11 March 2005

Vision Paper for a European Technology Platform on Sustainable Mineral Resources (SMR) [1]

VISION FOR 2030

The European Technology Platform on Sustainable Mineral Resources (SMR) will modernise and reshape one of the fundamental pillars of the European economy and society: the European extracting and processing sector of energy and non-energy minerals. It will achieve this by:

- **Securing the future supply of /access to European raw materials;**
- **Supporting the revival of exploration of Europe's mineral potential;**
- **Developing innovative and sustainable production technologies;**
- **Implementing best practices;**
- **Reuse, recovery and recycling as well as new product applications;**
- **Creating European added value through R&D-based technology leadership, education and training which could also benefit to developing countries if the Commission agrees to recognise the mineral resources sector in its development policy.**

KEY BENEFITS OF THE TECHNOLOGY PLATFORM

- **will stimulate growth and employment,**
- **will have a positive impact on a wider range of Community policies, and contribute to the forthcoming Thematic Strategy on the Sustainable Use of Natural Resources;**
- **will boost research and technology and support Europe's position as technology leader,**
- **will contribute to the EU's SD and development objectives,**
- **will provide mineral products responding to societal needs in the 21st century based on economically, environmentally and socially sustainable production of raw materials in Europe,**
- **will bring together small, medium and large enterprises (European and international), associations, scientific community, governmental authorities and financial institutions in order to develop leading-edge technologies and to promote innovations.**

[1] This vision document is a living document and will evolve over time. In its present form and contents it is supported by the following industry sector organisations and their companies, of whom several have contributed also individually to this document: Ceram-Unie, Euracoal, Eurogeosurveys, Euromines, Euroroc, IMA, UEPG, the Society of Mining Professors. Some organisations and their members were not in the position to contribute at this stage and might join later. More extended consultation will be required for the establishment of the Strategic Research Agenda. Miro is acknowledged for having provided the initial draft, its affiliated companies for further useful comments.

IDENTIFIED KEY ELEMENTS

- **will contribute to the continuing growth of the European economy by**
  - identification of the EU minerals potential, prospecting of yet underprospected areas, integration of the data on mineral resources in land-use planning GIS;
  - securing future supply of high quality raw material resources through development of advanced technologies for defining and improving[2] access to hidden, deeper or smaller mineral deposits,
  - improving supply of high quality raw materials through advanced production processes,
  - adding value and improving competitiveness through innovation and development of intelligent exploration and production technologies,
  - development of new approaches through value chain integration that result in the production of added value products with societal benefit;
  - ensuring future economic, environmental and social sustainability by an improved use of the existing resources and the reduction of waste and emissions/by enhancing resource efficiency,
  - decreasing the geopolitical risks related to EU's high dependence on metallic minerals and metals imports through improved access to EU resources;
  - development and adoption of advanced technologies to improve hazard identification and risk assessment to minimise EHS risks,
  - responding to European and national policies,
  - assessing existing and developing new business models;
  - securing economic and social sustainability by improved comprehensive knowledge of regional linkages between mining, especially for construction materials, and sustainable urban development;
  - reducing the environmental impact throughout the raw material supply chain.

- **will focus industrial and public investment in research and development by providing a clear strategy;**

- **will mobilize and focus existing research and development capabilities to enable a more efficient approach to innovation by**

  - establishing strategic cross-sectoral alliances to promote increased awareness of market opportunities and long term trends in consumer demand,
  - stimulating the coordination of European and national research agendas;
  - exploiting cross-sectoral synergies.

- **will improve the knowledge baseline for the sector by**
  - increasing the rate of technological transfer to the European raw materials sector through using existing and complementing networks that promote information exchange and knowledge transfer,
  - supporting the existing European academic and other institutional training and research infrastructure,
  - promote academic and industrial training to encourage increased expert knowledge,
  - supporting appropriate life-long learning and training,
  - promoting the development of increasingly knowledge-based employment through European, national and international programmes that support mobility of personnel to balance skills shortages.
  - promoting cross-industry links.

