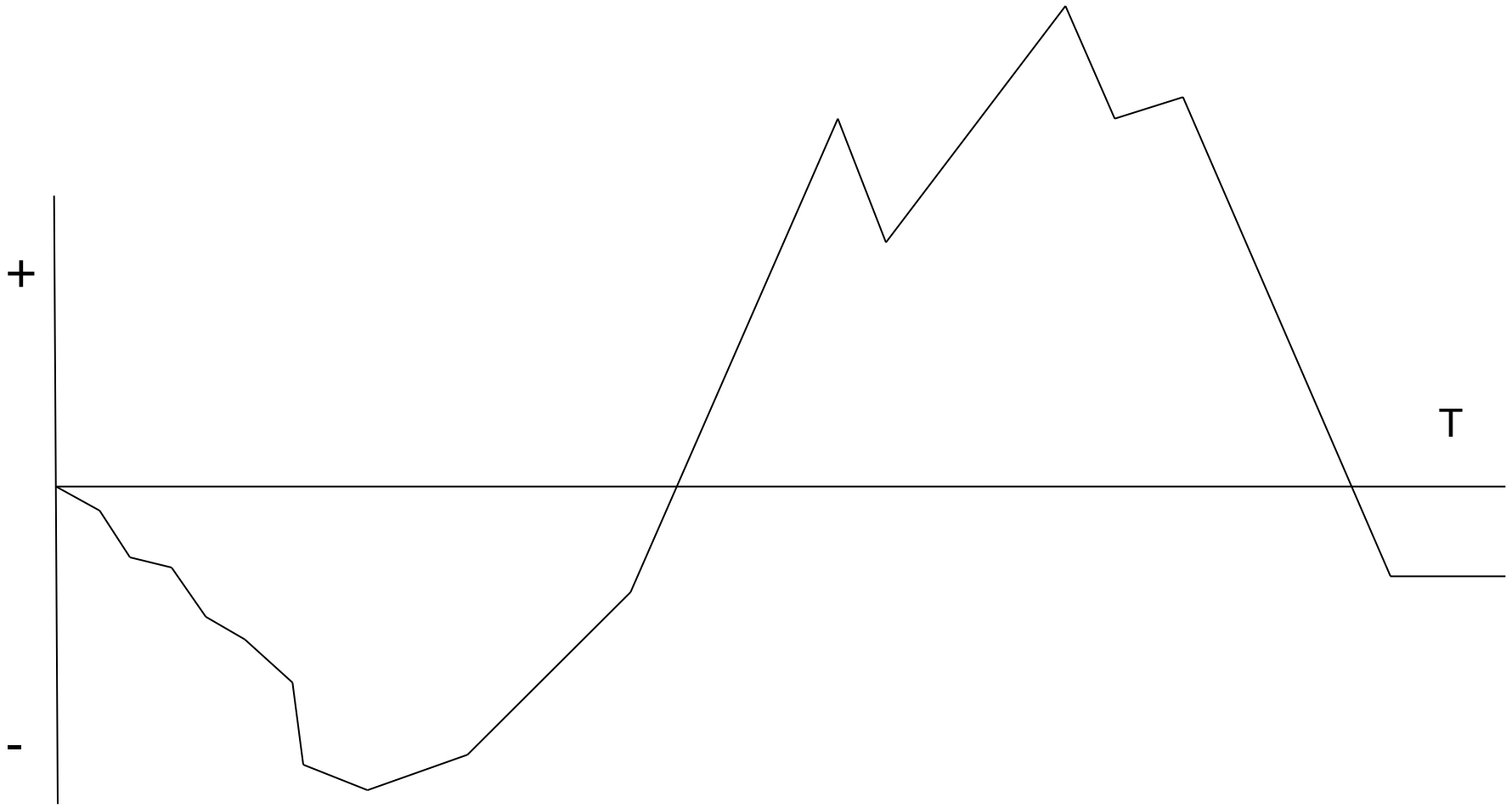
Principle Stages of Resource Development

- **Project Development and Construction**
  - Preparation of the minesite for production and processing
  - Construction of surface plant and mine infrastructure
  - Equipment acquisition
  - Mine development & stripping
- **Production**
  - The extraction, recovery, and sale of minerals
- **Reclamation**
  - Restoration of the project site to mitigate environmental impact and/or establish site to productive post-mining uses

