

Regional, National and Continental Minerals Indicators Projects: commonalities and differences in process and product

Regionalni, nacionalni in kontinentalni projekti kazalcev za mineralne surovine: podobnosti in razlike med procesi in rezultati

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Abstract

In recent years, the sustainability paradigm has been successfully extended to mineral resources and a body of literature on the linkages among the goals of sustainable development, mineral resources and societal needs has developed. This in turn has led to efforts to monitor and measure progress toward minerals-related sustainability goals. Initiatives in a number of regions have made substantial progress in creating sets of meaningful sustainable development indicators for minerals. We present background information on the European Union, Latin American, and United States, reviewing the goals of each process, applicable spatial scale, methods and structure of the indicator set, and current status. Each process has been unique with regard to its background, methods, and goals, and the indicators themselves differ. Although they are in different stages of completion, these processes have many common features and outcomes.

Kratka vsebina

V zadnjih letih so bila načela trajnostnega razvoja uspešno uporabljena tudi na področju mineralnih surovin. Na to kažejo številne študije, razprave in raziskave, ki obravnavajo povezave med cilji trajnostnega razvoja, mineralnimi surovinami ter družbenimi potrebami. Del teh raziskav je obravnaval tudi dosežke pri spremljavi in merjenju napredka proti ciljem trajnostnega razvoja, povezanega z mineralnimi surovinami. Številne pobude v različnih območjih so rezultirale v precejšen napredek pri oblikovanju smotnih naborov trajnostnih kazalcev za mineralne surovine. V članku prikazujemo ozadje, cilje procesov oblikovanja kazalcev, uporabnost v različnih merilih, metodologije in strukture nabora kazalcev, vključno s stanjem leta 2004 za območja Evropske unije, Latinske Amerike ter Združenih držav Amerike. Kazalci se med seboj razlikujejo, ker so procesi oblikovanja glede na ozadja, uporabljene metode in cilje različni. Opisani procesi imajo tudi skupne značilnosti, in to kljub temu, da so ti procesi tudi v različnih fazah oblikovanja naborov kazalcev.

INTRODUCTION

A commitment to sustainable development necessitates integration of policies and development strategies so as to satisfy current and future human needs, improve the quality of life, and protect the environment upon which we depend for life support services. Societies the world over have embraced the principles of sustainable development. They are debating and selecting sustainability goals, setting policies consistent with those goals, and enacting related legislation. Initially there were serious questions about the degree to which mineral resources fit in sustainability, given that they are not sustainable in the same way as are ecosystems or biological resources. However, people are coming to understand that mineral resources are an integral part of developed, modern societies and that a sustainable future is unachievable without the services they provide.

Societies need to be able to track progress toward their sustainability goals. In many cases, they are attempting to do so with special variables called indicators. Agenda 21 (United Nations, 1992) laid out actions to forward the goal of sustainability, including a call for the development of indicators of sustainable development that could provide a basis for stages of the policy cycle, including decision making at all levels. Indicators are organized under criteria, which describe what it means to be sustainable and serve as basis for evaluation, comparison or assessment.

An indicator is a parameter (a property that is measured or observed), or value derived from a parameter, which provides information about the state of a phenomenon, environment, or area with a significance extending beyond that directly associated with a parameter value.

Indicators describe, display, or predict the status or trend of some aspect of sustainable development.

There are three basic functions of indicators: simplification, quantification, and communication. Ideally, an indicator should meet the following criteria: (a) be representative and scientifically valid; (b) be simple and easy to interpret; (c) show trends over time; (d) give early warning about irreversible trends where possible; (e) be sensitive to

the changes in the environment or the economy it is meant to describe; (f) be based on readily available data or be available at reasonable cost; (g) be based on data adequately documented and of known quality; (h) be capable of being updated at regular intervals; and (i) have a target level or guideline against which to compare it (Meadows, 1998; DETR 2000; McCool & Stankey, 2004).

Indicators and indices package complex mineral information into understandable forms for stakeholders, decision makers and public use (Villas Boas & Beinhoff, 2002). These mineral indicators must be useful as analytical, explanatory, communication, planning and performance assessment tools. Indicators help people understand the complexities associated with mineral resource management policy decisions, such as the interconnectedness of physical and environmental systems and the inevitability of making tradeoffs among conflicting management policy objectives (Shields & Šolar, *in press*). Thus, the information contained in indicators can contribute to public understanding of the state of the world and the potential consequences of fulfilling various objectives, *i.e.*, they can facilitate social learning (ISG, 2004).

