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Important Features of Sustainable Aggregate Resource Management

Pomembne značilnosti trajnostnega gospodarjenja z mineralnimi surovinami za gradbeništvo

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Abstract

Every society, whether developed, developing or in a phase of renewal following governmental change, requires stable, adequate and secure supplies of natural resources. In the latter case, there could be significant need for construction materials for rebuilding infrastructure, industrial capacity, and housing. It is essential that these large-volume materials be provided in a rational manner that maximizes their societal contribution and minimizes environmental impacts. We describe an approach to resource management based on the principles of sustainable development. Sustainable Aggregate Resource Management offers a way of addressing the conflicting needs and interests of environmental, economic, and social systems. Sustainability is an ethics based concept that utilizes science and democratic processes to reach acceptable agreements and tradeoffs among interests, while acknowledging the fundamental importance of the environment and social goods. We discuss the features of sustainable aggregate resource management.

Kratka vsebina

Vsaka družba teži k stabilni, ustrezni in zagotovljeni oskrbi z naravnimi viri, ne glede na to, ali gre za razvito državo, državo v razvoju ali državo v obdobju tranzicije. Pri slednjih je povpraševanje po mineralnih surovinah za gradbeništvo večje, ker so le-te potrebne za obnovo infrastrukture, gospodarskih kapacitet ter za stanovanja. Mineralne surovine za gradbeništvo, katere uporabljajo v velikih količinah, je potrebno pridobivati na racionalen način, tako da v največji možni meri doprinesejo k razvoju družbe ter minimalno negativno vplivajo na okolje. V delu opisujemo pristop k gospodarjenju z mineralnimi surovinami, ki temelji na načelih trajnostnega razvoja. Trajnostno gospodarjenje z mineralnimi surovinami omogoča razreševanje nasprotij med potrebami in interesi gospodarstva, širše javnosti ter zaščite okolja. Trajnost je etično načelo, ki uporablja znanstvena in strokovna spoznanja in demokratične procese za dosego ustreznih dogovorov med predstavniki različnih interesov, da pri tem ne zapostavlja pomembnostI naravnih in družbenih dobrin. V delu bomo predstavili temeljne značilnosti gospodarjenja z mineralnimi surovinami, predvsem na primeru mineralnih surovin za gradbeništvo.

INTRODUCTION

Sustainable development in modern world

Many of the social and environmental problems we face today are complex, urgent, and interconnected across systems. The partial, system-specific solutions used in the past have proven ineffective when applied in such circumstances. The Earth Summit held in Rio de Janeiro in 1992 brought the concept of sustainable development to the attention of the world. The sustainability paradigm is applicable to the types of problems mentioned above because it is both comprehensive and flexible. The overarching goals of sustainability are: economic prosperity, environmental health and social equity. These goals are simple and flexible enough to allow for multiple interpretations and are applicable in a variety of circumstances (Šolar, 2003a).

Sustainability is sometimes controversial. This happens because sustainability is not science per se, although it uses science to achieve societal goals. Rather it is a value statement and human values are not fixed and independent of social, economic, and ecological context. Sustainability requires judgment about the state of the world. Inherent therein is our valuation of the tangibles we wish to persist in space and over time (USDA FS, Inventorying and Monitoring Institute, 2003). Thus, sustainability is about choices regarding what to sustain, how, when, where, and for whom. The debate about sustainability reflects differences of opinion about the appropriate answers to these questions. Differences in values are also reflected in the many definitions of sustainable development (Shields, 2004). The Mining Minerals and Sustainable Development project inventoried over 350 definitions during the course of their work (IIED, 2002).

Sustainable development and minerals

Mineral resources are not renewable; sustaining a producing deposit or mine is not possible. This does not mean that the principles of sustainability are irrelevant in the case of mining. Sustainable development involves managing resources in a way that is conducive to long term wealth creation and minerals are a form of endowed wealth. Moreover, mineral resources are integral components of economic and social systems; their use is fundamental to satisfying human needs and wants. At the same time, mineral extraction, processing, use, and disposal can impact the environment and threaten the quality of life. The environmental, economic and social costs and benefits stemming from mineral development and use can occur over multiple generations because of minerals' characteristics of durability and recyclability (Shields & Šolar, 2000a).

