1 Part 1: ”Strategy and vision”

1.1 State of the art (show the current situation), key drivers, needs, assumptions, vision= mutual and ultimate goal

Within mineral processing, different unit operations for comminution and separation are combined into a multi-stage beneficiation process in order to provide an ore concentrate or to produce an industrial mineral product of defined application properties.

The major challenge in mineral processing still lies in improving the overall resource efficiency and productivity, i.e. enhancing recovery of valuable minerals, with reduced environmental impact, in order to satisfy the increasing demand of metals and minerals needed for the sustainable development of our society. Besides that, the requirements on reduced energy consumption and related GHG emissions, decreased process water demand and finding alternative by-products from processing rejects or producing more benign tailings are current driving forces for mineral process development. Moreover, the increasing exploitation of deposits with complicated ore properties as well as the general trend towards lower grades, fine-grained ores and a more complex mineralogy, call for new process technologies that enable enhanced mineral liberation and separation.

Implemented processing technologies have matured during recent decades but are still far from being optimal, thus leaving room for further improvements through research and development. New processing routes and equipment are available that are waiting to be adapted to particular mineral deposits and to industrial scale. For the future, smart and innovative production systems are required that will utilize advanced online monitoring and data analytics.

(219 words)

2 Part 2: ”Tactics and operations”

2.1 Mineral Processing

2.1.1 Summary/purpose of the thematic area

The purpose of mineral processing is to treat ores by separating the valuable minerals from waste rock and gangue and by adjusting mineral grades and particle properties. It is usually the first step that ores undergo after mining in order to produce a concentrate for subsequent metallurgical extraction or an industrial mineral product, respectively. The main steps are usually comminution and classification, concentration and, in case of wet processing, dewatering.

Comminution is needed in order to liberate the minerals. This stage is usually not only the most energy-intensive step within mineral processing plants, but is also crucial for all subsequent steps in mineral beneficiation. Sufficient liberation of valuable minerals is the prerequisite for any downstream separation. However, selection and operation

Kommenterad [JR1]: Approx. 300-400 words
Background, current situation, key drivers, needs, macro environmental factors, assumptions, challenges etc, that had its own headline in the thematic areas in STRIM 2016, will be used as input for the strategy in part one. And once again the information should be connected to and in line with the main challenges, key drivers and opportunities that was identified in the three workshops.

Kommenterad [JR2]: Beyond 2045

Kommenterad [JR3]: Max 1000 words

Kommenterad [JR4]: Approx. 300 words
The only really new part in this disposition is the “summary/purpose”, which should be a razor-sharp summary of the thematic areas role in the strategy: What are we doing? Why are we doing it? Main challenges and objectives, what we hope to achieve with our research and how it push us towards the vision. The essence of everything that’s important.

of comminution circuits are often not optimal due to limited ore characterisation and incorrect parameter settings. Steps have been taken during recent years to adapt e.g. high pressure grinding rolls or stirred media mills to ore comminution. In comminution modelling and simulation, the approaches used today still need to be extended in order to take into account mineralogy and ore texture.

Within ore concentration, the efficiency of separation processes needs to be further improved. For instance, flotation separation requires suitable particle size ranges as losses occur in the very fine and coarse fractions. Several principle approaches exist to adjust the flotation process to fine particle flotation, involving high intensity dispersion and mixing, while low intensity is generally intended for coarse particle flotation. Selective flotation of minerals requires suited and environmentally sound reagent schemes.

One possibility of reducing the amount of ore that needs to be processed downstream is by separating liberated gangue already at coarser particle sizes, e.g. by sensor-based sorting or physical separation. Although the benefits of pre-concentration are obvious, these technologies are currently used only at a few mining sites. Other approaches, as more efficient classification steps within comminution circuits or successive concentration and size reduction, have also not gained acceptance yet due to more complex flowsheets.

(329 words)

2.1.2 Objectives and KPI (former "vision" and "beyond vision")

Kommenterad [JR5]: Approx. 150 words
This was named visions in the previous STRIM-agenda, but are more of objectives and key performance indicators. Most of them can defines as SMART-goals, when they are specific, measurable, achievable, relevant and time bound. Use STRIM 2016 as writing reference and really try to pinpoint the connection to and in line with the main challenges, key drivers and opportunities that was identified in the three workshops.