EUROPEAN ADDED VALUE

The ETP will provide a focal point for the industry's research efforts.
It will strengthen the competitiveness of this sector by a major increase in cost and resource efficiency. It will improve compliance with the sustainability agenda in Europe as well as contribute to a successful European economy. It will at the same time ensure the supply of European industry with indispensable energy and non-energy raw materials. Through integrating all stakeholders across the raw-material supply chain a critical mass will be established to implement successful R&D with cross-sectoral application potential. Over the past decade consumption of raw materials in Europe has remained steady, but is likely to grow due to increased market demand, particularly in the new member states.

Further development of technologies will provide further added value and export opportunities.
Europe being the home of important exploration, mining and metallurgical equipment manufacturers, engineering companies and consultancies, may engaged in global activities, the ETP will be a source of increased competitiveness and jobs.

SOCIETAL BENEFITS
The European raw materials sector provides the basis for many other industrial sectors, Europe's infrastructure, urban development, and social welfare. Substitution by renewable resources (biomass) may appear as an attractive option, but there a certain number of physical constraints that are limits to such substitution:

- in many cases minerals and metals are used because they provide specific chemical and/or physical functions and parameters needed in industrial processes downstream from extraction and metallurgy;
- the quantity of land extraction temporarily requires (0.2%) to be compared with 41.5% for agriculture (Eurostat, 2003). Any larger substitution of minerals and metals by biomass derived product could be constrained by the physical limits to available land and by competing land-uses;

The European raw materials sector must and can remain the starting point of the European material supply chain at least to an extent which will ensure a certain amount of industrial downstream production on Europe.

IMPACT ON EU POLICIES
The ETP will contribute to the achievement of the objectives of Lisbon agenda and of the Cardiff and Gothenburg summits. It will do so by contributing to the implementation of those EU policies that deal with the extracted raw materials within or outside of the EU.
The ETP could be used to address current issues such as economic, trade, environmental, H&S policies as well as for the strategies on sustainable resource use, sustainable production, energy policy, soil protection, water protection, “Clean air for Europe” programme, waste and recycling policies, and the integrated product policy

THE GLOBAL CONTEXT
The modern metals and industrial minerals industries are essentially global. About 250 EU companies are engaged in metals extraction, including three major multinationals with capitalisations of over 20 billion EUR ranking in the top five largest mining corporations in the world.
However, while the EU consumes about 25% to 30% of the world’s metal production, EU metal extraction accounts for a mere 3% of world production. A better balance between production and consumption and security of supplies considerations will, due to the demand within the EU, call for an increase in extraction within the EU.
Metals are traded on the international market which means that European producers are in direct competition with many lower cost producers. In order to maintain European EHS standards and remain competitive, European producers have to continuously cut costs through modernisation and innovation. If the mining, metals and minerals sector were not to remain in Europe the research competences as well as downstream industry will relocate, too, leaving Europe totally deprived of further possibilities of action economic, social and – at the end - environmental consequences should be dramatic.

At the same time the European metals industry has been one of the major technology providers in smelting technology around the world, aluminium and copper are just two examples. This technology know-how needs to be continuously developed further to maintain this European asset that provides considerable exports.

The European industrial minerals sector is present in all of the EU Member States. Mainly composed of SMEs, it also includes the world's leading international production companies. It offers direct employment to some 40.000 people With some 650 mines and quarries and 600 plants, Europe is a major producer of some industrial minerals, for example, feldspar, magnesite, bentonite and kaolin, for which over a quarter of global production was recorded within the EU25 and candidate countries. The industrial minerals sector produces an annual volume of some 100 million tonnes, contributing a value of around € 10 billion to Europe's gross domestic product (GDP). If downstream industries such as glass, foundries, ceramics, paper, paint, plastic, etc. are included, these figures are several orders of magnitude greater. In contrast to aggregates, the geological distribution of specific industrial minerals is more localised. This means there is much international trade in these minerals. Despite significant production of some minerals, the available data suggests that the EU is a net importer of all industrial minerals, even those for which the EU is a major global producer. With regards to the new member states the non-energy extractive industry as a whole directly provides 1 million jobs and approximately 4 millions jobs in downstream industries.