Certain environmental realities must be kept in mind when dealing with mineral development: a) the location of mineral resource deposits is a result of earth processes; b) extraction and processing change the form of mineral resources, and also generate wastes; c) some minerals are toxic at certain concentrations and in certain chemical forms; and d) processes such as recycling and conservation can never be totally effective. There are also economic realities: a) countries can become dependent upon extractive industries in ways that limit economic diversity, development and expansion; b) mineral prices are cyclic, which can lead to economic expansions and contractions; and c) the mineral industry generates jobs, income and foreign exchange earnings that can be invested in other forms of natural, human, human-built, and social capital.

Finally, certain social aspects are becoming increasingly recognized as important, including: a) in-migration resulting from mineral development that can alter the demographics of an area and in turn lead to pressures on local cultures and indigenous populations; b) mine closure can lead to out-migration that destabilizes communities and reduces the funds available for government services; c) consumption patterns and social preferences affect the rate of mineral development, use and disposal; and d) social equity necessitates that intra- and inter-generation costs and benefits be fairly balanced. Intra-generational equity means that the benefits and costs of the development and use of mineral resources should be shared fairly across regions of the world and segments of societies. Inter-generational equity requires that future generations should have available to them the amounts and types of mineral resources necessary to meet their needs and wants and should inherit a world with healthy ecosystems and functioning societies (Shields & Šolar, 2000a).

Different approaches

Different conceptual approaches have emerged that attempt to operationalize the sustainability paradigm. Each approach reflects the values and perspectives of the author's organization, and emphasizes a different theme. This has implications for the manner in which mineral resource sustainability issues are handled (Šolar & Shields, 2000).

One of several approaches describes sustainable development in terms capital, or the related terms endowments and wealth. (Costanza & Daly, 1992; Toman, 1994). The types of capital are: natural capital (traditional natural resources), human-made capital (physical, produced assets and the built environment), human capital (the health and well being of individuals), and social capital (the complex of social relations, norms and institutions.) The capital theory approach is particularly appropriate for minerals because nonrenewable natural resources are part of natural capital. They also represent a form of endowed wealth for societies, as previously noted.

Weak sustainability is distinguished from strong in terms of capital maintenance and augmentation, i.e., by the degree to which alternative types of capital are deemed substitutable for one another (Pearce & Atkinson; 1993; Faucheux et all., 1997). Weak sustainability preserves the net amount of capital, but not necessarily each of the four kinds of capital, so different types of capital are viewed as substitutable. Strong sustainability requires that each type of capital be preserved independently; capital of different types can be complements, but not substitutes, for each other (Shields & Šolar, 2000). Mineral resources are normally discussed in terms of weak sustainability, due to the inevitable transformations of natural capital the result from mineral extraction and use. The transition from natural capital to human-made, and further to human and social capital, can be described as moving from primary means to ultimate ends, i.e., well being. However, it is important to keep in mind that measures of economic capital such as GDP do not adequately describe human well-being.

Aggregates specifics

Mineral resources are classified in many ways. Most commonly they are classified into non-metals, metals and (solid or fluid) energy resources. Non-metals consist of two major groups: industrial minerals, and rocks and construction materials. Within the construction materials group aggregates are prevailing over others (such as clay, dimension stone, etc.) in terms of volume produced.

Natural aggregate is the world's number one mineral commodity (exclusive of energy resources) in terms of both volume and value. Natural aggregate consists of material composed of rock fragments that may be used in its natural state or used after mechanical processing such as crushing, washing, and sizing. Natural aggregate consists of gravel and crushed stone. Gravel generally is considered to be material whose particles are about 2.0 to 1024 millimeters in diameter. Their edges tend to be rounded. Crushed stone is of the same size range, but is artificially crushed rock, boulders, or large cobbles. Most or all of the surfaces of crushed stone are produced by crushing, and the edges tend to be sharp and angular. Natural aggregate has hundreds of uses, from chicken grit to the granules on roofing shingles. However, most aggregate is used in cement concrete, asphalt, and for other construction purposes. The average per capita consumption of aggregate generally ranges from 5 to 15 tons per year (Langer & Šolar, 2002).

