Futuribles

INTERMIN WP2 – BRGM
Foresight process and system definition

Madrid, January 30th, 2019
Part I : Foresight
Philosophy and Definitions
Foresight vs Forecasting

- **Foresight**
  - Global approach
  - Quantification and qualification
  - Considering discontinuities and ruptures
  - The risk: CHAOS effect (lost in the « if… then »s)

- **Forecasting**
  - Partial and sectoral approach
  - Built through numbers
  - Continuity principle
  - The risk: GIGO effect (garbage in, garbage out)
The simulation tools

- Foresight : scenarios
  - The base and its relevance ?
  - The path and the complexity of the routes ?
  - The final pictures

- Forecasting : models (comes from hard sciences)
  - The logic of the formulas and their perenity ?
  - The components of the system and their autonomy ?
  - The input data

But a complementary use of methods

*Numbers about the future are not more « true » than words*
The Foresight Process

Three essential features:

- The systemic approach
- The long-term dimension
- Discontinuities and changes

« see large, in depth, with a long view and keep humankind in mind » G. Berger
The Future, a Realm of Freedom
- It is open to many possible futures (futur-ibles)
- Just useful signs: heavy trends, emerging trends and weak signals

The Future, a Realm of Power
- Urgent = already too late

The Future, a Realm of Will
- Opportunities and threats make sense only if one has a goal

Foresight not to guess exactly the future but to explore: what may happen? Then, what can we do (strategy)? Exploratory, then Normative foresight (values)
Exploratory scenarios: what may happen?

- the possible futures: issues, range of action
  - from the possible futures (of mining and raw material) to issues revealed term of required skills

Strategy: process to perform a specified goal though time. Detailed in planning. Bound to a decided goal/vision in the future
Foresight: A systematic, participatory and multi-disciplinary approach to explore mid- to long-term futures and drivers of change.

Prospective: Refers to the French foresight method “La Prospective” which is based on the principle foresight is meant to lead to provoke strategic action.

Driver: Factors causing change, affecting or shaping the future (drivers are a mix of factor and actor)

Trend: General (factor) tendency or direction of a movement/change over time. A trend may be strong or weak, increasing, decreasing or stable. There is no guarantee that a trend observed in the past will continue in the future.

Heavy trend: a trend that cannot be reversed at a specific horizon, lead to one hypothesis.

Main (tendencial) trend: continuing trend from the past to the future. Not always the most probable: things change

Weak Signal: An early indication of a potentially important new event or emerging phenomenon that could become an emerging pattern, a major driver or the source of a new hypothesis.

Hypothesis: assumption about a specific driver for at a time horizon

Scenario: A description of how the future may unfold according to an explicit, coherent and internally consistent set of assumptions about key relationships and driving forces
Part II
SCENARIO METHOD
STEP BY STEP
Why the scenario method

• An assembly of engineering tools specific to foresight (not the base tools)
  ➢ A rationale process
  ➢ A common language

• Creativity limited by logic and rationale:
  ➢ *Pertinent* driver describing the system
  ➢ *Possible* hypothesis for each driver
  ➢ *Consistent* links between drivers (scenarios)
The Foresight Process

1. **Define** the problem/topic, boundaries, and horizon

2. **Identify** key variables and their relationship

3. **Build** different hypotheses variable by variable

4. **Explore** possible evolutions by assembling hypotheses

5. **List** possible futures and their paths

6. **(Construct)** strategic options
Do not confuse possible, probable and main trend future

Identify drivers influencing demand and offer mining and raw material sector
TOPIC DEFINITION
The future of mining and raw material sector to deduce future competencies
Geographical scope: EU inc. Russia, Turkey; Australia, Canada, Japan, South Africa, USA, Brazil, Chile, Mexico…..
Typology proposal for mining countries: OECD/rich countries and emerging countries

HORIZON
15 years; 2035 and deployment to 2050;

WORKING PROCESS
Expert foresight (researchers)
PHASE 2 – BUILDING THE DRIVERS SYSTEM

- **IDENTIFY KEY DRIVERS OR VARIABLES** (ACTORS/FACTORS)
  - Internal /External to the foresight topic
  
  (functional analysis)

- **GRADE/SORT THE DRIVERS** (DRIVING FORCE ; INFLUENCE ; UNCERTAINTY)

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No foresight in vitro
PHASE 2 : THE DRIVERS

➢ DRIVERS = FACTORS + ACTORS

➢ IDENTIFY THE DRIVERS

➢ HOW TO (Delphi, creativity/Metaplan)
  ▪ EXPERTS
  ▪ ACTORS/STAKEHOLDERS
  ▪ LITERATURE
  ▪ SURVEYS
  ▪ BRAIN STORMING