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Coal is a major energy source for the enlarged EU. Behind China and the US Europe is the world's third largest coal consumer. Together with other energies it forms a secure and well-balanced partnership for the EU's power generating structure and its role has clearly increased with the enlargement. Present coal production and imports totals about 370 Mt, lignite production amounted to some 550 Mt.

Altogether some 32 % of the power generated in EU-25 is based on coal and lignite. But this is not coal's only field of application as also the steel and base material industries are highly dependent on coal. The coal mining industries safeguard more than 350,000 direct jobs in the EU. The production value of generating power from coal in the enlarged EU amounts to almost 30 bn€. The production facilities of the coal power generating industries are capital-intensive operations that promise huge investments in the employment sector. The labour market therefore has an enormous significance as a value added factor that extends far beyond the actual mining regions. Coal-industry suppliers are mainly medium-sized companies.

The European Aggregates Industry is the main supplier of materials to all types of infrastructure works within the European Union. Construction of roads, railways, airfields, buildings, sewage systems and other civil engineering works depend on large amounts of locally and regionally extracted and processed aggregates. The sector produces 2.800 Mtonnes annually with a value of 35.000 M EUR.
Several other extracted materials such as limestone, ornamental and dimension stone provide substantial quantities of raw material to the European economy.

ORGANIZATION AND NEXT STEPS

As described by the EC, the Technology Platform will unite stakeholders around a common vision and approach to address major economic, technological or societal challenges and to stimulate more effective and efficient RTD. An industry-led High Level Group (HLG) of senior executives will define a Strategic Research Agenda (SRA) and Implementation Plan which will be implemented by experts in Technical Working Groups. The HLG will select projects according to the defined SRA.

Proposal of next steps in the development of Technology Platform

Envisaged agenda:	
Announcement:	**15 March 2005**
Vision paper:	**15 March 2005**
Development of Strategic Research Agenda	**2nd and 3rd Quarter 2005**
Development of structure and working groups	**March to June 2005**
HLG meeting	**end of March/beg. April 2005**
tender for coordinator	**end of March 2005**

The support of the European Commission for the establishment of this platform is highly appreciated.

Annex 1

1. THE ROLE AND CONTRIBUTION OF THE EXTRACTING AND PROCESSING MINERAL RESOURCES INDUSTRY IN EUROPE

CHARACTERISTICS OF THE EXTRACTING, MINERALS AND METALS SECTOR

Minerals can be broadly classified into metallic ores (ores of metals such as iron, copper, etc.) or industrial minerals (calcium carbonates, borates, diatomite, kaolin, plastic clays, bentonite, feldspar, silica, and talc, etc.), construction minerals including aggregates (sand and gravel), cement rock (limestone) and dimension stone (such as marbles and granite).

Europeans consume one-third of world mineral resources and the EU is home to several of the biggest multinational mining corporations which use multidisciplinary expertise to find, prepare for use and supply key metallic and non-metallic mineral materials in continuous daily demand by most other industrial sectors.

Minerals industry products are the starting point of many different value chains defined by the manufacturing, engineering, construction, water, chemical, agricultural, heritage and other sectors. Many mineral products are recoverable, recyclable and reusable for new products.

The European metals sector is a fundamental, strategic pillar of the downstream fabricating, service and consumer industry in Europe.
The sector has in the past developed some of the worldwide leading technologies.

Current concerns of the EU raw materials sector are:

- providing primary metals and minerals to society in a sustainable manner, which entails:
  - remaining economically viable whilst providing primary metal and minerals for downstream industries,
  - reducing the environmental impacts without jeopardising product quality nor sector's competitiveness
  - intelligent solutions for
    - access to suitable geological deposits,
    - extension of existing deposits,
    - deeper mines,
    - small scale and efficient mines and quarries,
    - resource efficient smelting and refining
  - developing new processing technologies and reducing energy and material consumption in existing technologies,
    - developing new products for new markets,
    - including sustainability aspects into product development
    - new raw materials for new applications.

- Responding to the EU policy on the sustainable use of natural resources by further improving its environmental performance as well as resource use,

- Responding to the EU policy on recycling and management of waste by conserving energy, materials and the environment by developing products applications for by and co-products, by recovering and recycling and by finding innovative solutions for "wastes".