Process democracy is one of the most important cornerstones of sustainability and so, as important as is the set of indicators, the process of creating, implementing and monitoring the set of indicators is crucial (Shields & Šolar, 2004). There are many possible processes for defining indicators for various sectors on different scales; recommendations and even requirements for the group defining the indicator set are similar. The conditions are: (a) shared ownership of process, (b) fair decision-making processes, (c) transparency and accountability, (d) adequate participation and representation, (e) a mechanism for future revision, (f) clear grievance procedure, (g) clear structure, and (h) auditability (Scrase & Lindhe, 2001).

Initiatives within the Canada, the European Union, Latin America, the United Kingdom, and the United States, among others, have made substantial progress in creating sets of meaningful sustainable development indicators for. Each process has been unique with regard to its background,

methods, and goals, and the indicators for each reflect these differences. This is to be expected for several reasons. First, sustainability is a value-based concept (Shields et al., 2002). Values are an expression of culture, history, experience, environment and geography, and necessarily differ across societies. People measure what they want to sustain; sustain those things they believe are important; and decide what is important based on their values. Second, sustainability is a working concept, a process that focuses attention on existing social-environmental-economic realities and geopolitical constraints that are inherently different across societies and geopolitical regions of the globe. Finally, practical issues of data availability necessarily drive the selection of indicators and collection costs.

THE INDICATOR PROCESSES

Main features of the indicator processes of Latin America, the European Union and the United States are presented below.

Latin America

Background - In October 1999, CYTED (<http://www.cytcd.org>), an official agreement between the Ministries of Science and Technology, or equivalent, in Iberoamerica, plus Portugal and Spain, launched via CYTED-XIII, one of its programs, a discussion on "Technological Challenges posed by Sustainable Development to the Mineral Extraction Industries", resulting in a publication under the auspices of CYTED, UNIDO, IMAAC and the Copper Study Group (Villas Boas & Fellows (eds.), 1999). Its aim was to prepare the mineral industries carrying on its operations in Iberoamerica to face the new challenges as well bringing government representatives into the new discussion.

Next year, 2000, enlarging the discussion, a "Mining Closure Experiences in Iberoamerica", document was presented and paved the road to present, in 2002, a publication titled Indicators of Sustainability for the Mineral Extraction Industry (Villas Boas & Beinhoff, 2002), which set forth some guidelines for starting the stakeholder

process to conceptualize and build up such sustainable development indicators, taking into account:

- The particular branch of industry (metals, industrial minerals, energy minerals);
- The given physical environment in which the operations are conducted (rain forest, desert, temperate)
- The specificities of the country economy in which the operations are carried out;
- The existence, or not, of social pressure mechanisms in the particular region or country where the industry is located;
- The existence, or not, of R&D infrastructure in the region or country where the industry is located to measure some of the measurable effects.

Goals - Indicators are supposed to ... indicate! However, what to measure and what, thus, to indicate? Formally, indicators are to be easily measurable and easily identifiable, when there is still time to act and propose solutions in a given set of risks/problems/performances. In reality, they measure the several, and eventually even contradictory, factors and events prevailing at a given predetermined time, in a given society or sub-sector of that society. Thus, creation of indicators brings together physical parameters, if identified and measurable, psychosocial parameters, whenever prevailing in the particular stakeholder group taking part in the creation process, inherently cultural parameters, "representative" of the region(s)/country(ies) where the action is taking place, etc. Indicators are a "mirror" of the anxieties of that set of stakeholders who established the indicator as a measure for the performance of industry and its commitments with sustainable development aims. They are dynamic in the sense of stochasticity, but can provide a minimum framework for decision-making and acceptance within a sufficient time.

Methods - Working Groups were established beginning in 1999 and continuing up to now, and are working under the aims and objectives of sustainable development on the following areas. The identified person and organization chair them:

- Land Use in Mining. (Luis Martins, INETI/IGM, Lisbon) 2003.
- Geomechanical Risks. (Roberto Blanco, ISMM, Moa, Cuba) 2001.

- Fertilizers in Iberoamerica. (Hugo Nielson, UNSAM, Buenos Aires, Argentina) 2000.

- Industrial Minerals and Building Materials. (Benjamin Calvo, E. de Minas Madrid, Spain) 1999.

- Mining Heritage. (Arsenio Gonzalez Martinez, UHU, Huelva, Spain) 2003.