- Specific
- Measurable
- Attainable
- Relevant
- Time-based

The main objective for mineral processing research and development will be to significantly improve resource efficiency by 2045. This will result in added value from high quality products and new by-products, lower energy consumption as well as decreased metal losses, and from improved environmental performance with respect to reducing water consumption and emissions.

For these targets the following key performance indicators are defined:

- Reduction of energy and related CO_2 emissions
- Reduction of metal losses
- Increase of by-products from processing rejects
- Minimisation of water consumption

(84 words)

2.1.3 Research and innovation needs, strategies and actions

Kommenterad [JR6]: Approx. 350 words
Will explain the RDI focus for the thematic area in a short-, medium- and long-term. Use STRIM 2016 for writing reference.

In the long term, research and innovation on resource-efficient mineral processing is needed to develop and implement:

- Energy-efficient comminution processes.
- Efficient separation processes for treating fine-grained, polymetallic ores and removing impurities.

- Optimised beneficiation processes for reduction of waste rock and tailings (turning rejects into products), reduction of process water (dry processing).
- Suitable pre-treatment processes for separation of coarse material close to the mining production face (e.g. sensor-based bulk sorting).
- New processing routes for producing minerals and metals from by-product and reject streams from beneficiation and extraction plants.

RDI strategies are proposed in the fields of comminution and separation, as well as their combined consideration in a systems approach in order to optimise entire mineral processing chains. The research needs and suggested short-term and medium-term actions presented involve both fundamental and applied research.

Comminution

For more efficient crushing and grinding, currently existing processes need to be optimised or novel technologies have to be provided:

- Enhance mineral liberation by adjusting breakage mechanism (comminution and assisting pre-weakening technologies) to ore properties.
- Improve comminution technologies and machinery for hard ore comminution with regard to energy for grinding and wear characteristics.
- Develop measurement technology and advanced models for optimising design and control of comminution circuits.
- Investigate alternative fragmentation methods and mill types for the efficient grinding of coarse and fine particles (considering dry and wet grinding).

Separation

Improvements in separation technology are required particularly for coarse and very fine particle sizes, involving the investigation of:

- Processing routes for bulk sorting prior to the concentrator, considering separation at coarser particle sizes.
- Reagent schemes and hydrodynamic concepts for improved flotation of valuable minerals from fine and ultra-fine as well as coarse size fractions, including cold flotation.
- Stability and degradation of flotation reagents and their effect on downstream processing and water recirculation.
- Processing routes for separation of complex ores and removing impurities.
- Dry processing technologies particularly for finer size ranges (classification, sorting, magnetic, electro-static and gravity separation).

Process design and analysis

Improvements along the entire processing chain need to be investigated, involving the introduction of new and smart process designs and methods. Innovative process design and control optimisation of comminution and separation processes will lead to intelligent production systems.

- Hybrid flowsheets based on successive separation and size reduction for efficient comminution circuits.
- Optimised chain of ore fragmentation (from blasting to grinding) in combination with pre-concentration.
- Geometallurgical modelling together with innovative analytics for resource characterisation and ore traceability.
- Flexibility in plant operation for different ores types.
- Strategies and models for the efficient management and treatment of process water.
- Digitized processing plants using advanced online characterisation, sensor technology and data analytics.

(431 words)

2.1.4 Expected impact

Kommenterad [JR7]: Approx. 200 words of the thematic area and STRIM in a technical, economical, environmental and social perspective. Use STRIM 2016 for writing reference.

Technical

- Availableness of energy-efficient comminution equipment and process designs.
- Reduced wear and enhanced mill control based on innovative measurement solutions and mill modelling.
- Provision of efficient coarse and fine particle separation processes, for wet and dry processing modes.

Economical

- Reduced costs due to less energy consumption and wear in comminution.
- Higher revenue from increased recovery of valuable minerals and metals.
- Increased production due to reduced material amounts after pre-concentration.
- Increased revenue by producing by-products.

Environmental

- Reduced CO_2 emissions due to decreased energy consumption.
- Less water usage due to more dry processing and reducing the tonnage in downstream processes.
- Less and coarser material to be deposited.
- Stabilised processing rejects with reduced hazards or harms.

Social

- Improved social acceptance of mineral processing plant operation due to higher resource efficiency and less emissions and waste.
- Increased awareness of civil society of how the mining industry can improve the quality of life in society.
- Generation of new knowledge through research to be included in educational programs and trainings.

(164 words)