- Responding to the Lisbon strategy by maintaining and creating jobs and
  - assuring security of supply through improved raw material resource management, developing a sustainable economic balance between the use of primary (extracted) and secondary (recycled) mineral resources;
  - providing a means for new member states and SMEs as well to non-EU countries to buy into Best Practice and Best Available Technologies in order to improve compliance with EU legislation on environment, water quality, waste, land use, etc, particularly at international and at the EU regional and local levels and to stimulate the creation of sustainable jobs.

Economic benefits

The turnover of the EU minerals industry is estimated at about 36 BEUR or about 0.5% of the EU GDP and its output is likely to increase in EU25. The downstream 'user' industries provide a major multiplier effect to minerals industry outputs. In 2004 the EU25 minerals industry, including personnel working at subsidiary companies outside the EU employed over 500,000 people. At global scale each mining job provides at least four indirect jobs. About 30,000 EU-based minerals industry companies are in operation. The transport of bulk minerals by road, rail, waterways and sea provides important revenue flows across Europe.

Environmental benefits

The minerals industry promotes expertise and voluntary best practice in the areas of environmental (EIA and EMS) and health and safety management. The minerals industry has greatly contributed to the improvement of environmental technologies and base line data. The EU experience in mining and environmental legislation, education, training, technology and know-how transfer as well as expertise is a base of the competitiveness of EU consultants advising mining companies, governments and NGOs worldwide. With the enlargement the New Member states have to face a series of challenges linked to extraction in the past which requires new innovative, low cost solutions.
The same is the case of the metal smelting industry that has continuously improved its performance and needs to develop new technologies to improve even further.

2. Key challenges facing today's raw materials sector:

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- Maintaining secure supplies of non-renewable raw materials while safeguarding the environment through resources management conformable to Sustainable Development ethics,
- Access to suitable geological deposits, in Europe and worldwide (here it is of concern to mineral resources are not considered as one of the 9 Societal Benefit Areas in the development of the Global Earth Observation System of Systems (GEOSS) a major global 10- years initiative supported by the European Union; Developing new exploration methods,
- Obtaining an economic and environmental balance in using extracted mineral products and energy, as well as substantially improving the industry's energy efficiency and thereby reducing the emission of green house gases,
- Developing and designing products that can be recycled and reused, increased cooperation with OEM's
- Achieving a significant decrease in capital intensity and increased production flexibility through process innovations, compatible with large expensive fixed plant installations,
- Industrial production costs (e.g. energy, transport, telecommunications, new taxes),
- Understanding better the needs of sustainable regional functionality, the linkages between suppliers and users and the creation of beneficial clustering processes,
- The availability of a sufficiently skilled workforce,
- Attracting young talents to the sector,
- The support to capacity building and institutional strengthening in developing countries.

As current **strengths** the EU possesses high technology and expertise, hosts some of the world's efficient Geological Surveys, research centre and mining schools as well as the biggest mining corporations, financial centres and the renowned London Metals Exchange for trading commodity metals.

However, the aspects that need improving are:

- the European economy depends on imports from countries which can at times be politically unstable and/or do not have the institutional capacities to efficiently promote and regulate this sector,
- the European extractive industry is in competition with non-European extractive industries that have more favourable production conditions; certain having not to face the stringent EU environmental and social conditions.
- research centres that can support industry globally, irrespective of their location and can rely on different schemes for taxation credits, some more favourable than in Europe.

New **opportunities** are the use of new member states minerals resources and integration of their expertise in classical science and selected areas.

A **threat** is that China, India, Brazil and Russia are becoming powerful low-cost, high-volume RTD and industrial competitors: it is possible that essential industries, their RTD and perhaps their education/training centres could relocate from the EU to China and India.

3. TECHNOLOGICAL STANDING AND RESEARCH POSITION

Technological standing

The EU mining, metals and minerals industry has a global lead in many technological areas and operates safely and successfully within the strictest environmental and health and safety legislations in the world**.**

The EU mining, metals and minerals sector currently supplies a wide range of metallic and non-metallic materials from an estimated 40,000 locations. The search for and commercialisation of each mineral type require different technologies and different market strategies. It is therefore difficult to generalise the technological standing of the sector in terms of any single criterion: the ETP criteria of radical change in a sector, sustainable development, strategic high-technology and industrial renewal all apply to different areas of the European mining, metals and minerals sector.