- Indicators of Sustainability. (Roberto C. Villas Boas CETEM/CYTED, Rio de Janeiro, Latin America and Jose Enrique Sanchez Rial, DEGEO, Cordoba, Spain) 2003.

These working groups hold regular meetings and reports of their discussions are available at <http://w3.cetem.gov.br/cyted-xiii>. They are in the process of disseminating the methodology of the stakeholder-based approach for developing the indicators, and discussing some groups of indicators. As usual, at the beginning of the process, circa 2000, the environmental indicators prevailed over the balance of others, but the set is evolving to balance "social indicators", "community indicators", Amerindians rights, etc. The method of the working groups is not to develop or propose common indicators, since Iberoamerica, as such, is just a cultural background area, legislated through several different legal diplomas. Rather they encourage discussions and propositions within the existing legal framework and diverse social setting of a given region.

The sustainable development indicators are grouped into the following categories, following the four pillars of sustainability (Villas Boas & Fellows (eds.), 1999):

- Mass Flow Analysis: minimization of mass generation is a must for mining sustainability;

- Environmental Impacts: minimization of heavy metals into environment and wastes; open pit against underground operations;

- Process Energy: the Free Energy challenge;

- Social Satisfaction: maximization of social indicators (health, ecology, jobs, rent, social security, local environment).

Scale - This is a fundamental question, which has to be addressed at the very beginning of the process to establish a set of sustainable development indicators, so that time, efforts, money and energy are put at

the right place, at the right amount. Normally, medium to large extraction companies do develop or are in the process of developing LCA type of procedures, such that some of the most obvious environmental indicators might be at hand; the large ones do have a set of social indicators at hand as well, which are quite helpful for some of their needs (company indicators). As a sector of an economy, as well, some indicators might be available, such as jobs, accidents, financing community events and festivals, total tonnage of extracted rock, federal, state and local tax payments, buying within a given municipality or region, etc. Sustainability, however, is an agreement that sets forward that your neighbor has to be as conscious as you are, otherwise there will be no major net gain. Thus, indicators have to focus on geopolitical areas. Realistically though, the process probably has to start from local or site scale and then expand.

Status - Since participation in the working groups are is voluntary, and they meet on average twice a year, and sometimes just once a year, their actions have been concentrated on disseminating propositions and results of discussions throughout their respective nets (industry, government and interested parties of their communities). It is envisaged that, by the end of 2005, some indicators might be available for reporting by several working groups.

Challenges and realities affecting the process - Financial realities: Lack of financing is, obviously, a big deterrent to any collaborative process. When inadequate it might even invalidate the indicator development process.

Geopolitical realities: In Iberoamerica, the geopolitical reality is a function of the geography of the region where the mineral development event is taking place: Andean, Amazonian, South Cone, Caribbean, Mezzo American. A given country could be made up of one, two or three regions, each having its particular interests and issues. Therefore, sustainable development indicators must be set forth for this geographical reality, vis-a-vis the overall policies of the country towards that particular geographic region.

Difficulties in data collection: There is often considerable variation in knowledge and skills within a given geopolitical/geo-

graphical region. Some regions or countries have limited scientific resources, and therefore fewer capabilities to propose, test, monitor and validate data and data quality. Errors in data aggregation are also prevalent in some areas.

The European Union

Background - In May 2000 the European Commission published a Communication on “promoting sustainable development of the EU non-energy extractive industry” (European Commission, 2000). Its aim was to set broad policy lines for promoting sustainable development in the EU non-energy extractive industry. It identified a number of key challenges for the industry and set out a number of priority actions, which were considered necessary to maintain or improve competitiveness in this sector while achieving sustainable development. Stakeholder dialogue was one of the important issues mentioned in this Communication that should be improved to achieve a more sustainable minerals industry. Indicators are a useful tool to create a platform for dialogue where different stakeholders are able to define, discuss and evaluate the performance of industry and its contribution to society.

Goals - The indicators are to serve as a generally understandable means of communication between the different interest groups:

- the companies, which can represent their economic, ecological and social welfare benefits vis-à-vis other stakeholders.
- the national, regional and local administrations, which (depending on the legal conditions) examine these performances, and/or give access to land for mineral extraction.
- the public (local, regional or national population, NGO, media), whose interests are affected by existing or new sites.

Methods - A Working Group was set up in 2000 as a sub-group of the Raw Materials Supply Group. This Group met eleven times between its kick-off in December 2000 and January 2004, with extensive consultation occurring between meetings. The Working Group, chaired by the Enterprise and Industry Directorate General, consisted of about 20 experts from industry, Member States, a university and an NGO.