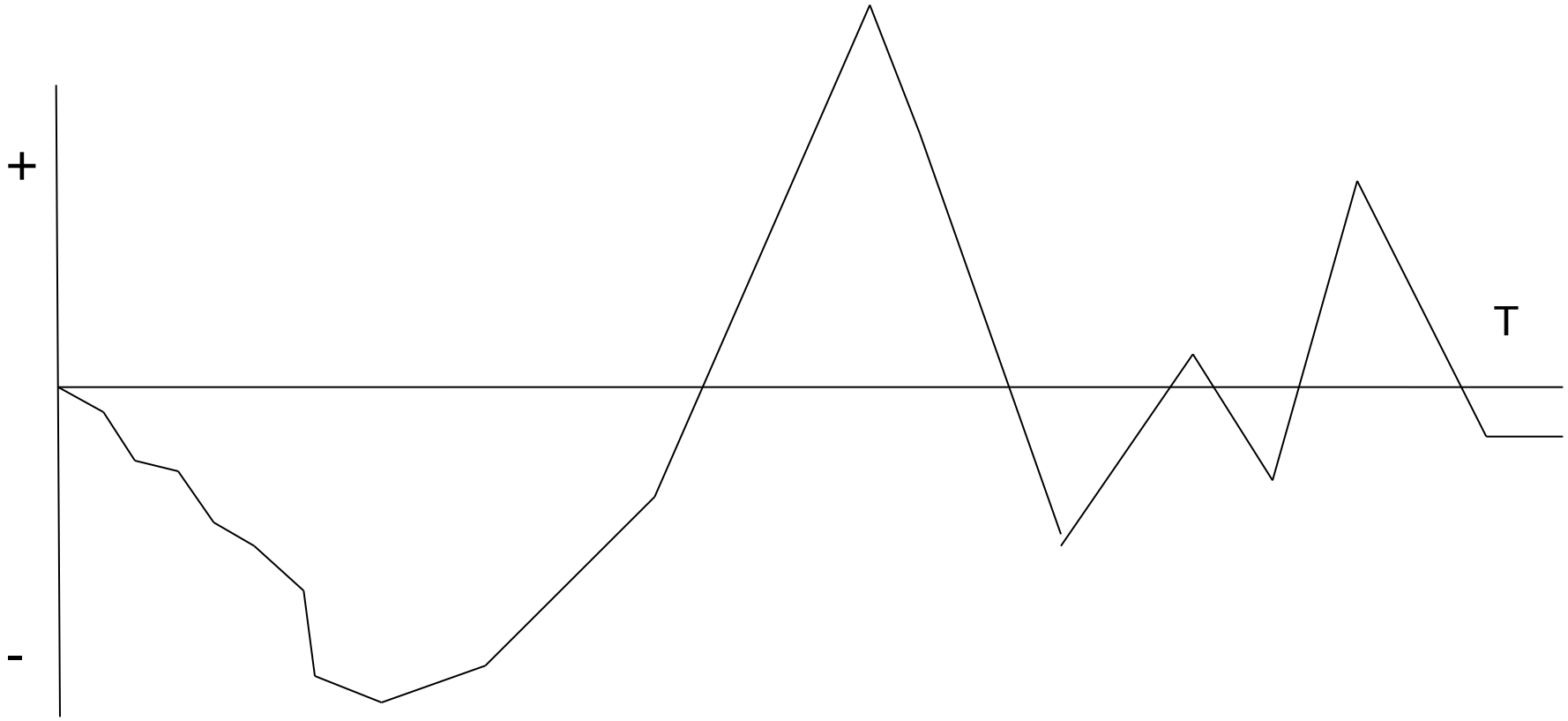
Principle Stages of Resource Development

- Drawings of the Mine Life Cycle with Cash flows
- Scheduling of Stages
  (Do they occur sequentially, simultaneously, or in loops?)
- Distinct Features:
  - Timing (costs vs. revenues)
  - Long Pre-production Periods
  - Terminal Decisions (reclamation & standby/idle)
  - Capital Intensity
  - Risk (economic, market & geologic)
- Company Sustainability & Production Replacement
- Optimization of Production & Return on Investment

Principle Stages of Resource Development
Mine life – Net Project Revenues vs. Time



Principle Stages of Resource Development
Mine life – Net Project Revenues vs. Time



What happens if time-value of money is considered?