Research position

Most mining, metals and minerals industry research in Europe is carried out by universities, mining schools, Geological Surveys or research institutes supported by varying proportions of public and private sector funding. Company sponsored research is directed at the development of technologies and processes that are directly relevant to their business plans. Europe hosts many very distinguished mining engineering schools; however, too few school leavers are entering mining engineering and economic geology courses. Industry is concerned that by 2015 this will lead to a scarcity of suitable researchers, technicians and managers in Europe. It is critically important for the EU to create future competent exploration, mining and minerals scientists and technicians if the industry is to remain competitive in a world economy. Mining is one of the most cross-scientific areas of technology. By using the new possibilities of different technologies there is large potential to develop the competitiveness of the European mining and at the same time new mining technology for worldwide market. This will require research to address the recurring negative image of mining in the general public.

4. SOCIETY, CONSUMER NEEDS AND COMPETITIVENESS

Globalisation, urbanization and increased access to media information, at the expense of the physical experience of resources gaining processes, are societal drivers which can impact on the minerals sector and affect its markets and products as well as public perceptions of minerals. However modern society uses most minerals in forms that are highly derived (building materials, cosmetics, fillers in plastics, paper and packaging) or as components in essential high-technology (e.g. small-scale electronics, telecommunications, computers, watches, cameras and other digital systems). New technologies and high standards of living in developed industrial societies influence consumers who thus drive changeable demand trends which contrast with the steadier trends for long-established, less easily substituted products such as building materials, glass, ceramics, steel, aluminium, copper and chromium. In order to maintain the European standards of living it will be necessary to continue to provide mineral raw materials, but in a more sustainable way without jeopardising the development of third world countries.

Global trade in retail goods coupled with a certain disregard for the related externalities, has increased competition and has attracted imports from producers from countries with lower raw material, labour, environmental and energy costs. Cutting costs of European production and products is therefore a must.

At the same time the transport of bulk minerals by road, rail, waterways and sea contributes to the development and viability of transport infrastructures which in many cases benefit society and local communities*.*

5. Key research areas

The following annexes contain lists of research areas and topics that are very preliminary to show the wide scope of potential research areas and are not exclusive, particularly from some sub-sectors input is missing and needs to be complemented. The SRA (Strategic Research Agenda) that will be developed by the High Level Group will review this list and set priorities.

A. Improving the access to Europe's and global resources

- **New exploration techniques for improved identification and exploitation of special deposits (lower grade deposits and/or deeper deposits, etc.)**
- **New methods in exploration of near surface raw materials**
- **3-d geological modelling for enlargement of ore productive districts for exploration of different ore types; for understanding the dynamic linkages between the mining and/or metallurgical project and the surrounding natural environment.**
- **Geology control and prediction system for selective and effective minerals extraction.**
- **Development of new metallogenic concepts to identify the guides toward the much needed strategic minerals (gallium, germanium, indium, lithium, niobium, platinum group element, scandium, tantalum, rhenium …) without which the global economy would come to a standstill;**
- **Adaptation of GIS technology-based ornamental stone exploitation**
- **Development of an EU-wide database of dimension stone and construction materials used in the past for the construction of EU's heritage;**
- **Multi-access data bank of Europe's underground and open-cast mining**
- **Improved geophysical/geochemical sensor technology, remote sensing and (satellite/air), positioning systems; digital imaging and analysis; spatial and financial modeling; chemical, mineralogical and engineering laboratory analysis; financial and commodity modeling and analysis to define mineral reserves equitably for investors.**
- **In line with the INSPIRE draft Directive and the GEOSS/ GMES initiatives, development of seamless EU-wide and international, interoperable, harmonised databases and GIS on remote-sensed data, geophysics, geology, tectonics, geochemistry, alluvial heavy minerals soils, aquifer systems and natural hazards;**
- **Societal acceptance of effects of extractive industry and the relocation of communities.**