Natural aggregate extraction is the most important mining industry in the world in terms of production volume (15,000 million tonnes per annum), and is second only to fossil fuels in terms of production value (70,060 million euros) (Regueiro et all., 2002). Potential sources of natural aggregate are widely distributed throughout the world in a variety of geologic environments; there is no global shortage of aggregate resources. But even though natural aggregate is widely distributed, it is not universally available for consumptive use. Some areas are devoid of sand and gravel, or potential sources of crushed stone may be covered with sufficient unconsolidated material to make extraction impractical. In some areas natural aggregate does not meet the physical property requirements for use or it may react adversely when used in certain applications such as in cement concrete or asphalt. Furthermore, an area may contain abundant amounts of aggregate with characteristics suitable for the intended purpose, but conflicting land uses, zoning, regulations, or citizen opposition may preclude commercial exploitation of the aggregate (Langer et all., 2003).

Quarrying is a type of mining that should be treated differently than metal mining due to its unique characteristics and a precise, unified definition of what quarrying is contributes to its proper treatment. Quarrying is in most cases defined as surface mining of construction materials – aggregates, and in many cases, crushed stone. Quarrying differs from other types of mining in many respects, including the potential for alternate extraction sites which can lead to the existence of numerous individual mine sites, large production quantities, a high volume to value ratio, and regional importance (Šolar, 2003b).

Aggregate is heavy and bulky. Transportation can add significantly to the cost of aggregate. For example, transporting aggregate 30 to 50 kilometers can double the price of the aggregate (Langer & Šolar, 2002). As a result, aggregates have a narrow economic transportation radius, which can lead to the presence of extraction near urban areas.

Developing aggregate resources impacts the environment. Most environmental impacts are not serious and can be controlled by employing careful mining practices using available technology. However, there are some geologic situations where mining aggregate may lead to serious environmental impacts, especially with regard to ground water, air, and noise pollution. Environments that are particularly prone to impacts from aggregate extraction include karst and stream channels. One of the most serious environmental problems is the dereliction of abandoned pits or quarries. The reclamation of mined-out land is an important aspect of reducing environmental impacts of aggregate extraction (Langer & Šolar, 2002).

In regions with economic growth, the negative public perception of quarrying increases in tandem with demand for aggregates. Operators face serious difficulties in opening new or maintaining current quarries or pits. More generally, societies face several dilemmas with regard to aggregate resource management: a) the existence of abundant sites with suitable aggregate that also have conflicting land uses, zoning, regulations, or citizen opposition, and b) conflict between regional demand and local opposition to resource extraction.

Sustainable mineral, or more precisely, aggregate resource management (SARM), when properly used, is an appropriate framework for addressing the complex issues associated with aggregates quarrying. It is an approach that supports development of policies that reflect good science, public preferences and financial and social constraints. Such management should be supported by complete information so as to ensure that all multi-stakeholders' objectives are at least acknowledged, and if possible addressed.

SUSTAINABLE AGGREGATE RESOURCE MANAGEMENT FRAMEWORK

Policies reflect the values and objectives of the people involved in their creation. That is as true for mineral policies as it is for environmental, monetary or trade policies. According to most general definitions, management deals with the process of planning, organizing, and governing the efforts of co-workers in order to achieve stated goals of an institution. Management therefore is about optimizing the use of human and material resources, together with financial and other contributions, in operationalizing policy goals. The objectives of a sustainable mineral resource policy and associated management plan, and the form they take, will differ between regions and countries due to the interplay of differing value sets, goals and objectives (Langer et all., 2003).

Differences not withstanding, there are similarities across sustainable mineral policies and management plans. The foundational concepts are: a) facilitating the transformation of natural mineral capital into built physical, economic, environmental or social capital of equal or greater value; b) ensuring that environmental and social impacts of mining are minimized; c) addressing the trade offs that society needs to make; and d) taking all relevant scale hierarchies into consideration.

A SARM plan can be organized according to the three main dimensions of sustainability: environmental, economic and social.

Environmental aspects of SARM

SARM requires developing aggregate resources in an environmentally responsible manner that does not result in long-term environmental harm, even if short-term environmental impacts are unavoidable. Two main environmental categories should be considered in SARM: reducing negative environmental impacts and resource protection / conservation. These goals are very achievable because the aggregate industry has made, and continues to make, great strides in environmental management.