The first phase of the work involved agreement of the work programme and time frame. It was decided to develop the indicators taking a bottom-up approach and applying the characteristics used for the Global Reporting Initiative (GRI, 2000), i.e., that the indicators should have relevance, reliability, clarity, comparability, timeliness and verifiability. It was also agreed that the indicators should also adhere to SMART targets. The work was limited to those phases of the production process that involved the extraction of raw materials, primary refining and the use of secondary raw materials.

In order to develop relevant indicators, the working group relied particularly on existing initiatives, projects and studies, whose results could be adapted for the requirements of the extractive industry sectors. Therefore, an analysis of relevant projects and studies available at the time completed this first phase.

In *the second phase*, an extensive preliminary list of potential indicators was drawn up at the level of companies and sites. Considering the large number of SMEs in Europe, it appeared necessary to support those companies which do not have sufficient resources to develop sets of indicators independently, but have frequent contacts with other stakeholders. Nevertheless, very early in the process a distinction had to be made between indicators at company/site level and indicators at national (Member State) level. The preliminary list of indicators was divided in 4 categories: environmental, economic, social and institutional. They were presented using the following scheme: Key fields, Indicator, Measure and Ultimate goal.

In *the third phase*, the list of possible indicators was progressively refined. Reasons for deleting certain indicators included the level of complexity being too high; the unavailability of a good workable definition (e.g. biodiversity); (future) legislation would already cover a certain aspect; or the limited relevance of certain indicators for the sector (e.g. CO₂ emissions). An initial list of 31 indicators was then subjected to a pilot test at the end of 2001, which involved 152 sites. As a result of this exercise, the list was shortened to provide 13 priority indicators at company level, and 7 indicators at Member State level. They were not developed with a

specific policy application in mind, but instead were chosen because they provided a useful picture of the sustainability of the industry, while the data collection requirements were considered to be achievable.

Representatives of the Member States, however, identified that the data required to construct the Member State level indicators was problematic due to the lack of a legal base for this exercise. It was therefore decided to proceed with the data collection at company level and to consider other means of obtaining data at Member State level. However, progress has since been made, following discussions with Eurostat, in particular, on the contribution the industry makes to the Gross Domestic Product (measured as value added at factor cost), material demand per capita, and trade balance.

In the *fourth phase*, a questionnaire and guidance document explaining how to complete it was developed for the company level indicators. This was then circulated to individual companies via their trade associations in the second half of 2002. It is stressed that the exercise was voluntary, and companies were invited to participate. The responses from companies were sent to their associations, which collated the data received, before forwarding the aggregated data to the Commission. The Working Group prepared a draft report on the indicators which was endorsed by the Raw Materials Supply Group in January 2004 and shortly after published on the Commission's website. Unfortunately, because of the large number of companies supplying construction minerals, it was not possible to obtain a meaningful set of data for this sub-sector for 2001, so their results were not presented in the report. However, there is a clear commitment from this sub-sector to participate more fully in future data collection exercises.

Following a Conference on Sustainable Development Indicators held on Milos, Greece, in 2003, an exchange of information and co-operation with other players such as the GRI, MMI (Canada) and the US SMR has taken place.

Scale - The aim was to develop indicators, which can serve at the following levels as a common basis for dialogue for all involved interest groups: companies and/or sites, industrial sectors, regional or national, and EU.

Status - The industry federations have started collecting data for the years 2002 and 2003. It is expected that a report on these data will be finalised in the first half of 2005. In parallel with this process, further consideration is being given to the questionnaire and guidance document in light of comments provided by the Working Group members.

The 2001 report was published on the Commission's website. Hardcopies have been produced and distributed by the federations (Euromines and IMA Europe). The report provides a useful baseline against which future years data can be compared.

Challenges and realities affecting the process - Financial realities: Commission's involvement is mainly to costs involving chairing and hosting meetings of the Working Group, some translation costs and hard copy publications. Industry federations and companies have mainly contributed involving people to the process of the Working Group, investing time and money in the data collection process and disseminating the results.

Difficulties in data collection: SME-dominated sector (see above), highly concentrated sectors (e.g. gypsum), business sensitivity of certain data (e.g. lime: energy efficiency) and motivating the companies in general to participate.