Study duration is bound to the number of drivers thus limited to 6 to 8 drivers for the INTERMIN Project
Goal: drivers shaping the future of mining and raw material sector (BRGM 1/25\textsuperscript{th})
max : 5 possible hypotheses
max : 2 uncertainty level by driver

Example : Perception of risk and management

Perception of high risk

H1

Collective management

H2

Individual management

Perception of low risk

H3

H4
BUILDING THE HYPOTHESIS

FOR THE KEY-VARIABLES

1. THE PAST EVOLUTION
2. THE CONTINUOUS TREND
3. PRECISE THE POSSIBLE WILD CARDS, FACTORS OF DISCONTINUITIES

5 MAJOR PROBLEMS

1. INDICATORS
2. DATA
3. TIME SERIES
4. CAUSES
5. IDEAS

CLEARLY INDEPENDANT HYPOTHESIS ABOUT THE KEY-VARIABLES FUTURE STATE
A template to fill for each key variable:

**Driver name**

1. Definition
2. Indicators: numbers or facts
   - Weak signals - uncertainties
4. Hypotheses 2035 (and evolution to 2050): a name and definition for each hypothesis
5. (Actors involved)

**A watch system if maintained to organize knowledge**
Phase 3 : Driver documentation

Questions to find contrasted foresight hypotheses :

- Is there a threshold ? ,
- A change of actors ruling ? ,
- of geographical scale ? ,
- similarities with other activities … : ideas !

Driver file documentation :
- arguments about the possible hypotheses
- The “scientific base”
Phase 3 FROM DRIVERS TO HYPOTHESES

- **NO FORESIGHT WITHOUT WATCH**
  
  But dynamic watch (trends)
  The purpose of the driver file: arguments about hypotheses

- **FORESIGHT BUILDS A WATCH SYSTEM**
  
  Drivers documentation files: a watch system if updated

- **Each hypothesis covers the all range of the driver**

  - Hypotheses are mutually exclusives

| For drivers related to mining countries: |
| possibly 2 sets of hypotheses |
| - OECD countries |
| - Emerging countries |
PHASE 4: A FERTILITY FORESIGHT

Key drivers

1. Sterility rate
2. Age for first child
3. Infant and motherhood care and services
4. Dwelling
5. Female employment (first job age)
6. Child wish
7. …

System “fertility”

Hypotheses

<table>
<thead>
<tr>
<th></th>
<th>H1</th>
<th>H2</th>
<th>H3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sc 1</td>
<td>A 1</td>
<td>A 2</td>
<td>A 3</td>
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</tbody>
</table>

scenarios

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PHASE 5 – USE AND LIMITS OF SCENARIOS

- **THE BASIS**: is our scanning of the « system » correct?

- **THE PATHS**: IF, THEN?
  Taking dynamic evolution and drivers links into account

- **THE FINAL PICTURES**

Watch time horizon and levels of magnitude
In practice:

• « main trend scenario » (if possible)

• Find different « engine » for each scenario

• scenario consistency : ability to tell credible different stories (hypotheses) with the same ingredients (key drivers)

• Possible and contrasted scenarios : the black, le white, the grey versus rue choices to raise debate

• Scenario writing
  - Who, what format (beware of PowerPoint) ?
  - technical writing/communicational writing
Study impacts of scenarios on
- activities,
- **human resources,**
- regulation,
- research topic,
- Etc.

General: Risk and opportunities for different actors (range of action) or SWOT analysis for a specific organization or territory

- Our case: impact of each scenario on skills and competencies
- Importance of skills/competencies bound to their occurrence in several scenarios
Workshop 1: Topic and horizon

- Future of mining and raw material sector by 2035 (and evolution 2050)

- to deduce skills required in each scenario

Workshop 1: Drivers (performed January 25th in Orleans)

What are the factors (actors) impacting/influencing the development of mining and raw material sector?