Three principles inform the forgoing requirements: the precautionary principle, the polluter pays principle, and eco-efficiency. The meaning of the precautionary principle has evolved since its introduction in the 1970's. Initially it stated that actions to protect the environment should not be delayed simply because full information was unavailable. This is the meaning used in the Rio Declaration, which states that the lack of "full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation" (UN 1992). The obverse definition is now dominant. We should not take actions in the absence of full information, if those actions have a high probability of causing significant social, economic, or environmental damage (Foster et all., 2000). Both versions apply to quarrying. The precautionary principle implies the use of environmental impacts assessments, risk analysis and other tools so as to promote the goal of nature conservation. The polluter pays principle requires funding reclamation / remediation of negative impacts within the quarry and over the mine life cycle including after-care. Eco-efficiency insists on efficient production (with minimal material and energy use and emissions), and efficient use of land / space and exploitation of reserves and resources.

Most destructive environmental impacts of aggregates are on the landscape (visual intrusions), air (noise, dust), water (surface, underground water), soil (erosion, pollution), and on biota (loss of biodiversity). Besides type, the nature of impacts (range, timing, duration, ability to prevent /control) should also be considered (Langer & Arbogast, 2002). There are many regulatory and voluntary tools that can be used to identify, reduce and control negative environmental impacts. These include environmental impact assessment, environmental management systems, environmental accounting, environmental reporting, life cycle analysis, ISO 14000 standards. These tools can be applied both on-site (quarry & processing facility) and to transportation routes.

SARM, however, is not just about protecting the environment from the potential negative impacts of aggregate extraction. Reclaiming aggregate operations or orphaned sites has tremendous potential to improve our quality of life, create additional wealth, increase biodiversity, and restore the environment. In the expanding suburban areas of today, mined-out aggregate pits and quarries are converted into second uses that range from home sites to wildlife refuges, from golf courses to watercourses, and from botanical gardens to wetlands. Reclamation should be a major consideration in sustaining the environment and in creating biodiversity (Langer, 2003a).

Mineral resource (aggregate) protection includes: a) minimal exploitation of primary aggregates with rational production by introducing the recycling and reuse of construction materials as aggregates; b) exploitation of renewable aggregate and substitute resources; c) increasing the knowledge about aggregate potential, and d) preserving the land access to aggregates in designated areas The first two of these protection measures are intended to reduce the demand for aggregate that is newly mined or from newly developed sites. The latter two address the long-term need for primary materials (Šolar, 2003).

Economic aspects of SARM

There are four main economic aspects to SARM: a) providing for the material requirements of society; b) maintaining a viable business environment; c) encouraging value-added production and employment; and d) embracing full cost accounting while remaining competitive. The first three of these are the responsibility of government. The fourth is the responsibility of the firm.

All societies utilize a stream of material inputs for manufacturing and construction. In the case of transition and post-conflict economies, there is particular need for construction materials to support development and rebuilding of infrastructure, industrial capacity, and housing. One aspect of SARM involves ensuring that these resources are available to the marketplace. This is sometimes referred to as secure supply. The main elements of secure supply are creation or maintenance of production capacity, identification of sufficient reserves and resources, provision of land access (extraction and exploration sites / areas), and development of the country's or region's infrastructure capacity (roads, railroads, power). All the foregoing issues are interlinked and need to be balanced by policy makers and resource managers.

A viable business environment exhibits the following characteristics: a) a stable and feasible permitting regime; b) consistent application of rules and regulations; c) functioning capital markets; d) reasonable levels of taxation; and e) well defined property rights. Underemployment and unemployment are serious problems in many parts of the world. Therefore, governments should also consider setting policies that support the availability of a trained workforce and promote employment in the extractive industries. Development of value-added manufacturing is another important issue. Existence of a value-added sector can reduces the need for imported materials while allowing the domestic economy to capture the economic benefits (profits, employment, tax revenues) that would otherwise accrue in another country.

Economic realities drive industry activity. Firms need to remain competitive if they are to stay in business. Nonetheless, firms have a responsibility to accept the full cost of doing business, including costs of preventing or remediating environmental damage. Industry must be willing to accept the fact that in some cases, when all the costs are taken into consideration, a quarry will not be a viable economic enterprise and must be either shut down or not developed. Firms can, however, increase competitiveness by modifying production processes, upgrading product quality, and maintaining a well trained workforce. Production process and product quality can be achieved through voluntary quality control procedures such as adherence to ISO 9000 requirements. Quality is an important market element that can be labeled and traded. Research and development (R&D) is another issue that increases the enterprise's overall performance and has a great impact on increasing the added value. Some of R&D's goals include new products, and using BAT (best available technology) in the field. Finally, maintaining or increasing employment is not only governmental issue, because human resources are one of most important driving forces of every enterprise. Corporate culture, knowledge and skills need to be created, maintained, reviewed and revised (if necessary). Special attention with regard to human resources should be put on health and safety of employees.