The United States

Background - In its report "Sustainable America," the U.S. President's Council on Sustainable Development recommended that the Federal government develop national indicators of progress toward sustainable development in collaboration with the private sector and non-governmental organizations, and regularly report on these indicators to the public (PCSD, 1996). The United States Department of Agriculture Forest Service was an active participant in the Montreal Process and, along with other signatory nations, agreed to utilize the 7 criteria and 67 indicators of sustainability developed by the Montreal Working Group to report at regular intervals on the status of the nation's forests. The Forest Service subsequently committed to implementing the criteria and indicators (C & I) on the lands they hold in trust and to use them as part of their comprehensive monitoring program.

Shortly thereafter, the agency created the Sustainable Forest Roundtable to provide stakeholder input and guidance to the implementation process. It was soon clear that the lack of indicators for rangelands, water resources and minerals in the Montreal C & I limited the agency's ability to practice sustainable resource management. Therefore, in 1999, the US Forest Service brought together representatives from 16 governmental and non-governmental organizations to discuss the development of a multi-stakeholder forum for creating C & I for non-renewable resources. Out of this meeting came the Sustainable Minerals Roundtable (SMR). The Sustainable Rangeland Roundtable was started the same year, and the Sustainable Water Resources Roundtable a few years later.

Goals - All of the U.S. resource Roundtables are self-governing processes that set their own agendas. The goal that the SMR set for itself was to develop a set of national scale C & I of sustainability for mineral resources. The indicators were to have broad applicability and be acceptable to a wide range of stakeholders, including agencies of the Federal government interested in mining, minerals, and energy development, private firms engaged in non-renewable resource extraction and development, local governments, tribal organizations, and nongovernmental organizations. The primary purposes of the set of indicators developed by the Roundtable are as follows:

- to encourage a national dialog about how energy and mineral systems can best contribute to a sustainable America;
- to identify the types of information that will be needed for an informed public dialog;
- to highlight trends and priorities related to energy and mineral systems; and
- to support an interim assessment of the Nation's progress toward its sustainability goals in relation to non-renewable resources.

Methods - The SMR is co-chaired by the U.S. Forest Service and U.S. Geological Survey, and convened by Dr. Dirk van Zyl of the Mining Life-Cycle Center, MacKay School of Mines, University of Nevada at Reno. As noted above, participation in the SMR is open to all interested individuals. In order to facilitate broad participation, and

involve diverse publics in the process, regional meetings have been held around the country since the fall of 1999. Over that time 153 participants from almost seventy federal agencies, mining firms, non-governmental organizations, professional organizations, academic groups and tribes have participated. Meetings were led by a professional facilitator and would begin with background presentations intended to familiarize newcomers with sustainability principles, indicator theory, scale concepts, and the work to date of the SMR. Thereafter participants would work collaboratively, or in subgroups, to define criteria and refine the indicator set. This process had both strengths and weaknesses. One strength was that participants felt a sense of ownership in both the process and the products of the Roundtable. Another was that the process was inclusive and welcomed input from a wide range of interested communities, which led to a more robust product. A potential weakness was the necessarily circular nature of the process, given the need to review concepts and past work at the beginning of each meeting.

SMR participation has not been limited to attending the scheduled meetings. As specific areas of work have surfaced, work groups have formed to meet the demands of the task. In addition, in order to facilitate the gathering of data and the development of a group consensus, the Delphi process has been utilized by the SMR. In this "collaborative" process, the Delphi technique was used to provide a method of continuing the work begun at the meetings and allowing the group participants who were unable to attend a meeting to continue to contribute to the on-going work.

During the early stages of the SMR, participants decided that it was necessary to develop a sense of direction and set boundaries for the project. Over the course of several meetings, and through vigorous debate, a mission statement and a vision for the group were developed to serve these purposes. Additionally, it was determined that in order to maintain consistency and discipline over the selection and development of issues a set of guiding principles would also be necessary. Several meetings were devoted to identifying mineral sustainability issues and organizing frameworks. After reviewing the work of several other indicator pro-

cesses, including the Canadian Mining and Mineral Indicator project, participants decided to utilize the Montreal Process criteria, with some modifications. Where the Montreal Process had developed seven criteria, the SMR scientists focused on a subset of four:

- Maintenance of Capacities to Produce Commodities
- Maintenance of Environmental Quality
- Maintenance and Enhancement of Long-term Social, Economic, and Cultural Benefits to Meet the Needs of Societies
- Legal, Institutional and Economic Framework to Support Sustainable Development