B. Designing tomorrow's mine, quarry, smelter– life cycle of operations

- **Mining systems for thin ore deposits**
- **Deep mining – improving the sustainability of existing and future reserves**
- **Optimisation of mine and quarry infrastructures**
- **Improving competitiveness and safety in existing and future mines, quarries, beneficiation plants and smelters – automation; development of robotics in mining**
- **Monitoring of ground motion and seismic activity, development of proactive actions to reduce their impacts**
- **Mining engineering and specialised constructions**
- **Rock mechanics**
- **New drilling methods**
- **New methods for tunnelling**
- **Minerals extraction at great depths**
- **Dam safety, design and evaluation of tailings dams and dumps**
- **Dust reduction and control**
- **Maintenance strategies**
- **Optimisation of automatic control systems**

- **Improving the processing/metallurgy**
  - **New process technologies**
  - **Fragmentation of bedrock based on new theoretical grounds and process optimisation.**
  - **Optimisation of the comminution system**
  - **Mineral surface reactions and chemical modelling.**
  - **Minerals bio-processing.**
  - **Management of microelements and man made substances (precautionary principle)**
  - **Low grade heat recovery**
  - **Feed stock recycling**
  - **Slag products including incorporation of wastes**
  - **Furnace integrity**
  - **On-line measurements (e.g. XRF of process gasses, process tomography)**
  - **Corrosion management and prevention**
  - **Combustion engineering and heat recovery**
  - **Biofuels rediviva**

- **Innovative concepts**
  - **Sustainable industrial small-scale extraction in Europe - reorganising SME extraction and in developing countries**
  - **Access to future resources – Extraction and processing in harsh environments**
  - **Development and promotion of regional functionality and connected industrial clustering to obtain economic development**

C. Reducing the environmental footprint

- **Energy efficiency**
- **Optimisation of the Comminution System**
- **Improving ground and surface water quality**
- **Improving air quality: Reduction of particulates and noise levels in the vicinity of mineral processing plants**
- **Rehabilitation and new methods for revegetation.**
- **Biochemical processes (including phytomining) methods for extraction of metals from contaminated soil and for remediation.**
- **Waste (tailings) deposit engineering and management, dam design and construction and development of automatic monitoring systems with the sustainable perspective**
- **New alternative methods for insulation of mine and smelter waste by various means of coverage.**
- **Development of the waste to resources concept – classification, certification and deposition engineering.**
- **Insulation and management of historical mine and smelter waste.**
- **Maximization of process by-products, use and minimization of land filling; solid waste, nitrogen leakage, effluents and wear particles,**
- **To develop improved methods for clean-up of drainage systems, waste water and flue gas emissions.**

C. Designing tomorrow's products – life cycle of products

- **Product design obligations and related life cycle & material flows analysis issues**
- **Integration of Re-use and recycling into design**
  - **Using the by-product blasted rock as raw material for aggregates**
  - **Integrated Resource and Waste Management concepts**
- **Re –use of emissions, heat and wastes from production**
- **Sustainable waste handling by turning waste into products and to treat, handle and deposit waste in an environmental friendly way – developing new by-products**
- **New materials (lightweight, anti-corrosive, high temperature resistant, dust-free, …)**
  - **New resources for and better quality of ceramic refractories**
  - **Investigation of metallurgical properties of new mineral products, i.e. iron ore pellets**
- **New natural materials**

D. Risk management

- **Improving health and safety performance**
- **Risk management - supply level**
- **Quantified pan-European inventory and modelling of scenarios**
- **Sustainability decision support -Life Cycle Analyses and Modelling**
- **From local to global: predicting needs and risks**
- **Risk Management - operations level**
- **Risk management - product level**
- **Product quality control**
- **Development of eco-toxicity protocols for minerals and products**
- **Integrated concepts for safety and health in mining**
- **Automation and transfer of robotics**
- **Improved dust control and monitoring**
- **Improved personal protection equipment**
- **Integrated medical surveillance and exposure data management**
- **Reduction of gas and fire hazards**
- **Increase computer assisted process management (for increased efficiency and safety)**
- **Co-operation with ESA and vehicle manufacturers**