The issues described above, along with many others, represent the economic aspects of managing aggregates in a manner that would ensure future aggregate supplies and achieve the sustainability goals of different stakeholders. Their various and different goals and linkages among those interests and goals are described within social aspects of SARM (Šolar, 2003).

Social aspects

Identifying stakeholders' values, interests, goals and the scale at which they apply is the first step in resolving the complex situations that impact a country's ability to maintain a secure material supply and achieve other policy goals. As an example, there may be abundant sites in a region that have suitable aggregate, but the existence of conflicting land uses, zoning, regulations, or citizen opposition can lead to insufficient or more costly supply. Scale of interest is a consideration in such situations due to fact that benefits and costs accrue to different parties in different regions. A third important issue is intra-generational equity, fairness to those living near or impacted by quarrying. Equity implies a need for transparency and public participation in decision making, as well as access to information within democratic process (Šolar, 2003).

Broader societal aspects can be described in terms of the legal framework, communication and education. The legal framework should protect the interests not only of country or region, but also investors and all other stakeholders. An effective legal framework needs balance between administrative requirements and flexible, time efficient, inexpensive procedures of licensing. Further, a country or region needs to have the institutional capacity to implement and enforce the legislation (monitoring and control components in particular), to develop and maintain resource information infrastructure, to foster research and development, to use funds from mineral rents (taxes) for the benefit of current and future generations, and facilitate cooperation with other sectors

In addition to the legal framework, voluntary initiatives from different stakeholders (industry, non-governmental organizations) enrich dialogue and facilitate agreements. Voluntary initiatives include communication, education, partnership, and participation. All stakeholders should have access because increased awareness of the costs and benefits of supplying materials to society will lead to more timely agreements about how to (re)distribute costs and benefits of aggregate extraction and use (Šolar, 2003). We can conclude that social aspects facilitate the implementation of sustainability-based resource management that is discussed in next chapter.

MAKING SUSTAINABLE AGGREGATE RESOURCE MANAGEMENT A REALITY

Implementation

To ensure that aggregate resources are managed in a sustainable manner, each of the primary stakeholders – government, industry, public, and other non-governmental organizations – must accept certain responsibilities. The government is responsible for developing the policies and climate that provide conditions for success. The industry must work to be recognized as a responsible corporate and environmental member of the community. The public and non-governmental organizations have the responsibility to become informed about natural resource management issues, take personal responsibility for their consumption patterns, and to constructively contribute to a process that addresses not only their own, but a range of objectives and interests. All stakeholders have the responsibility to identify and resolve legitimate concerns, and the government, industry, and the public must cooperate at the regional and local levels in planning for sustainable aggregate extraction (Langer, 2003).

To be effective, SARM must be a pragmatic pursuit, not an ideological exercise. It is an iterative process and government, citizens, and industry should all be involved in the pursuit. The process consists of a number of steps, including issuance of ***policy statements***, elaboration of ***objectives***, establishment of ***actions***, identification of ***indicators***, and ***monitoring*** (Langer, 2003c).

- ***Policy statements*** issued by governments commonly identify the aggregate industry as a key industry contributing to jobs, wealth, and a high quality of life for their citizens, and commit the government to the protection of critical resources and protection of citizens from the unwanted impacts from aggregate extraction. Industry policy statements commonly identify environmental and societal concerns and commit the company to environmental stewardship and interaction with the community.
- ***Objectives*** describe what is to be accomplished and commonly are subsets of the social, economic and environmental components of SARM. Typically objectives will include, but not be limited to: a) ensuring future supplies of aggregate; b) reducing the demand for newly mined aggregate; and c) protecting and restoring the environment (Langer, 2003b).
- ***Actions*** are associated with each objective and describe the steps to reach the objective.
- ***Indicators*** deserve special mention. They measure progress as well as the effects of efforts to protect and enhance natural and human systems and will be discussed in more detail below.
- ***Monitoring***, feedback, and the regular reconsideration of requirements as events develop all help to refine the SARM process.

The establishment of a joint monitoring process presents an excellent opportunity to forge partnerships with communities and involve citizen groups.

