Determination of uncertainties in DSM economic models for polymetallic nodules project

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PROCESSING TECHNOLOGIES, METAL RECOVERIES & ECONOMIC FEASIBILITY OF DEEP SEA MINING
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DSM economic models

- WEF-RESOLVE-ISA workshops (Chennai, Goa, San Diego, London, Singapore)
- Contractor’s models (BGR, GSR)
- MIT model (ISA meeting)
- Articles and proceedings (UMC, ISOPE)
DSM economic model uncertainties

Resulting from:

- Technology issues (mining, processing)
- Legal issues (payment regime, environmental regulations)
- Economy issues (demand, prices, market)
Technology uncertainties

Pilot mining test
- complete DSM system has never been tested so far
- carrying out complete mining tests will take several years

Determination of mining efficiency will provide information on real production capacity, scope of area mined, number of mining vessels and collectors needed, etc.
Technology uncertainties

Processing

- processing of 3-5 metals requires complex and costly operations = construction of new plant (70-80% of costs)
- seeking possibilities of PNs processing in existing plants (mixing with terrestrial ores)
- use of other metals contained in PNs (REE, precious metals)
Legal uncertainties

Mining Code

Commerciably acceptable regulations, including payment regime, are crucial for future DSM business.

- Fees (administration, environmental)
- Royalties

Technical issues connected with weighting of mined ore on sea.

Definition of wet/dry polymetallic nodules?
Legal uncertainties

Environmental regulations

- environmental rules, EIA/EIS procedures, setting of pollution limits, monitoring requirements
- experiences of environmental regulations in EEZs for deep sea oil/gas extraction (?)

❓
Economy uncertainties

Demand

- Forecasts based on increasing population, urbanization, industrialization
- Recycling, substitutions
- Low carbon technologies – demand for specific metals (not only electric vehicles)
Economy uncertainties

Demand
The growing role of minerals and metals for low carbon future (World Bank Group, cooperation with ICMM, IEA, 2017)

- commodities demand up to 2050
- focus on renewable technology demands to meet different climate scenarios (Paris Agreement, 2015)
- political decisions influence
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<th>Wind</th>
<th>Solar photovoltaic</th>
<th>Concentrating solar power</th>
<th>Carbon capture and storage</th>
<th>Nuclear power</th>
<th>Light-emitting diodes</th>
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Economy uncertainties

Prices forecast

- **metal prices** – simulations based on historical data and market forecasts
- **oil prices** – impact on the entire DSM project value chain

Prices (especially of metals and oil) are sensitive to political issues, market speculations = hard to predict price fluctuations.
Economy uncertainties

Market analysis

- influence of one or more PN producer’s output on metal markets (increasing of stocks, prices erosion)
- competitiveness with terrestrial deposits (lowering metal grades and increasing mining depth)
- terrestrial mines protection, compensation or DSM support?
Economy uncertainties

Activities in the Area

Off-shore operations
- Exploration & Evaluation
- Mining
- Transport from the Area

On-shore operations
- Port operations
- Transport to processing plant
- Processing operations

Extraction point
- Sales point 1 nodules (ore)
- Sales point 2 nodules (ore)
- Sales point 3 (concentrates)
- Sales point 4 (metals)

One company covering all value chain? What final product?
Economy uncertainties

Missing data

- calculated from model by determination of limit values for commercially viable project
- theoretical results, need for practical tests for confirmation
Psychological barrier

- deep sea mining for metals represents new frontier
  “terra incognita” for investors and public
- role of communication strategy, acceptable CSR policy
- hesitation until first operation starts - breaking point
„In the not too distant future, seabed minerals would become one of the major sources of supply of the world's minerals”.

J. L. Mero - The Mineral Resources of the Sea, 1965