E. Knowledge Management

- **The extractive and mineral processing sector and the society**
  - An all embracing European extractive region functionality analysis and clustering process - development and implementation.
  - Impacts on the society of the extractive sector.
  - The importance of the functionality of the region on the conditions for a sustainable mining sector.
  - European needs of a sustainable extractive sector as a foundation for the mineral based industrial system and as an important cradle for the development of machinery and equipment industry that supports mining industry worldwide.
  - New business models and technical services for increased business use
  - **Support to capacity building and institutional strengthening in developing countries**

- **Maintenance**
  - Production IT for steering and operational control of mining equipment.
  - Service reliability analysis of production systems and development of maintenances strategies.

- **Process IT**
  - Modelling and optimisation of automatic control systems.
  - Measuring systems for critical parts of the mine to mill flow.
  - Mobile machine and industrial steering.
  - Development of the machine – man interface
  - digital communications and data transfer

- **Education and recruitment**

  For a competitive mining industry competent manpower is needed. Highly educated personnel for management, research and development and implementation of new ideas and technologies are therefore crucial for the success of the industry. To achieve this may include the following:
  - Development of strategies to attract new students
  - Interaction between industry and academia at undergraduate and graduate level
  - Networking, building critical mass in undergraduate and graduate teaching
  - Knowledge transfer in learning:
    - Between universities
    - Between industry and universities
    - Between industry
  - Improve recruitment to postgraduate studies in economic geology, mining technology, mineral processing
  - Apply gender aspect to teaching; improve recruitment of female students into economic geology, mining technology, mineral processing
  - European Metals Society (corresponding to TMS or SME in the US, CIM in Canada or AUSIME in Australia, in Europe we have only GDMB, should be GEMB …)

Annex 2: Aggregates Industry

The European Aggregates Industry is the main supplier of materials to all types of infrastructure works within the European Union.
Construction of roads, railways, airfields, buildings, sewage systems and other civil engineering works depend on large amounts of locally and regionally extracted and processed aggregates:

Number of production sites	25.000
Production volume of aggregates	2.800 Mtonnes
Production value	35.000 M EUR
Number of employees	250.000

European Aggregates Industry – Key RTD Areas
Project examples for the European Technology Platform

1. Raw material access and Aggregate extraction for sustainable development

- New exploration & investigation methods for improvement of extraction and quality planning - "Rock properties for optimum production"
- Environmental impact from production plants – key parameters.
  Development of important indicators and methods for selection of
  relevant and cost-efficient environmental limits. Development of best practices.
- Future aggregate for concrete – development of crushed rock aggregates for use as fine aggregate in concrete. To substitute natural sand and gravel by "crushed concrete sand" for long-term protection of ground water resources or better land use.
- New methods for the restoration of gravel pits and quarries – use of stripped soil, discarded products and fines.

2. Competitiveness/efficiency of operations

- Optimization of the production chain: drilling/blasting – loading/haulage – crushing/screening and other unit operations for improvement of competitiveness and energy-efficiency.
- Cost- and energy efficient mineral processing methods for aggregates – dry/wet classification, dewatering, filler and dust separation etc.
- Computer-based optimization & simulation models, software programmes and control methods on-line for extraction and aggregate processing – new innovative tools for the modeling, simulation and control of processes necessary for the improvement of production efficiency.

3. Added value for the customers and the society

- Road and railway construction – improvement of design methods, function-related product properties and demands, life cycle analysis and function-based contracts.
- Development of aggregates and fillers for future concrete. Increased use of crushed rock aggregates, improvement of concrete mix design for better cost- and energy-efficiency.
- Development of aggregates and fillers for future asphalt.
- Increased use of recycled products from the aggregate industry for reduction of environmental impact.
- Further implementation of European Aggregate Standards – continuous improvement.
- Development of the 2nd generation related to the aspects of Environment, Health & Safety and Sustainable Development.
- New logistic and transportation concepts – of great importance for the improvement of competitiveness and reduced environmental impact.
- Development of new methods to enable downstream industries to use local aggregates to lower transportation environmental impact.