Initially incorporated within the four criteria were approximately two hundred indicators. Over the course of discussion the numbers of indicators were first pared down to eighty-two and eventually to sixty-one (including the sub-indicators). For each indicator, six questions were answered: relevance to sustainability, scale to which they apply, whether the science exists, the amount of interest from stakeholders, whether the data exist, and the complexity, time, and resources necessary to populate the indicator. Based on the answers, indicators were allocated to either Phase I or II

Scale - Sustainability requires the analysis and interpretation of complex phenomena at multiple scales. However, inferring pattern and process at one scale based on information collected at another is fraught with potential difficulties. Some phenomena are applicable only at certain scales; others, such as production and safety, are relevant across many different scales. Although the SMR initially focused on national scale indicators, many of these indicators are based on the aggregation of site-specific data and so are relevant at smaller spatial scales as well. The Government Performance and Results Act requires, among other things, that agencies monitor the outcomes of their activities. In response the Forest Service has begun to apply sustainability indicators for forests, rangelands and minerals at the Management Unit scale.

Status - The SMR has completed selection of the initial set of 61 indicators. Progress reports on each criteria and associated indicators have been written and are

being circulated. A meeting will be held in the summer of 2005 to solicit critical feedback from SMR participants, after which report will be created, reviewed, and published. Next steps include populating indicators with data, and extending to set to the fossil fuels sector. The SMR is also developing an integrated framework for the minerals indicators, as part of the work of the Integration and Synthesis Group (ISG). Comprised of leaders of the four roundtables and other projects, and under the sponsorship of the White House Council on Environmental Quality, the ISG is developing a systems-based framework to be used to promote greater commonality in the C&I developed by the four roundtables. This will provide a mechanism for synthesis and the eventual reporting of national sustainability indicators for all lands and resources in the United States. The four resource indicator sets will also be used by the U.S. National Academy of Sciences' Key National Indicators Initiative.

Challenges and realities affecting the process - Financial Realities: The Federal agencies that have sponsored the Roundtables to date are now facing significant budget cuts. Continued work populating indicators with data, and testing the validity of individual indicators, will depend upon the availability of funds.

Difficulties in data collection: Indicators can be selected based on availability of data, or based on their contribution to understanding of sustainability issues, should data become available. The SMR took a mixed approach with the result that data do not currently exist for every proposed indicator. The SMR has no authority to require reporting of additional data by industry and no funding to undertake new monitoring initiatives. However, as the GPRA reporting process proceeds, it is assumed that some new data will become available at least on federal lands.

COMPARISON

The process of creating defensible, scientifically-based, sustainable development indicators requires transparency and public involvement, as well as balance among the stakeholders involved in the process, and

among the dimensions of sustainable development. Comparison of how different processes have dealt with these issues has its merits and also downsides. Pointing out actions of one process that are deemed valuable in the theoretical literature, but which are missing in some other process is not appropriate due to differences in the culture, including feasibility, and policies of the government and nation.

Caveats notwithstanding, some comments on the three processes described above are warranted. The three processes have much in common: a commitment to sustainable development, extensive processes, difficulties in implementation in the real world, financing. Each has created indicator sets that address the various dimensions of sustainability, at least to some degree. Some are more extensive than others; however, to date none are fully comprehensive or completely populated with data. The processes have attempted to balance the cost of obtaining data with the real value of the outcome, given how the results will be used. This has necessitated consideration of the ratio between "old" and "new" data, as well as of data quality and accuracy, and has led to the exclusion of some potential indicators. Each process has attempted to achieve balance among participants in a manner that is appropriate for the culture and values of the region or countries involved. In all cases, a group of diverse stakeholders has participated, either through invitation or self-selection. Those stakeholders, and other interested parties, are left free to assign relative weights to the indicators as they see fit. Differences between the processes are mostly cultural, having to do with the feasibility of alternative approaches and the prevailing driving forces.

CONCLUSIONS

Sustainability is a complex problem that can be informed by science but not solved thereby. As a result, it is essential that social processes involving dialogue, deliberation, and learning be used to create indicator sets (Šolar, 2004). However, process itself cannot solve all open issues as the indicator set is established because there is delicate, and in most cases unachievable, balance between

process democracy and process viability/feasibility. Process democracy is achieved through balance among chosen stakeholders, their number, the time spent in discussions and decision-making, and the never-ending cycling of the process. Process feasibility is clearly framed by an agreed-upon time schedule, expectations with regard to outcomes, and consensus based agreements within the whole stakeholders' group. These processes have demonstrated that there is hope that minerals indicators will be populated and play an important role as information tools in decision making.

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