- list 5 main influencing factors /actors influencing mining ad raw material sector
- collective collecting of ideas / mapping drivers
Goal: drivers shaping the future of mining and raw material sector

- Resource availability
- Knowledge
- New technologies (demand)
- Regulation
- Channels of education
- Urbanization
- Ecological transition
- Geopolitics
- Social acceptability
- Mining and Raw material
- Raw material cost-price
- Mining actors activities / values
- Mining technologies
- Recycling economy
- Mining waste
- World Demography
- Resource accessibility (landuse)
- New technologies (demand)
- Regulation
- Mining culture

ECOSYSTEM/ENVIRONNEMENT
Workshop 2: Sorting the drivers

- Place the collected drivers in a graph importance/uncertainty (driver comparison)
- We keep only 6 to 8 most important and uncertain drivers
- Other possible drivers: heavy trends (one hypothesis) or secondary drivers (disregarded)

Workshop 3: Definition /documentation

- Clear definition of each driver
- Possible indicators: to measure evolution through time (incl. facts)
- Documentation sources to gather dynamic evolutions (indicators) of each driver
# Workshop 2: Sorting the drivers

<table>
<thead>
<tr>
<th>Demand drivers</th>
<th>Definition/rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>World demography</td>
<td>Raw material consumption is bound to the number of people and individual consumption for quarries materials and equipment (cell phones....)</td>
</tr>
<tr>
<td>Urbanization</td>
<td>World Urbanization lead to an increase in building (quarries) material which is less true for rural population using more local materials</td>
</tr>
<tr>
<td>Resource accessibility</td>
<td>Land use conflicts due to urbanization or biodiversity protection (protected areas) may limit raw material accessibility and lead to raw material mining in new places: ocean grounds, Arctic or Antarctic areas, space.</td>
</tr>
<tr>
<td>Resource availability and knowledge</td>
<td>Resource availability and knowledge including depth of the resource for the geographical scope of Intermin project (Europe, Australia, USA, Chile...)</td>
</tr>
<tr>
<td>Geopolitics</td>
<td>Geopolitical context of countries with resources, condition of access (from bribery, quotas, to sustainable label ?)</td>
</tr>
<tr>
<td>Regulation/legislation</td>
<td>Environmental impact regulation, taxation, exploitation permits</td>
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</tbody>
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### Workshop 2: Sorting the drivers

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<tr>
<td><strong>Social acceptability</strong></td>
<td>Environmental consciousness and acceptability bound to mining and material processing (“not in my backyard”, acceptability of impact transfer to other countries....)</td>
</tr>
<tr>
<td><strong>Mining culture</strong></td>
<td>Mining history and culture/view of mining</td>
</tr>
<tr>
<td><strong>Ecological (energy and digital) transition</strong></td>
<td>As a proxy of mineral and specific material demand, pace of the energy and digital transition</td>
</tr>
<tr>
<td><strong>New technologies</strong></td>
<td>New technologies (digital, batteries...) requiring new materials</td>
</tr>
<tr>
<td><strong>Channels of education including field experience</strong></td>
<td>Channel to access knowledge and competencies especially about field experience (enhanced or virtual reality ?)</td>
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</tbody>
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## Workshop 2: Sorting the drivers

<table>
<thead>
<tr>
<th>Mining or offer drivers</th>
<th>Definition / rationale</th>
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</thead>
<tbody>
<tr>
<td>Recycling and circular economy</td>
<td>Waste treatment, recycling technologies or business models like service economy (rent a product instead of selling it)</td>
</tr>
<tr>
<td>Mining and processing actors and activities</td>
<td>Number of actors and strategy on the value chain (mining, processing, recycling); corporate social responsibility</td>
</tr>
<tr>
<td>Price and production cost of raw material</td>
<td>The profitability of raw material production is driving mining choices of companies</td>
</tr>
<tr>
<td>Companies technologies to find, access and process materials</td>
<td>Technological improvement in finding, accessing and processing raw material, including artificial intelligence</td>
</tr>
<tr>
<td>Mining waste</td>
<td>Mining waste use /valorization</td>
</tr>
</tbody>
</table>
Workshop 2: sorting drivers (max 8 drivers)

- **Main uncertainties**
  - Heavy trends
  - Secondary drivers
  - Critical drivers

- **Importance**
  - Strong
  - Weak

- **Uncertainty 2030**
  - Strong
  - Average
  - Weak

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<table>
<thead>
<tr>
<th>Driver name /definition</th>
<th>Indicators</th>
<th>Documentation sources</th>
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<tbody>
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<td>Driver 1</td>
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<td>Driver 6</td>
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<td>...</td>
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</tbody>
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- This part can be done by remote work
- Driver files shared among researchers WP2.2 ?
- Time series
A template to fill for each key variable:

**Driver name**

1. Definition
2. Indicators: numbers or facts
   - Weak signals - uncertainties
4. **Hypotheses 2035 (and evolution to 2050)**: a name and definition for each hypothesis
5. (Actors involved)

**A watch system if maintained to organize knowledge**
Drivers files and hypotheses per driver to discuss (February to April 2/3 half day remote meeting)

Scenario meeting in May/June