Realities Associated with Mineral Resource Production

- Public Perception & Historical Memory
- Mineral production directly tied to our standard of living
- Vast majority of minerals can not be recycled
- Economically viable deposits are rare
- Ore deposits are irregularly distributed
- Depleting assets
- Capital intensity and Long Pre-Production periods
- High Risk Industry
- Regulatory Scrutiny (all facets)
- Unique and inelastic Supply/Demand characteristics
- International Equivalencies

Distinctive Features of the Mining Industry
Long Lead Times Between Project Inception to Production

- Entirely all cash outlays (10–35 yrs) until mine is producing ore and net revenue

<u>Many Examples:</u>

- Battle Mountain/Kinross Crown Jewel Mine: 16 years in feasibility & M$60+ Feasibility
- Rio Tinto Resolution Mine: 30 +years @ $300 Million+
- Afghanistan (Inak Copper) ???

Distinctive Features of the Mining Industry
Capital Intensity

- Often total capital expenditures for large mines can approach $ 8 Billion (US)
- Private project financing is almost impossible and usually ill advised for most companies
- Financing for large projects often complicated and difficult to secure:

  Example: Antamina, Peru
  - $ 2.2 Billion (US), 60+ Banks in 10 Countries

Distinctive Features of the Mining Industry
Dependence on Volatile Short-Term Product Pricing

- Inelastic Demand
- Limited Supply and Capacity
- Artificial Market Conditions
- Sensitive to External Market Conditions and Economic Activity

Grade Equivalence

Traditional Definition

- Grade equivalence refers to the common practice of calculating a composite average grade, as represented by a single mineral commodity or metal within a polymetallic resource, that incorporates the economic contributions of both primary and secondary/by-product mineralization.

Grade Equivalence

Purpose and Description

- Whenever there is more than one economically valuable mineral type within a deposit, it is often convenient to use a single composite grade as a descriptive means of representing “worth” or “value”

- Often used to assign value to ore blocks, reserves, stopes, exploration targets, vein structures & shoots, etc.

Common abbreviation

- Equiv. or Eqv.
- Precious Metal Example: 2.5 g Au Equiv./mt or 2.5 g/tonne Au Eqv
- Base Metal Example: 3.0% Cu Equiv.

Grade Equivalence

Calculation Process: Grade Equivalence (Insitu)

- Step #1: Establish Average Grade for Each Target Metal/Mineral Commodity Sample and Assay
- Step #2: Determine Appropriate Market Price for Each Metal or Mineral
- Step #3: Calculate the Insitu Value of Each Metal/Mineral Grade x Price
- Step #4: Calculate the Total Insitu Value by Summing the Insitu Values of all Target Metals/Minerals
- Step #5: Divide the Total Insitu Value by the Market Price of the Equivalent Metal/Mineral

Grade Equivalence

Example: Insitu (in-place) Calculations

Given:	Metal	Assay Value	Metal Price
	Au	10.9 g/tonne-ore	$ 38.5/g (US)
	Ag	25.10 g/tonne-ore	$ 0.55/g (US)
	Cu	1.40%	$ 5.525/kg (US)

Determine Au Equivalence:

Au: (10.9 g/tonne) x ($ 38.5/g)	=	$ 419.65/tonne-ore
Ag: (25.1 g/tonne) x ($ 0.55/g)	=	$ 13.81/tonne-ore
Cu: (1000 Kgs/tonne) x (1.4/100) x ($ 5.525/Kg)	=	$ 77.35/tonne-ore
Total Insitu Value		$ 510.81/tonne-ore

Au Equivalence = ($ 510.81/tonne-ore) / ($ 38.5/g Au)
= 13.3 g Au Eqv/tonne-ore

Grade Equivalence

- It is a common convention for metallic ores to determine equivalence relative to the mineral of greatest concentration and/or recoverable value within the resource.

- An equivalent grade may or may not include adjustments for mill and smelter recovery, smelter charges and price adjustments, and occasionally, production costs

  - Without cited references, often difficult to tell whether equivalent grades are calculated using an insitu or recoverable value

  - Equivalent grades used in the sampling of exploration targets usually do not include recoveries and production costs because much of the required information has yet to be determined.

Grade Equivalence

- When assigning equivalent grade value to ore blocks it is important to understand that this value is dynamic because of metal price and recovery/cost assumptions.
- Know what metals are included and in what proportions!!!

End of Lecture Review
Contact Information & Thank You

Contact Information

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