Measurement

Progress toward the policy goals that have been described in detail within a resource management plan need to be measured over time. Measurement can be described in terms of a hierarchical model that places definition at the top. Beneath are, in order, principles, criteria, indicators and actual data. An agreed upon definition is a broad, over-arching, vision statement that provides the rationale for policies, practice, and initiatives related to sustainable development. A principle is a fundamental truth or law as the basis of reasoning or action. Criteria describe principles in detail and what it means to be sustainable. They serve as basis for evaluation, comparison or assessment. Achievement of sustainability is judged against relevant indicator(s).

There are three basic functions of indicators: simplification, quantification, and communication. Indicators of sustainability should be used as tools for knowledge, information transfer; as integral parts of other initiatives and sets of indicators; and as a solid base for decision making. The selected set of indicators should express a need for balance: (a) among stakeholders; (b) between the process of defining indicators and the set of chosen indicators; and (c) among dimensions of sustainability (Šolar, 2003).

Indicators for aggregates therefore should support public awareness of issues related to sustainable resource management of aggregates and facilitate explicit consideration of the full range of costs and benefits of mineral development of aggregates. Mineral resource development, extraction, use and disposal are complex activities that can be described in many ways. It follows that there are multiple ways to organize mineral indicators. One method is to organize indicators according to the three dimensions of sustainability: economy, environment and society. An alternative is use a life cycle approach.

In *Planning for Supply of Aggregates in England* (Department of the Environment, Transport, and the Regions- DETR, 2000), the DETR lists a number of indicators that include (1) the percentage of aggregate coming from areas that have been identified for extraction, which measures efforts toward protecting critical resources; (2) the percentage of natural aggregate compared to recycled aggregate, which measures efforts toward reducing demand for newly mined aggregate; (3) the percentage of aggregate coming from environmentally sensitive areas; and (4) the area of land undergoing extraction compared to the area of land that has been restored, both of which measure efforts towards protecting and restoring the environment.

Adaptation

It is useful to think of policy making as a continuous process, the steps of which are: (1) identification of objectives and interests, (2) definition of policy, (3) codification of policy in laws and acts, (4) establishment of a regulatory framework, (5) monitoring, and (6) review and adaptation. Sustainable aggregate management has a place in all these stages. Over time societal goals, governmental policy, laws and acts, public and corporate management plans, regulatory regimes, and data sets can change. SARM should be seen as an adaptive process that responds to changes in social, economic and environmental system and to changing public preferences as well.

Like mineral resource management policy also aggregate resource management has many aspects. These can be grouped as: natural settings (amount of natural resources, impacts on the environment); the economy (market conditions, technological level); the social dimension (acceptance of mining, local culture); and administrative organizational (political system, regional, state and local borders).

The type of input scientists provide will depend upon where a society is in this policy cycle, which aspects are under consideration, and also upon the decision context. Experts can provide input during the process of policy development. The consensus building process necessary to the achievement of a relevant and widely accepted mineral policy will depend in part upon information about the impacts and consequences of choosing one policy option over another. For example, decision makers will need information about the depletion of mineral resources, and the social and environmental effects of mining.

Several different problems need to addressed during the adaptation phase of sustainable mineral resource management. Some of these problems are: (a) too high expectations, (b) lack of commitment, and (c) past mal practices. Therefore it should be made a very clear roadmap of management plan and also a plan to address disappointment. In order to straighten to commitment all open issues should be discussed in a way that there is a consensus on the outcomes. Building a trust and confidence during the process of creating of management plan should overcome the distrust of the past malpractices.

CONCLUSIONS

Sustainable aggregate resource management is about what to do (content) and how to do it (process). It occurs at the intersection of the public values and objectives, science and information, and government policy. SARM provides a framework for developing resource management policies through a fair, democratic, and transparent process. It requires that mining be conducted in a publicly acceptable manner and also brings together in comprehensive manner different economic, technological, social, environmental and other disciplines. SARM puts the stress on materials supply, and balancing benefits and costs of aggregate supply.

Implementing SARM requires challenging the myths about the aggregate industry. Aggregate companies are not solely wealth generators, but most are responsible, responsive organizations that are aware of the role they play in society; they are organizations that have moved into the 21st century in terms of technology and values.

Venturing into the SARM arena is not without risk. Skeptics and others with hidden agendas debunk it. Reporting on SARM achievements creates an expectation from stakeholders – continuous improvement. However, the benefits can be great – enhanced stewardship of public resources, an improved business climate, and progress toward more sustainable future.

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